

## Geographic Variation in Neuroimaging

For a generation or more, we have tried to understand why medical services vary among regions (1, 2). Implicit in this enterprise is the concern that regional variation represents irrationality or injustice in our health care system. In this issue, Rao et al (page 1643) show us that variation in the use of neuroradiologic procedures is greater than expected by chance. They also observe a substantial increase in overall use between 1993 and 1998. Their inquiry is limited to patients in fee-for-service Medicare programs, which is methodologically sound, because adverse selection and the insurance paradox suggest that the overall health of those in Medicare health maintenance organizations differs from that of others in the community. Interestingly, the authors observe that MR imaging and myelography of the spine are increasing in tandem and that introduction of MR angiography was accompanied by a large increase in the use of conventional angiography. Complementary studies, it seems, are sometimes additive.

There are many factors that may account for the variation in medical services in the 1990s. Impending health care "reform" in 1993 may have stifled the demand for medical services, and economic growth in the late 1990s may have stimulated it. The then recent North American Symptomatic Carotid Endarterectomy Trial study increased awareness of carotid artery disease. New spine surgery techniques may have stimulated spinal imaging of all sorts. Interestingly, medical malpractice awards and settlements also increased 60% between 1993 and 1999.

Surely, epidemiology explains some of the regional differences. The distribution of races and sexes differs across the country. Lifestyle choices, such as smoking, diet, occupation, and sexual behavior, must affect use of medical services. Artificially increased use may occur in urban areas where hospitals are a short walk away, and comparatively decreased use of medical services has been documented in rural areas where they are distant. Higher socioeconomic- and educational-status groups use medical care more readily and demand more elective services than do lower socioeconomic- and educational-status groups, so regional variations in income, wealth, and education must also be taken into account.

Each of the local Medicare carriers promulgates its own medical review policy that dictates which procedures are covered benefits and which disorders are valid indications for those procedures. The compensation system under Medicare is a system of wage and price controls, which is known to produce economic distortions. Perhaps regional variation in rates of service is one of them.

It may be that state-to-state differences in tort law influences use of neuroradiologic procedures because of the practice of defensive medicine. For example, one might test whether damage caps, joint and several liability rules, contingency fee regulations, arbitration rules, judge selection and election procedures, and a host of other characteristics of the legal system affect use of imaging services.

The literature on regional variation paints a peculiar picture. We know that procedures used to diagnose and treat a particular condition vary up or down together (2). We know that a few high-volume providers can drive use for an entire community. We know that financial gain cannot explain variation in use, and we can be sure that inappropriate use does not explain geographic variation (3).

Areas of the country with higher rates of hospital use are those with the highest density of hospital beds. The phenomenon persists when socioeconomic status and other variables are controlled. The rate of payment to physicians seems to depend not on the number of physicians but on the distribution of specialists and primary care physicians. These two phenomena have been linked in Roemer's Law or the supplier-induced demand hypothesis, which may be summarized as "build it, and they will come." Conflicting data exist on the benefit to the health care consumer. Some studies show that increased hospital use does not confer a mortality benefit, whereas others show that increased Medicare spending, primarily driven by hospital costs, is associated with lower mortality (4).

It is important to remember that diagnostic testing is ultimately a risk-stratification enterprise. Neuroradiologic procedures provide information regarding the relative risk of various diagnoses, including the diagnosis of "normal," which drives the frequency of imaging.

The most profound external driver of variable rates of Medicare use is probably our lack of knowledge of the natural history of disease, the efficacy of therapy, and the accuracy of the various tests we perform. We cannot expect conformity in the application of diagnostic tests when so much is in doubt about the diseases they depict and the treatments they direct. Consider the example of lumbar spine degenerative disease. We do not know enough about who requires imaging, which imaging findings require treatment, or which treatments are the most efficacious and for how long. We do not know whether the application of practice guidelines increases or decreases demand for diagnostic imaging. The professional uncertainty hypothesis seems to possess profound explanatory power.

The most fruitful research in geographic variation in medical services is not likely going to come from epidemiologic or classic economic models. The most likely explanations will be cultural, anthropologic, psychologic, or behavioral.

The most important question regarding geographic variation in the use of medical services is simply, is it good or bad? Most analysts assume that it is bad for regions to vary in use of medical services. If area A provides more than area B, the residents of area B are either being cheated of health care they need or money they want. The people in area A might be over-treated and exploited. Or worse, this could all be true.

A more basic objection to variation is unspoken. If medicine is a scientific, evidence-based enterprise, the principles of which apply uniformly across populations, medical care needs ought to be similar in similar populations. But this analysis of our medical system is incomplete. The more one examines the role and results of medicine in our culture, the more one is forced to conclude that medical care plays some other role. International differences in health care expenditures and mortality rates support this conclusion. Because it is clear that much medical expenditure is either futile or unnecessary altogether from a biologic point of view, we must ask ourselves whether we are getting our money's worth from this fraction, which drives regional variability. If regional variation simply represents different regional preferences superimposed on epidemiologic differences between regions, variation would be a good thing, because it would reflect real regional differences in risk perception. The only conditions that must lead one to criticize geographic variation are poor medical outcomes, poor patient satisfaction, or unjust diversion of resources from the sick to the worried well.

Medicine is evidently a local phenomenon. Just as there are regional dialects and personalities, there may be recognizable differences in risk preference or tolerance for uncertainty about the future. For example, Midwesterners tolerate a risk of blizzard unimaginable to a Californian, yet Californians ignore a risk of earthquake that would be unacceptable to Midwesterners. This may be more than an amusing observation. A preference for rare catastrophic events over more frequent minor problems with similar aggregate mortality might manifest itself in patient and physician decision making. Alternatively, exposure to the different natural-risk profiles of different regions might cause differences overall risk preferences in society.

Medicare regional variation, if it is a problem, can be solved in one of several ways. The overall regional Medicare allocation could be specified on the basis of population and epidemiologic data, and care could be rationed within each region by the local Medicare carrier under the allocated cap. This approach, based on centralized planning, is likely to be politically unpopular and difficult to implement. Alternatively, we could celebrate diversity and allow the regions to proceed independently. We would accept regional variation as a consequence of our social, cultural, and epidemiologic differences, making a better effort to understand and explain them. A third approach would be to allow citizens to choose the solutions that best suit them. Medicare could be reorganized to provide each beneficiary with a grant to cover basic services. They might pay extra for additional benefits or receive a rebate if they chose to assume some of their own risk or allow others to manage it for them. In this way, the preferences of individual beneficiaries are taken into account as they implicitly express their tolerance for uncertainty through their own choice.

If regional variation in Medicare use is irrational, perhaps it indicates irrationality in the health care system as a whole. We employ market forces modulated by regulatory structure to rationalize other aspects of our society. Ought Medicare be next?

DAVID SEIDENWURM, M.D.  
Radiological Associates  
Sutter Medical Center  
Sacramento, CA

### Acknowledgments

My thanks and appreciation to Deidre Tidmore and Casey Robbins for expert manuscript preparation.

### References

1. Wennberg J, Gittelsohn A. **Small area variations in health care delivery.** *Science* 1973;182:1102-1108
2. Chassin MR, Brook RH, Park RE, et al. **Variations in the use of medical and surgical services by the Medicare population.** *N Engl J Med* 1986;314:285-290
3. Ashton CM, Petersen NJ, Soucek J, et al. **Geographic variations in utilization rates in Veterans Affairs hospitals and clinics.** *N Engl J Med* 1999;340:32-39
4. Hadley J. **Medicare spending and mortality rates of the elderly.** *Inquiry* 1988;25:485-493