CHAPTER 1

# Geographic variation in per beneficiary Medicare expenditures

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## In this chapter

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- Sources of variation
- Analysis of total variation
- Does variation in adjusted service use imply inequity?
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Large variation in per beneficiary local fee-for-service expenditures raises concerns about whether beneficiaries in low-expenditure areas are getting the care they need and whether care is being efficiently provided in high-expenditure areas. Understanding the sources of the variation may shed light on whether the concerns are justified. Costs of providing care, special payments to hospitals, and health status are known sources of variation. We found that about 40 percent of the variation is attributable to these sources. The variation in adjusted service use across states, therefore, is much less than the variation in expenditures. The remaining variation primarily reflects differences in service use due to practice patterns, propensity to use care, and other factors. We have investigated this remaining variation using regression analysis and found several factors (for example, the proportion of the under-65 population without insurance, the racial and ethnic mix of the 65 and over population, and, depending on the model specifications, several variables representing supply and technology) that explain about 35 percent of the remaining variation.

## Background

Policymakers have given considerable attention to the geographic variation in per beneficiary Medicare expenditures. At the metropolitan statistical area level, per beneficiary program expenditures for beneficiaries in traditional fee-for-service Medicare in 2000 varied from about $3,500 in Santa Fe, New Mexico to almost $9,200 in Miami, Florida. At the state level, expenditures vary as well, from a low of about $3,800 in Hawaii to as high as $6,700 in Louisiana and $7,200 in Washington, D.C.

Policymakers are particularly concerned with the large variation among states, because it suggests inequities in a national program. Some are concerned that in states with low expenditures, perhaps beneficiaries are not getting their fair share, or providers are not being adequately compensated for the care they deliver. Others are concerned that states with high expenditures may be using too much care or are being overcompensated for the care provided. To understand if these concerns are justified, we look at how best to measure state-level variation, some of its causes, and what it does or does not indicate about equity in the program. The basic issue is whether differences in expenditures are symptoms of inequity or simply reflect underlying differences in state health care markets and beneficiaries.

Many health services researchers investigating geographic variation in Medicare are interested in variation in **service use** per beneficiary. They immediately adjust for prices and demographic or health status differences, and then attempt to explain the remaining variation in service use, usually at a local market level.[1] This chapter instead first focuses on the beginning steps—adjusting for prices and health status—because we have to address geographic variation in **expenditures** at the state level. Only after we make those adjustments and show they account for about 40 percent of the total variation do we start to discuss what accounts for the remaining 60 percent, which many would ascribe to variation in service use. Like other researchers, we look at that variation in smaller geographic areas than the state because the sources of that variation are often local in nature.

## Measurement of variation

Meaningful analysis of state-level variation in Medicare expenditures requires a reasonable definition of program expenditures per beneficiary. This analysis starts with the amount Medicare spends for beneficiaries in the traditional fee-for-service (FFS) program. It does not consider the amount spent on beneficiaries who instead are in some form of Medicare managed care—for example, Medicare+Choice (M+C) coordinated care plans, cost plans, or demonstration plans—or in the M+C private FFS program. These Medicare private plan alternatives to the traditional FFS program are interesting and important subjects in their own right, but their payment methods reflect many objectives and tend to obscure the underlying causes of variation in per beneficiary expenditures.[2] This analysis uses FFS expenditures per beneficiary at the county level reported by CMS for two reasons. First, it captures all FFS expenditures on behalf of beneficiaries who reside in a county regardless of where the beneficiary goes for health care. That is, if beneficiaries go to a nearby state for health care, those expenditures are still accounted for and attributed to the beneficiaries and their counties of residence. Second, it accurately captures expenditures for services provided during a year.

In contrast, some concerned with the issue of variation in state-level expenditures have concentrated on another measure formerly published by CMS that is misleading. The text box opposite discusses the problems with that measure in more detail.

## Sources of variation

Variation in Medicare expenditures stems from two basic sources: differences in the cost of providing care and in the quantity of care provided. Differences in the cost of providing care are primarily reflected by input price adjustments. Medicare payment systems use input price adjusters to address geographic differences in the cost of inputs, such as wages and office rents. Previous MedPAC analysis found that the input price adjusters the Medicare program uses do reflect local differences in the cost of providing care. For example, the hospital wage index is used to adjust payments to providers for local differences in the wages paid by health care facilities. In general, one would expect the wage rates paid by providers to vary with the overall wages paid by other employers in the same market area, with both reflecting the local cost of living. MedPAC has found that the hospital wage index and an index of overall wages are closely correlated (MedPAC 2001). Moreover, in Chapter 3 we find that hospital profit margins are largely unrelated to the level of the local hospital wage index. This refutes to some extent arguments that wage indexes in low-cost areas are too low, resulting in hospital payments that are inadequate for hospitals to cover their Medicare costs.[3]

1 For example, John Wennberg and associates have done considerable work on the variation in service use, as is discussed later in this chapter. Their starting point is expenditures adjusted for health status and input prices. In Chapter 4 of this report we look at variation in use of physician services. That analysis also starts with adjusted expenditures.

2 See MedPAC's March 2003 Report to the Congress for a discussion of M+C payment methods.

3 This is not to say that the hospital wage index is a perfect measure. For example, in previous work we found that the wage index could be improved by properly accounting for the occupational mix in hospitals.

## An invalid measure: provider payments per beneficiary

The measure often used to analyze variation in expenditures among states is conceptually: program payments sent to providers and managed care plans in a state divided by the number of beneficiaries living in the state. (The fee-for-service [FFS] amounts are actually the national cash flow amount from the Treasury allocated to states based on their FFS utilization.) Its shortcomings make this measure invalid and it should not be cited in any debate over variation in Medicare expenditures. The measure has two serious shortcomings:

- It does not account for beneficiaries going across state borders to receive care. Thus it can be particularly misleading in states that experience either significant in- or out-migration. For example, providers in Washington, D.C. treat significant numbers of beneficiaries from nearby states. As a result, this measure of Medicare payments to Washington, D.C. providers per resident beneficiary exceeds $10,000, nearly double the national average, reflecting the high concentration of providers in a city with relatively few beneficiaries. Conversely, in some states there is significant net out-migration for health care. Simply totaling the Medicare payments to providers in those states and dividing by the number of Medicare beneficiaries will always underestimate health care actually received by beneficiaries residing in them.
- It uses the payments providers receive in a year rather than the payments that result from services provided in a year. This can be a problem when introducing new payment systems, because there are usually delays in claims and payments resulting in an uneven flow of payments over a year. Also, Medicare managed care plans sometimes receive more than 12 cash payments in a year, and other times receive fewer than 12. Payments received by providers in a state can thus vary markedly from year to year.

CMS no longer publishes this measure but rather simply reports total annual state-wide payments to providers—Medicare estimated benefit payments by state (CMS 2002). The footnote to the CMS table reporting these data states that payments are on a paid (not incurred) basis and that "This distribution may differ from similar tables based on the state of the beneficiary. Since payments are based on the state of the provider or plan, **the average payment per beneficiary is not meaningful** and will no longer be provided" [emphasis added]. ■

The Medicare program adjusts physician payments using three geographic practice cost indexes (GPCIs): physician work, practice expense, and professional liability insurance (PLI).[4] Every three years, CMS reviews the three indexes and updates them with the best available data. The latest revision was in 2000.

Taken together, the three indexes can be combined into the geographic adjustment factor (GAF). That factor has values that range from 0.89 to 1.22 across the country. About 44 percent of beneficiaries live in areas with GAFs within 5 percent of the national average and 90 percent live in areas within 10 percent of the national average.

The mix of providers in a state can also contribute to variation in expenditures. Medicare makes special payments to hospitals to reflect the costs of providing uncompensated care to the poor, the additional costs incurred by teaching hospitals, and conditions facing certain groups of rural hospitals.[5] If the mix of hospitals that receive special payments differs between two areas, Medicare payments will differ as well.

Medicare payments for the same procedure often differ across sites of care. For example, physicians can perform many of the same procedures in hospital outpatient departments (HOPDs) or in ambulatory surgical centers (ASCs). Medicare pays different facility rates for the same procedure across these settings. Consequently, variation in expenditures can be affected because, for example, physicians use ASCs rather than HOPDs more frequently in some areas than others.

Variation stemming from differences in quantity of care is due to differences in beneficiaries' health status and propensity to use care, and in practice patterns among

4 The physician fee schedule assigns each procedure code three relative weights. Those weights are multiplied by the appropriate index value and summed to arrive at a value that, when multiplied by the conversion factor, yields the payment for that procedure code. The physician work index is based on professional wage data from the Census. It weights local wages by 25 percent and the national average at 75 percent. Hence, it varies much less than local wages vary across the nation. The practice expense index is derived empirically from Census data on nonphysician staff, Department of Housing and Urban Development data on rental housing costs as a proxy for office space costs, the cost of equipment and supplies, and miscellaneous items. The first two factors vary locally and account for 67 percent of the index. The remaining items are presumed to be bought on the national market and account for the remaining 33 percent. The PLI GPCI is based on data CMS collects from several of the largest malpractice insurers in each state.

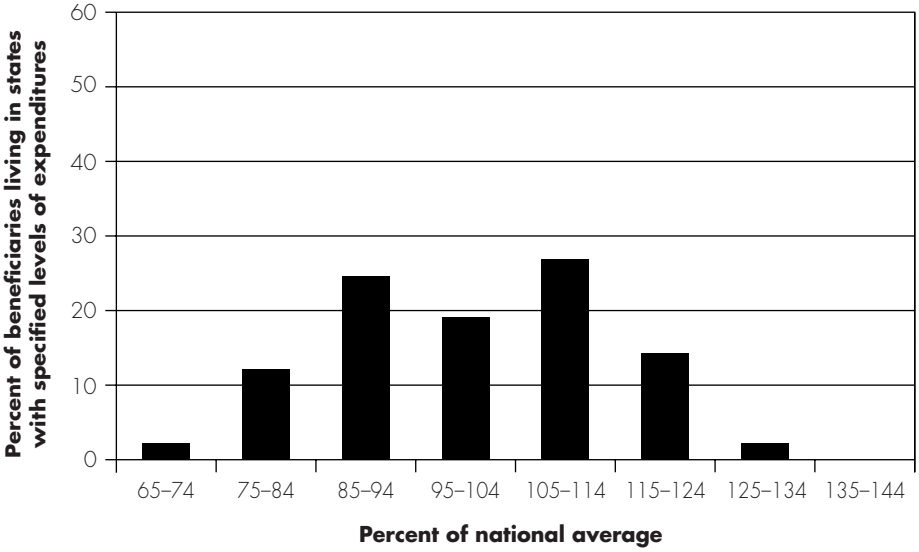
5 Some of these special payments are directly related to the costs of providing patient care to Medicare beneficiaries, while others reflect different policy aims. For example, part of the special payments to teaching hospitals increase payments to teaching hospitals beyond the additional costs they incur in caring for Medicare beneficiaries. Because these payments do not strictly reflect cost differences, we adjust for them separately to better understand underlying variation.

physicians. Beneficiaries in relatively poor health tend to use more care than those in good health; hence areas with sicker populations such as Miami tend to have higher use than areas with healthier populations such as Fargo, North Dakota. Beneficiaries' propensity to use care is affected by many factors, including access to care and personal characteristics such as income, education, race, and sex.

Physicians' practice patterns affect quantity of care in two ways. First, physicians in some areas tend to provide more services such as diagnostic tests than physicians in other areas, as discussed in Chapter 4. Second, physicians may prefer to use certain sites of care more frequently in some geographic areas than others. For example, physicians in some areas may prefer the inpatient setting to treat a particular condition, while physicians in other areas may prefer outpatient settings. If inpatient care leads to more service use, then the quantity of care will be greater.

**FIGURE 1-1**

**State-level per beneficiary FFS expenditures, weighted by number of beneficiaries, 2000**




Note: FFS (fee-for-service). National average per beneficiary Medicare expenditures are $5,360.
Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS.

## Analysis of total variation

To effectively evaluate variation, the unit of observation should be the beneficiary because providing benefits to beneficiaries is the reason the Medicare program exists. Consequently, we illustrate variation among states by weighting each state by its Medicare population. The result is beneficiaries, not states, being weighted equally. Without weighting, beneficiaries in less populous states would count more than those in more populous states.

Figure 1-1 shows that weighting each state's per beneficiary fee-for-service expenditures by its number of beneficiaries produces a nearly bell-shaped curve that is fairly symmetric around the national average per beneficiary expenditures of $5,360. About 20 percent of the distribution is within 5 percent of the national average. However, the distribution reveals a large variation in per beneficiary expenditures among states. As is shown below, much of the variation is due to two factors: the cost of providing care and differences in beneficiaries' health status. Adjustments for input prices are intended to make payments more closely reflect differences in the costs of providing care and generally track with other measures of cost of living (MedPAC 2001). Differences in beneficiaries' health status are important because sicker beneficiaries usually use more health services than healthier beneficiaries. Further, some of the variation is due to special payments to hospitals and to other causes. In the remainder of this section, we show the effect of adjusting expenditures for some of these factors.

Adjusting states' per beneficiary expenditures for differences due to input prices substantially reduces the variation in per beneficiary expenditures. As Figure 1-2 shows, the weighted distribution still has the same average value of $5,360, but the variation is less by any measure. For example, almost 40 percent of the distribution is within 5 percent of the national average, as compared with about 20 percent in the unadjusted diagram.

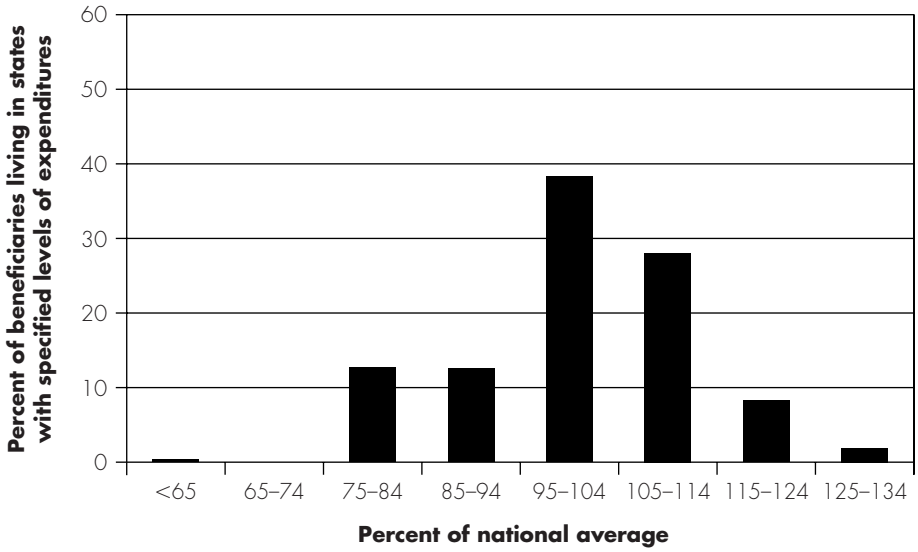
Much of the variation that remains after removing the effects of input price adjusters is attributable to the quantity of services beneficiaries use. We further adjusted state per beneficiary expenditures for two factors that explain some of the variation in quantity of services. The dominant factor is health status. Areas with relatively healthy beneficiaries will tend to use fewer services than areas with sicker beneficiaries. Our state-level measure of health status ranges from 11 percent above to 15 percent below the national average but there are methodological issues that need to be considered.[6] The other factor we adjust for is beneficiaries' Part A and Part B participation rates.[7]

6 We use risk scores from the hierarchical condition category risk-adjustment model as our measure of health status. The measure, which is based on diagnoses, incorporates demographic factors such as age and sex, and is considered to be one of the best measures currently available. Nevertheless, it has its limitations. For example, diagnoses require a visit to a practitioner; thus sick persons who do not seek treatment will not have their conditions reflected in the risk score.

7 Variation from differences in beneficiaries' Part A and Part B participation rates, which is small, simply indicates that not all beneficiaries have both Part A and Part B benefits, that participation rates vary among states, and that participation affects use.

**FIGURE 1-2**

**State-level per beneficiary FFS expenditures adjusted for input prices, weighted by number of beneficiaries, 2000**

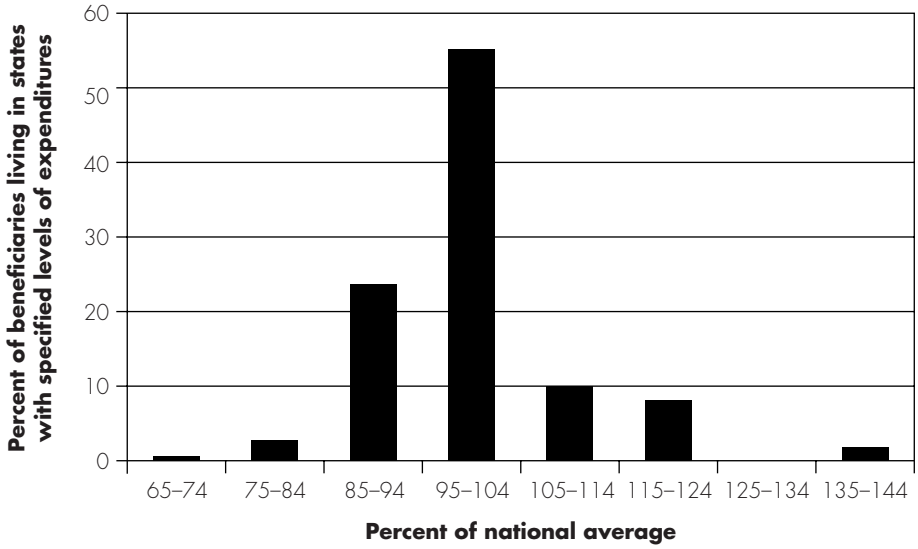



Note: FFS (fee-for-service). National average Medicare expenditures per beneficiary are $5,360.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS.

**FIGURE 1-3**

**State-level per beneficiary FFS expenditures adjusted for input prices, health status, and special payments, weighted by number of beneficiaries, 2000**




Note: FFS (fee-for-service). Also adjusted for Part A and Part B participation rates. National average Medicare expenditures per beneficiary are $5,360.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS.

Figure 1-3 shows these adjustments for differences in health status and Part A and Part B participation rates, as well as differences from input prices and special payments received by some hospitals. This measure shows less variation than that in Figure 1-2, and has substantially less variation than the unadjusted expenditures. About 55 percent of the resulting distribution is now within 5 percent of the national average, as opposed to only about 20 percent in the unadjusted graph. (Alternatively, the average of the absolute difference among states from the national average per beneficiary expenditure is about $650 before adjustment, but only about $400 after adjustment.)

Table 1-1 (p. 8) summarizes the results as the adjustments just discussed are made to the original distribution of Medicare expenditures.

Removing special hospital payments after making the other adjustments does not make much difference in the amount of variation, although it changes some states' relative position within the distribution. By one measure the resulting distribution is slightly less dispersed, by another slightly more.[8] The text box on page 10 explains the methods and data used to make the adjustments. We refer to the final distribution as a measure of adjusted service use. Removing the effects of differing input prices, health status, and special payments to hospitals reveals that the rate of service use by state varies much less than would appear from looking at unadjusted Medicare expenditures.

8 The order of adjustment makes a difference in the apparent contribution of each factor. For example, adjusting for special hospital payments first would make the variation attributable to them appear greater and that attributable to input prices appear less. However, the final adjusted service distribution resulting after making all adjustments will be the same regardless of order.

## Does variation in adjusted service use imply inequity?

This adjusted service use measure still exhibits some variation. The remaining variation could be random, or reflect unadjusted differences in cost from provider mix, differences in beneficiaries' propensity to use care, or providers' differing practice patterns. Beneficiaries' propensity to use care depends on many factors such as income, education, race, sex, and supplemental insurance coverage. Other analysis has shown that practice patterns depend on many factors, including the concentration of hospital resources (such as number of hospital beds per resident) and the lack of established guidelines for treating many conditions (Wennberg and Cooper 1999). That work concludes that a greater supply of providers is associated with greater utilization of health care. Recent work indicates that greater use of health care is not associated with better quality or access over the time period analyzed (Fisher et al. 2003). Disentangling the explanatory contribution of these various factors is a difficult task and cannot be done by simply adjusting for known factors as we have done up to this point. Before we attempt to do so let us ask some more fundamental questions.

Is variation in adjusted service use a serious problem and if so, what policies might be pursued to reduce it? The variation in adjusted service use may be a source of concern if some of the care in high-use states is inappropriate or unnecessary, or if beneficiaries in low-use states are not getting sufficient care. We look at three different aspects of this issue.

## Use and quality

If the variation in adjusted service use reflects underservice of beneficiaries in low-use states, one might surmise that those beneficiaries are receiving lower-quality care. Figure 1-4 illustrates the relation between states' per beneficiary adjusted service use and one, admittedly limited, measure of quality of care. It sorts states in order from lowest adjusted service use to highest. In the same order, the diagram plots an ordinal measure of quality. That is, the state with the best quality has the highest rank (51) and states with poorer quality have lower ranks, down to 1. Measuring health care quality is fraught with difficulty. An article in the Journal of the American Medical Association used this measure to compare states (Jencks et al. 2003). It is based on how frequently Medicare patients received 24 preventive measures or treatment methods with strong indications of improving outcomes. It does not include all services that might be associated with high quality care.

Figure 1-4 shows that many states with low adjusted service use have relatively high quality by this measure, and many states with high adjusted service use have relatively low quality rankings. This is true even though some measures of quality—for example, mammography—require use of Medicare-covered services. The figure includes a trend line that indicates the relation that would occur between adjusted service use and quality rank if adjusted service use were a perfect predictor of quality.[9]

Using this measure of quality, Figure 1-4 does not support the hypothesis that low-use states have low-quality care. The data show that some high-use states have low quality by this measure. Other recent research has also shown no increase in quality (using a similar measure of quality) with higher use. That research used smaller geographic areas in its analysis (Fisher et al. 2003).

The measure of quality used above is limited to the use of some specific preventative measures and effective treatments. It is not an overall measure of

**TABLE 1-1**

**Effect of adjustments on variation in Medicare FFS expenditures by state, 2000**

| | Percent of distribution (as percentage of national average per beneficiary) | | | Measures of dispersion | |
|---|---|---|---|---|---|
| **Measure** | **<85%** | **85%–115%** | **>115%** | **Standard deviation** | **Average of absolute difference** |
| Unadjusted expenditures | 15.2% | 68.9% | 16.0% | $740 | $648 |
| **Expenditures adjusted for:** | | | | | |
| Input prices | 13.0 | 77.6 | 9.5 | 625 | 486 |
| and, health status and Parts A & B participation | 3.2 | 87.3 | 9.5 | 551 | 415 |
| and, special payments to hospitals | 3.2 | 87.3 | 9.5 | 552 | 402 |

Note: FFS (fee-for-service).

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS.

9 We performed a regression analysis on the same data. The result is in the same direction, higher service use is correlated with lower quality rank. The coefficient is negative (–.57) with a t-statistic of 4.9, and the $R^2$ is 0.33.

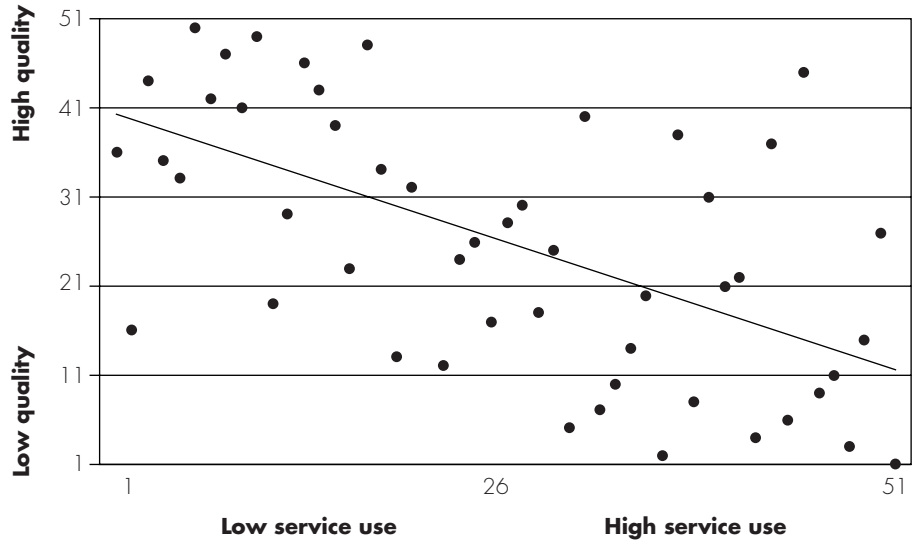
quality, or of appropriate use. Simply knowing the aggregate use rate, shown in Figure 1-4, is not enough to tell whether the services used are appropriate are not. Earlier research, which looked at three procedures, suggested that the use of appropriate care increases with increasing overall use. Also, the ratio of appropriate to inappropriate use did not always change with increases in aggregate use (Chassin et al. 1987, Leape et al. 1990). However, different kinds of procedures show different rates of variation. For example, in Chapter 4, we show that the rate of use of major procedures varies less than the rate of use of other services such as testing and imaging. Therefore, analysis of how appropriate and inappropriate use vary with overall use is sensitive to the kind of procedures analyzed. A fully effective measure of quality would take into account whether the care delivered was appropriate and would permit better analysis of aggregate use and quality.

## Use and cost sharing

A simplistic way to reduce the variation in adjusted use rates would be to somehow increase use in low-use areas and decrease it in high-use areas. However, reducing the variation in adjusted service use by increasing use in low-use states (for example, by overpaying for services, which would increase provision of services) would increase beneficiaries' cost sharing (that is, deductibles, coinsurance, and balance billing) for services covered by Medicare. Beneficiary cost sharing increases directly with higher payments in most settings.

Figure 1-5 sorts states in order from lowest adjusted service use to highest. In that same order, it plots per beneficiary cost sharing for services covered by Medicare. The diagram shows that states with low use tend to have low beneficiary cost sharing, and those with high use tend to have high beneficiary cost sharing. Consequently, increasing either the use of care or the prices Medicare pays for care in low-use states would likely increase beneficiaries' cost sharing. Associated with increased cost sharing could be increased premiums for Medigap

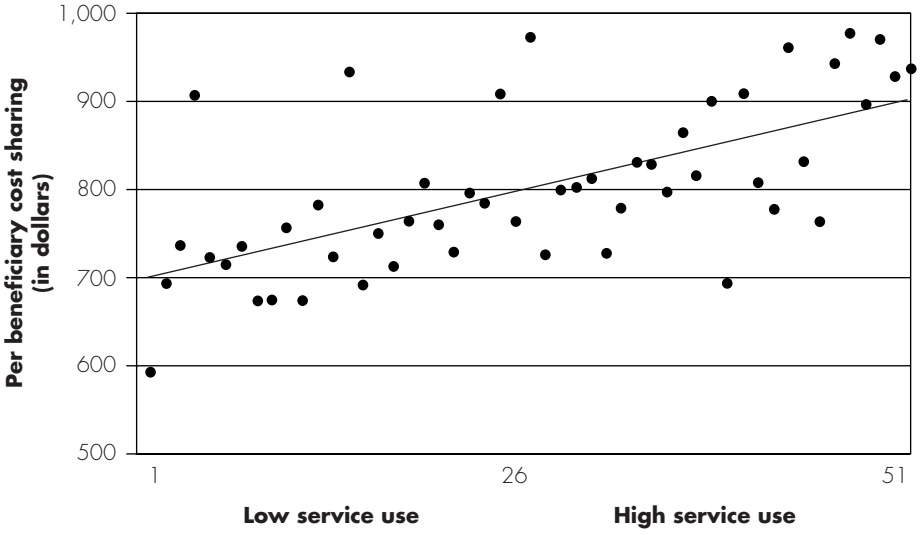
**FIGURE 1-4** **States' adjusted service use and quality of care, 2000**




Note: The measure of both adjusted service use and quality is ordinal. For example, the state with the highest quality has a quality measure of 51 and the state with the second-highest quality has a measure of 50, and so on down to 1.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS, and Jencks et al. 2003.

**FIGURE 1-5** **States' per beneficiary adjusted service use and per beneficiary cost sharing**




Note: The cost-sharing data are from 1998; the service use data are from 2000. The measure of adjusted service use is ordinal. For example, the state with the highest service use has a service use measure of 51 and the state with the second-highest service use has a measure of 50, and so on down to 1.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS and data from the Health Care Financing Review, Medicare and Medicaid Statistical Supplement, 2000.

supplemental insurance; increased costs to employers for supplemental retiree coverage; and potentially higher costs to Medicaid, because Medicare's cost sharing for beneficiaries directly influences premiums for Medigap and retiree coverage as well as costs to Medicaid.

It is doubtful whether the increased cost sharing that might occur with higher use would be accompanied by better quality of care under the given measure, because there is not a positive relation between use and quality (Figure 1-4).

## Variation among counties

Although of tremendous interest to policymakers in the Congress, the state is not the best geographic unit for understanding variation in service use. Substantial variation exists, for example, in adjusted service use among counties within the same state. Figure 1-6 shows the variation in service use among beneficiary-weighted counties in Iowa. At the extremes, per beneficiary adjusted service use ranges from about 30 percent below to about 25 percent above the state average.[10] A similar result is found among counties in New York (data not shown), which although quite different from Iowa, is similar in that it has large differences in adjusted service use among its counties. The standard deviation (a measure of how spread out the counties' per beneficiary service use is) is similar in the two states, $588 in Iowa and $655 in New York.

The substantial variation among counties within the same state suggests that much geographic variation would probably remain even if variation among states were eliminated. Our finding of large variation among counties in the same state is consistent with the work of other analysts who have noted that the primary sources of the variation in adjusted service use—practice patterns and propensity to seek care—vary among geographic units smaller than the state (Fisher et al. 2003, Miller et al. 1995, Wennberg and Cooper 1999). Therefore, it may be useful to study smaller geographic units.

## Factors affecting variation in smaller geographic areas

Because health care is delivered in local markets, we continue our investigation by looking at local health care markets for the sources of variation in service use. Although we are interested in variation in service use for Medicare beneficiaries, variation may be a phenomenon of health care in those markets in general and not be specific to the Medicare program. Therefore, some factors not associated with the Medicare population may still help explain variation in the amount of care Medicare beneficiaries receive. Disentangling these factors has been a subject of research for the past several decades. Others have examined variation in health care use in smaller geographic

### Methods and data sources

We determined states' per beneficiary expenditures using fee-for-service expenditure and enrollment data from CMS's website. We calculated per beneficiary adjusted use by removing geographic differences in the following factors from the unadjusted expenditures. All data are from CMS's website, except where indicated.

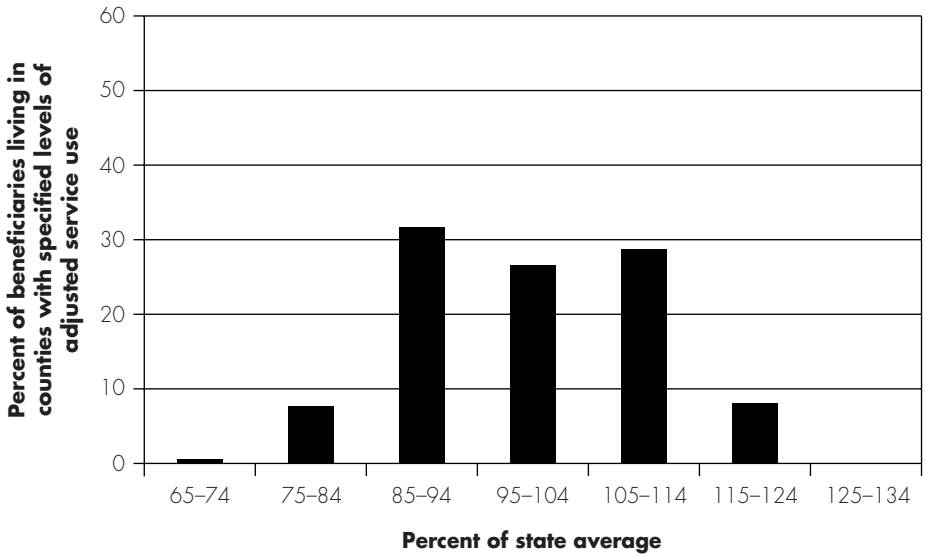
- Input price adjusters are based on the hospital wage index for Part A expenditures and the geographic adjustment factor for Part B expenditures. The Part A adjustment takes into account where beneficiaries resident in a county obtain services. The adjustment normalizes all indices to one.
- Health status is based on risk scores from the hierarchical condition category (HCC) risk adjustment model. We used claims and demographic data to determine HCC risk scores for a 5 percent sample of beneficiaries. An average of those risk scores serves as a health status measure for each state. The adjustment normalizes all weighted states to a risk factor of one.
- Part A and Part B participation rates are from CMS data on county-level participation. The adjustment normalizes all states to the national average Part A and Part B participation rates.
- Special payments to teaching hospitals are direct and indirect payments for graduate medical education, and payments to hospitals for care to low-income people are disproportionate share payments. We removed these payments from expenditures and added them back in proportion to remaining Part A expenditures. This essentially keeps all hospital payments in the program and pays all hospitals at the national average rate.

A more precise measure would adjust each element of Part A and Part B expenditures by the appropriate input price adjuster, adjust for base payment differentials, track Part B spending to where it was delivered, and treat special payments to rural hospitals analogously to other special hospital payments. ■

10 Figure 1-6 shows data for one year (2000) only. Averaging over several years dampens variation somewhat, but still shows significant differences among counties.

**FIGURE 1-6**

**Variation in county-level per beneficiary adjusted service use, weighted by number of beneficiaries (Iowa, 2000)**




Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS.

areas. For example, John Wennberg and colleagues at Dartmouth College have done extensive research on this topic. They use the hospital referral region (of which there are 306 in the United States) as the geographic unit of analysis. The text box below summarizes some of their key findings.

## Regression analysis to understand variation in smaller geographic areas

To better understand the variation remaining among states in our analysis after we adjusted for cost and health status, we moved to a smaller area of analysis: the metropolitan statistical area (MSA) for beneficiaries living in urban areas or the non-MSA area of a state for beneficiaries living outside metropolitan areas. We chose this definition because the MSA is a better proxy for medical

## Findings from research by John Wennberg and colleagues at Dartmouth College concerning variation in service use

Wennberg and Cooper find variation in Medicare expenditures (adjusted for input prices and health status) is affected by the supply of hospital beds, which varies considerably across areas. As the number of hospital beds per beneficiary increases, the amount of hospital care per beneficiary increases (Wennberg and Cooper 1999).

Variation in expenditures is also affected by differences in rates of surgical procedures. The rates at which beneficiaries receive some surgical procedures—such as radical prostatectomy, carotid endarterectomy, coronary artery bypass grafting, and coronary angioplasty—are very different across areas. The rates of radical prostatectomy (surgery for prostate cancer) are nine times higher in Baton Rouge, Louisiana, than in Binghamton, New York. Wennberg and colleagues believe that much of this variation is reflected in differences in diagnostic intensity (how intensely physicians search for a condition that results in surgery). For example, patients in the early stage of prostate cancer are often asymptomatic, so diagnosis is often made through a screening test for prostate-specific antigen (PSA). The frequency of PSA testing varies greatly, so there is much variation in how frequently patients are diagnosed and, consequently, how often they undergo prostate surgery. Wennberg and colleagues also believe gaps in medical science as well as uncertainty physicians have about the benefits and problems associated with many procedures affect variation in surgical rates. They suggest that variation in radical prostatectomy, for example, may be due in part to a lack of clinical trials comparing the risks and benefits of surgery, radiation therapy, and watchful waiting (Wennberg and Cooper 1999).

Geographic differences in per beneficiary Medicare expenditures are highly correlated with differences in the amount of services beneficiaries receive in the last six months of life. Also, geographic differences in the amount of supply sensitive care (where the effectiveness has not been scientifically determined and use is largely driven by resource availability, such as number of hospital beds) strongly influences differences in the amount of care at the end of life. In particular, Wennberg and colleagues found large differences in the number of physician visits, likelihood of dying in a hospital, and the percentage of beneficiaries admitted to an intensive care unit at the end of life (Wennberg and Cooper 1999).

Fisher and colleagues examined differences in the services physicians furnish in high- and low-spending areas. They found that physicians' greater use of evaluation and management services—especially inpatient visits and inpatient specialist consultation—and use of diagnostic tests and minor procedures, such as magnetic resonance imaging, skin biopsies, and prostate-specific antigen tests drive spending differences. As discussed, they have also found no correlation between higher use and quality of care (Fisher et al. 2003). ■

care market areas than the state, and CMS uses MSAs and statewide non-MSA areas as the geographic areas for defining the hospital wage indexes used to adjust for differences in price levels.[11]

We examined factors that may affect variation by performing a regression analysis measuring the relation between adjusted service use and variables that may affect providers' practice patterns and beneficiaries' propensity to use care. We used a set of variables that have been considered in several studies of variation (Cutler and Sheiner 1999, Miller et al. 1995, Skinner et al. 2001). We also examined several other variables, including the hospital wage index and the percent of the non-Medicare population that is uninsured.

We examined demographic variables that may be associated with use of care including: poverty rate among people age 65 or older, percentage age 65 or older who are African American, percentage age 65 or older who are Asian American, percentage age 65 or older who are Hispanic, and percentage of the non-Medicare population that is uninsured. We also examined variables that may affect practice patterns including: HMO penetration among the general population, supply of health resources (measured by the number of hospital beds per 1,000 population), and sophistication in the health care system (measured by the percentage of hospital beds that are in intensive care units [ICUs]).[12] Table 1-2 provides summary statistics for each of these variables.

We performed our analysis in two steps. First, we examined how much of the variation is explained by the demographic variables. Our results indicate that all of the demographic variables are important under a statistical test for significance; that use rates increase as the percentages of African American, Hispanic, and uninsured increase; and that use rates decline as the percent Asian American and the poverty rate increase (Table 1-3). Interpreting these results is difficult because whether use rates are directly affected by these variables or if the variables are proxies for other factors that affect service use is not known.

**TABLE 1-2**

**Summary statistics for variables explaining variation in adjusted service use, 2000**

| Explanatory variable | National average | Minimum | Maximum |
|---|---|---|---|
| Uninsured, not eligible for Medicare | 17.7% | 7.7% | 30.5% |
| Hospital beds per 1,000 residents | 3.5 | 0.9 | 10.6 |
| Percent of hospital beds in ICUs | 5.8% | 0.0% | 20.6% |
| Poverty rate, 65 and older | 9.4% | 3.6% | 26.4% |
| Percent African American, 65 and older | 8.1% | 0.1% | 40.5% |
| Percent Asian American, 65 and older | 2.3% | 0.1% | 72.6% |
| Percent Hispanic, 65 and older | 5.0% | 0.2% | 92.3% |
| HMO penetration | 27.1% | 0.0% | 72.3% |
| Adjusted per capita service use | $5,360 | $3,678 | $8,105 |

Note: ICU (intensive care unit). Sample for regression includes 322 metropolitan statistical areas and 46 statewide rural areas.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS, 2002 Area Resource File, March 2002 Current Population Survey, and 2002 Interstudy database.

In the second step, we added variables to our regression that reflect differences among health care markets. These variables include HMO penetration, number of hospital beds per 1,000 population, and percent of hospital beds that are in ICUs. A potential problem with these variables is that they may be endogenously determined. That is, the level of service use may affect the values of these variables, rather than the other way around. For example, it is not clear whether a high concentration of hospital beds increases use of health care services or if hospital capacity expands in areas where there are many sick people who need a lot of care. Despite this uncertainty, we assume that the direction of cause and effect is that the market-related variables affect the level of service use.

Our results indicate that the concentration of hospital beds and percent of hospital beds in ICUs are significant, but HMO penetration is not (Table 1-4). Also, all the demographic variables remain statistically significant. The size and significance of the coefficient on concentration of hospital beds suggests that health care use is greater in areas with greater supply of health care resources. The size and significance of the coefficient on the concentration of ICU beds suggests that greater concentration of sophisticated, high technology resources is associated with greater health care use.

11 The Office of Management and Budget defines MSAs as geographic areas consisting of a large population nucleus together with adjacent communities having a high degree of economic and social integration with the nucleus.

12 We also considered number of physicians per 1,000 population as a measure of resource concentration and percentage of physicians who are specialists and concentration of medical residents as measures of sophistication in the health care system. We chose not to use them because of high levels of correlation among them, which adversely affects statistical tests of significance. Finally, we examined the hospital wage index as an explanatory variable to see if price level has an effect on use—it does not.

**TABLE 1-3**

**Using demographic data to explain variation in adjusted service use, 2000**

| Explanatory variable | Coefficient from regression | t-statistic from regression |
|---|---|---|
| Uninsured, not eligible for Medicare | 46.1* | 6.7 |
| Poverty rate, 65 and older | –53.7* | 5.1 |
| Percent African American, 65 and older | 38.8* | 8.8 |
| Percent Asian American, 65 and older | –19.7* | 3.2 |
| Percent Hispanic, 65 and older | 19.6* | 4.6 |
| $R^2$ | .32 | |

Note: Sample for regression includes 322 metropolitan statistical areas and 46 statewide rural areas.
* Statistically significant at 5-percent level.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS, 2002 Area Resource File, and March 2002 Current Population Survey.

**TABLE 1-4**

**Using demographic and health care market data to explain variation in adjusted service use, 2000**

| Explanatory variable | Coefficient from regression | t-statistic from regression |
|---|---|---|
| Uninsured, not eligible for Medicare | 49.6* | 7.2 |
| Poverty rate, 65 and older | –42.0* | 3.4 |
| Percent African American, 65 and older | 34.4* | 7.6 |
| Percent Asian American, 65 and older | –18.2* | 2.9 |
| Percent Hispanic, 65 and older | 17.8* | 4.0 |
| HMO penetration | 3.7 | 1.6 |
| Hospital beds per 1,000 residents | 69.6* | 2.6 |
| Percent of hospital beds in intensive care units | 43.7* | 2.6 |
| $R^2$ | .35 | |

Note: Sample for regression includes 322 metropolitan statistical areas and 46 statewide rural areas.
* Statistically significant at 5-percent level.

Source: MedPAC analysis of county-level fee-for-service expenditures and other data from CMS, 2002 Area Resource File, March 2002 Current Population Survey, and 2002 Interstudy database.

In summary, Table 1-4 indicates that per capita service use decreases by $42 for a percentage point increase in the poverty rate and $18 for a percentage point increase in the percent Asian American. Also, service use increases by $34 for a percentage point increase in the percent African American, $18 for a percentage point increase in the percent Hispanic, $50 for a percentage point increase in the percent uninsured, $70 for a unit increase in the number of hospital beds per 1,000 population, and by $44 for a percentage point increase in the percent of hospital beds in ICUs.

## Conclusions

- A frequently used measure of variation in Medicare expenditures is based on the Medicare payments that states' providers receive over a year. This measure is misleading and should not be used when addressing the issue of equity associated with variation in Medicare expenditures.
- Much of the variation in expenditures in different areas of the country is caused by differences in (1) the cost of providing care to Medicare beneficiaries and (2) the health status of beneficiaries.
- Much of the remaining variation is likely caused by differences in the practice patterns of providers and beneficiaries' propensity for seeking care. Together these can lead to wide differences in the use of services by beneficiaries in some states.
- We can explain some of the remaining variation by accounting for several additional factors, including the proportion of the under-65 population without insurance, the racial and ethnic mix of the population age 65 and over, and, depending on the model specifications, several aspects of health care supply and technology.
- Higher quality care does not necessarily follow from higher use of services by the measure we used. In fact, our data show that low-use states tend to have higher-quality services relative to high-use states. It could be that beneficiaries receiving low-quality services do not get well and require more services or are simply receiving inappropriate services. Further analysis is called for to understand what is happening.
- Reducing the variation at the state level that remains after controlling for differences in costs of providing

care and health status may be difficult. Because significant variation exists within states at the county level, the causes of that remaining variation may be better addressed at some level below the state. If practice styles or quality play a major role, they may be local phenomena not accessible at the state level.

- We assume that the objective of the Medicare program is to assure access to quality health care for beneficiaries. To simply increase payments or use in low-expenditures areas arbitrarily would be a questionable policy. More importantly, policies directed at raising payments for all providers in a geographic area, regardless of their cost or quality, are unlikely to improve quality and would likely increase beneficiaries' cost sharing. Further, these policies would not address quality or efficiency in areas with high expenditures. None of these would be attractive outcomes. The better policy would be to introduce incentives for quality to increase payments to providers and delivery systems with high quality health care—which are often located in low-use areas. Targeting increased payments in this way is a more attractive option and is discussed further in Chapter 7. ■

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