Primer on Geographic Variation in Health Care

Although regional variation in health care has long been recognized,[1] studies describing variation in intervention rates across geographic areas continue to appear regularly in medical journals. This primer is intended to help readers make sense of reports about geographic variation. We focus on two basic questions: 1) How much variation is there? 2) What causes variation?

How Much Variation Is There?

Regional rates of medical interventions always vary. Chance alone creates some degree of variation in intervention rates, particularly when many geographic areas are compared. Although debate remains about which method is best, a variety of statistical approaches can be used to evaluate the role of chance in studies of geographic variation.[2]

In most studies, however, geographic variation in intervention rates is not due to chance alone (i.e., it is statistically significant). So readers must consider the "clinical significance" of observed variations: How much variation is there? Many studies simply report the extremal range (ratio of highest to lowest rates) to reflect the magnitude of variation (e.g., "rates of carotid endarterectomy varied 7-fold, from 1.1 to 7.6 per 1000 enrollees").[3] However, this measure can be misleading because procedures performed infrequently generally appear more variable than more common procedures. The extremal range also reflects rates only in high and low outlier regions, thus ignoring practice patterns in all other regions.

To compare procedures reliably, variation measures should be standardized (i.e., on the same scale). One approach is to divide observed procedure rates in each region by the overall average. As illustrated in Figure 1, plotting standardized rates is useful for comparing the "variation profiles" of different procedures.[4] Some procedures, such as hip fracture repair and colectomy for colon cancer, vary little—regional rates cluster near the national average. In contrast, radical prostatectomy and back surgery vary markedly—their variation patterns are scattered diffusely. Peripheral arterial angioplasty varies even more than these high-variation benchmarks.[5]

What Causes Variation?

Considering the entire sequence of steps by which a patient ultimately gets to surgery (or any medical intervention) is a useful way to understand the potential explanations for geographic variation (Figure 2).

Prevalence of Disease

Procedure rates may vary because of underlying differences in disease prevalence across regions. For example, generally higher rates of cardiovascular interventions in the southeastern United States may be in part related to a higher prevalence of cigarette smoking and other risk factors in that region.

Access to Care

To receive a procedure, patients must first get into the medical system. Procedure rates may vary if there are regional differences in access (e.g., related to socioeconomic status, insurance) or patient proclivity to seek medical care (e.g., related to race/culture).

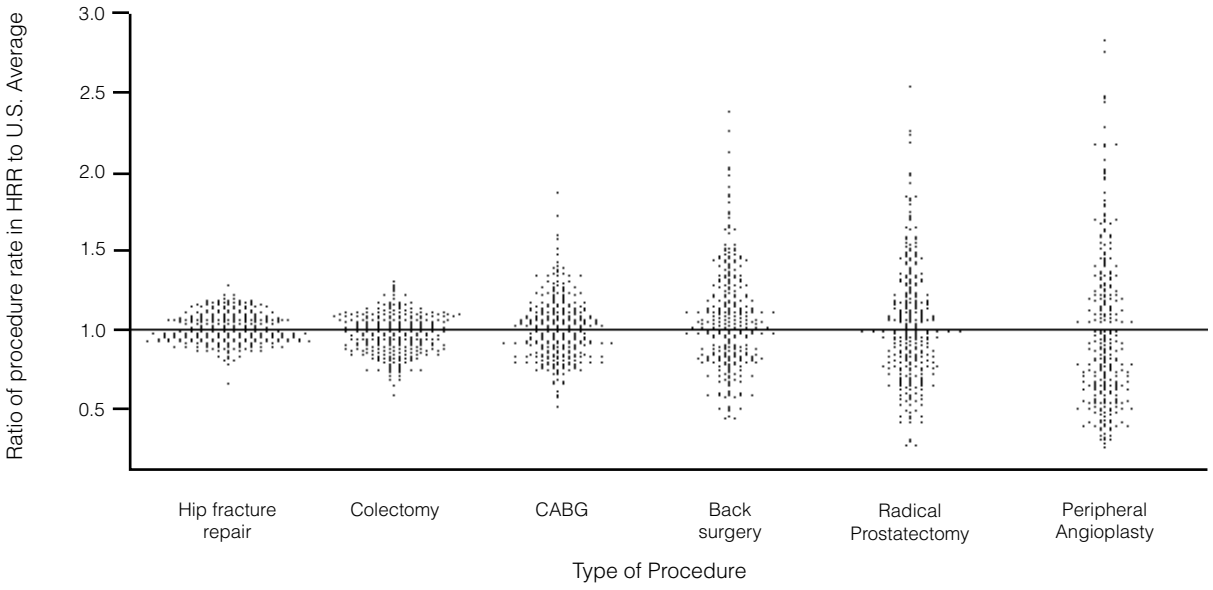

FIGURE 1. Variation profiles of six common procedures. Data for peripheral angioplasty from Axelrod and colleagues.[3] Other figures derived from 1995–6 national Medicare data from the *Dartmouth Atlas of Health Care*.[5] CABG = coronary artery bypass grafting; HRR = hospital referral region.

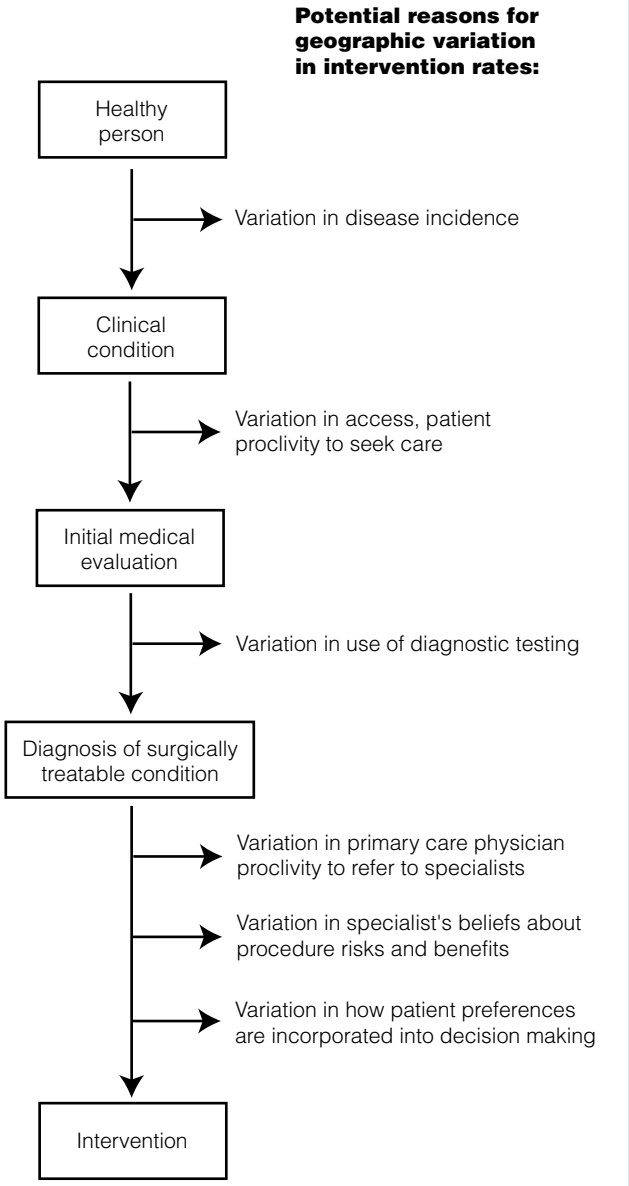

FIGURE 2. Process by which a healthy person becomes a patient and ultimately receives a medical intervention and potential reasons for geographic variation in intervention rates.

Decision To Test

Many surgically treatable conditions are identified primarily by diagnostic tests (e.g., prostate-specific antigen testing, coronary angiography). Thus, surgery rates may vary because of regional variation in the use of diagnostic testing. For example, regional rates of carotid endarterectomy have been shown to be highly correlated with rates of carotid ultrasonography.[3]

Decision To Treat

Finally, it is important to consider how treatment decisions are made, particularly in instances where treatment is not constrained to a single therapeutic option. Several components of this decision process may contribute to regional variation in intervention rates. Primary care physicians may vary in their propensity to refer patients to specialists (and delegate decision making to them). Specialists may vary in their beliefs about the risks and benefits of a given procedure, and thus vary in the recommendations they give patients. Finally, there may be regional variation in the degree to which individual patient preferences are incorporated into clinical decisions.

Conclusion

Differences in the degree to which procedures vary can be explained in the context of these components of decision making. Consider hip fracture repair, a low-variation procedure. Hip fracture prevalence does not vary geographically—all patients seek care, the diagnosis is usually made without discretionary testing, and decisions about treatment are constrained to a single option (surgery). In contrast, regional rates of radical prostatectomy vary widely. This is not surprising: Prostate cancer prevalence varies widely (likely due to variation in testing), and there is wide disagreement among both primary care physicians and specialists about the risks and benefits of several different treatment options.

Geographic variation studies often identify unrecognized problems in clinical decision making. These studies stimulate us to ask, but cannot answer, the question, "Which rate is right?" Research aimed at better understanding of clinical effectiveness, patient preferences, and economic implications is necessary for addressing this basic question.

References

1. Wennberg JE, Gittelsohn A. Small area variation in health care delivery. Science. 1973;182:1102-8.
2. Diehr P, Cain K, Connell F, Volinn E. What is too much variation? The null hypothesis in small area analysis. Health Serv Res. 1990;24:741-71.
3. Wennberg JE, Cooper MM. Practice variations and the quality of surgical care for common conditions. In: 1999 Dartmouth Atlas of Health Care. Chicago: American Hospital Publishing; 1999.
4. Birkmeyer JD, Sharp SM, Finlayson SRG, Fisher ES, Wennberg JE. Variation profiles of common surgical procedures. Surgery 1998;124:917-23.
5. Axelrod DA, Fendrick AM, Wennberg DE, Birkmeyer JD, Siewers AE. Cardiologists performing peripheral angioplasties: impact on utilization. Eff Clin Pract. 2001;4:191-8.

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This primer was contributed by John D. Birkmeyer, MD, Dartmouth Medical School, Hanover, New Hampshire.

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