Small Area Variation in Orthopedics

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INTRODUCTION

Musculoskeletal conditions are a major cause of disability in the United States and consequently are responsible for considerable health-care expenditures.[51] Epidemiologic studies have found significant variations in the per-capita rates of hospital admissions and surgical procedures in almost all fields of medicine including orthopedics.* These variations in utilization and expenditure are curious because they occur in nearby communities that seem to be otherwise similar. For instance, Wennberg and Gittelsohn[55] wrote more than 20 years ago:

> There is a city in Maine where the surgical procedure of hysterectomy (removal of the uterus) was done so frequently in the past decade that if the rate persists, 70% of the women there will have had the operation by the time they reach the age of 75. In a city less than 20 miles away the rate of hysterectomy is so much lower that if it persists, only 25% of the women will have lost their uterus by age 75. What could account for this disparity? It seems unlikely that there would be any large difference in the general health of the populations of the two neighboring cities, and after looking into the matter we have found none. The populations are similar in economic status. Differences in the number of physicians, the supply of hospital beds and coverage by medical-insurance plans cannot explain the difference in the rate of surgery. Instead the most important factor in determining the rate of hysterectomy seems to be the style of medical practice of the physicians in the two cities.

This ubiquitous phenomenon of area variation is not new, and it is present at all levels of aggregate ranging from large geographic comparisons of countries to smaller comparisons of neighboring counties. The differences are not due solely to price or insurance coverage variability because similar variations exist in Great Britain and Canada—countries that both have universal health-care coverage.[34,35,65] These variations in health-care services and expenditures have important policy implications in the current climate of cost containment.

In 1938, Glover[20] found an order of magnitude difference in per-capita rates of tonsillectomy among school districts in Britain. In 1948, the National Health Service would have presumably lessened any economic motives; however, Glover reported similar variations in tonsillectomy rates in 1959.[60] Differences in surgical rates have been found to exist at all levels of geographic aggregate, eg, between nations,[6,35] between states,[38] between cities,[61] between hospital areas within a single state or province,[26,42] and within single institutions.[14,19]

AREA VARIATION RESEARCH FINDINGS

With support from the Robert Wood Johnson Foundation, the Dartmouth Atlas Project has been at the forefront of area variation research.[58] This project is the most comprehensive descriptive analysis of area variation in the US Medicare population. There is a separate atlas dedicated to musculoskeletal conditions.[51] This work has established much of the area variation methodology that is used by most researchers, including the documentation of hospital service areas and hospital referral regions.

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Proximity is the primary factor influencing where patients seek care.[60] Accordingly, they describe 3426 hospital service areas that are based on a localization index, which is the amount of local hospitalizations of residents in certain zip codes divided by all the hospitalizations of those residents.[51] While hospital service areas define usage patterns of local hospitals, they do not account for care that occurs in referral centers. Hence, hospital referral regions were defined by where patients sought care for major surgical procedures such as neurosurgery.[51] Using this method, there are 306 hospital referral regions in the United States.

Many different strategies have been used to study area variation. Perhaps the most familiar is the population-based utilization technique popularized by Wennberg et al.[61] These data are typically abstracted from hospital discharge records and use the hospital service areas and hospital referral regions described earlier. They are purported to be population-based and not hospital-based because they account for migration of patients out of their hospital service area. Hence, all hospital services are attributed to a patient's service area even if the care actually took place in another area.[26]

This method allows per-capita rates of utilization (typically adjusted for age and sex) to be calculated, which when applied to surgical procedures generate a "surgical signature" for an area.[51] These surgical signatures are fairly stable over time, making it possible to distinguish communities by their signature. Dramatic differences in these surgical signatures for many orthopedic procedures have been documented, which has led many to conclude that while it is unclear which surgical rate is appropriate, such variation is worrisome. Implicit in this concern is that low rates might represent underserved areas and high rates might represent unnecessary surgery. Furthermore, evidence is accumulating that greater health-care utilization does not necessarily equate to better outcome.

Supply- and demand-side factors are believed to drive area variation. Demand-side factors are patient-related, the most important of which are likely disease prevalence and severity, which are also the most difficult to account for. Supply-side factors include capacity measures of institutions, number of physicians, and reimbursement. Several studies have correlated high use areas with the number of hospital beds.[31,55] Supply-side factors have been studied more than demand-side factors, perhaps because most policy initiatives regarding escalating Medicare costs have focused on these factors.[40]

The extent to which these factors drive area variation is still unknown. However, the most accepted explanation is the "practice-style" hypothesis (or professional uncertainty hypothesis) popularized by Wennberg.[51,54,60] According to this hypothesis, area variation is the result of clinical uncertainty about the management of conditions for which there is no clinical consensus about treatment options. Physicians, to some degree, acquire information and attitudes toward treatment options from colleagues within their region lending support to the practice-style hypothesis.[39] Under this paradigm, medical conditions for which admission to the hospital is more discretionary exhibit higher variations than medical conditions for which there is wide agreement that hospitalization is required (eg, acute myocardial infarction or hip fracture fixation). Hip fracture surgery rates are associated with relatively low variation compared with other procedures, such as knee arthroscopy. For example, in 1996 and 1997, hip fracture surgery rates varied by a maximum factor of 2 between some American cities, whereas knee arthroscopy rates varied by as much as a factor of 7. In Palm Springs, California, the rates of knee arthroscopy were 7.1 per 1000 Medicare enrollees versus 0.9 per 1000 Medicare enrollees in Waco, Texas.[51] Total knee replacement rates varied by a factor of approximately 5, with rates ranging from as low as 2.2 per 1000 Medicare enrollees to 10.8.

To explore the possibility that inappropriate surgery was responsible for high rates in certain areas, Chassin et al[9] studied the appropriateness of the use of endoscopy of the upper gastrointestinal tract, coronary angiography, and carotid endarterectomy. They identified areas of high, medium, and low use of procedures among Medicare beneficiaries (age and sex adjusted) and reviewed the medical records at each site to determine if the procedures were appropriate. While they identified 17% of coronary angiographies, 17% of upper gastrointestinal tract endoscopies, and 32% of carotid endarterectomies were inappropriate, these findings did not correlate with geographic variations in rates. The US Department of Health and Human Services has declared as many as 25% of procedures may not be required.[47] Hence, while there is clearly some concern regarding unwarranted surgery, it does not appear it is necessarily occurring in high-rate areas. Low-rate areas are equally concerning as they may represent areas of underutilization. Hawker et al[21] concluded variation in the rate of hip and knee arthroplasty was related to underutilization in Ontario, particularly in women.

ORTHOPEDIC STUDIES

There have been relatively few studies on area variation in orthopedics, and the majority of these studies have focused almost exclusively on the Medicare population. For instance, *The Dartmouth Atlas of Musculoskeletal Care* focuses exclusively on Medicare beneficiaries, ie, individuals older than age 65.[51] The dramatic variation that exists across the country in the rate of total knee arthroplasty is clearly identifiable, with rates as high as 9

per 1000 Medicare beneficiaries in some areas and as low as 1.5 per 1000 Medicare beneficiaries in other areas. Hip fracture surgery shows the lowest variation among orthopedic procedures, presumably because there is agreement this condition requires hospitalization and surgical treatment.[18,26,51] On the other hand, high variation procedures are believed to represent more discretionary conditions that, because of a lack of consensus regarding treatment options, are plagued by uncertainty in the medical decision-making process.[51]

The size of the orthopedic workforce also varies dramatically among hospital referral regions. The average for the United States is 6 per 100,000 residents and varies from 3 to 12 per 100,000 residents.[51] It is unclear whether this is driving the variation in surgical rates. The possibility of supplier-induced demand as a driving force for the variation is of great concern. Because of the information asymmetry (patients have limited understanding of their condition compared to physicians) that exists and the professional control of this information, the dual role of the physician as provider and agent permits manipulation of demand.[60] In other words, unlike seeking professional advice in other areas such as architecture, for example, in which clients can take an active role in decision making, consumers in the medical market typically allow physicians to make decisions for them due to the complex nature of the information involved. Hence, physicians are in a unique position as advisors to patients about medical services while at the same time being the providers of those services, which can lead to supplier-induced demand.

Workforce policy hinges on an understanding of the demand for musculoskeletal care, which is very difficult to measure. While there appears to be some correlation between the workforce and surgical rates, it is unclear whether this relationship is causal.[52] Furthermore, two studies have found no association between the number of surgeons and surgical rates of arthroplasty and shoulder surgery in Medicare beneficiaries.[38,50] Both of these studies also found an inverse relationship between surgical rates and population density.

Perhaps the most significant contribution to this area of study in orthopedics has been from the Maine Medical Assessment Program, which was started in 1980 to address area variation.[25,26] This study group monitors variation using Maine discharge data for 29 service areas.[62,64] They focused on lumbar diskectomy (a common orthopedic procedure with high variation) to examine differences in medical decision making. Keller et al[26] noted the rates of this procedure were stable for several years until they rose in a few neighboring areas in 1983. It was determined these increases were due to the relocation of three new surgeons into these areas. Feedback to the surgeons regarding these findings, including a discussion of the indications for the procedure, caused the rate to return to baseline. The authors concluded the increase in rates were due to uncertainty about the best treatment for a herniated disk.

Keller et al[25] took this a step further in 1999 by examining, for the first time, the relationship between different surgical rates and clinical outcome measures. They identified three service areas of high, medium, and low utilization of spine surgery. An inverse, graded response was found between service area and outcome. Patients in the high-rate area were the least satisfied (49%), patients in the medium-rate area were 63% satisfied, and patients in the low-rate area were the most satisfied (72%). These findings suggest the surgical indications in the high-rate area were potentially less stringent than those in the low-rate area. It is unclear how these findings relate to the growing body of volume-outcome literature documenting better outcomes in high-volume centers[24,29,30,37] because the methods used to determine "high" volume are not the same as those used to define a "high" rate.

LIMITATIONS OF STUDIES

Many authors have suggested more research in this area is necessary.[9,11,22,48] For example, studies need to be performed in non-Medicare populations such as in young patients with sports injuries because the Medicare population has been overrepresented in prior research. Medicare historically has been a major payer in the United States and data are readily available, hence this population has received a disproportionate amount of study. However, Medicaid is now a major contributor to the health-care market.[45] In fact, Medicaid recently has exceeded Medicare in expenditures, which might support the rationale for future studies to focus on non-Medicare populations. In addition, many of the prior studies do not perform hypothesis testing, or if they do, many do not report their methods. Instead, they simply assume the observed variation is "too much." Diehr et al[11,12] point out there are no known distributions of small area statistics and the amount of chance variation is high.

Most initiatives have focused on supply-side factors, eg, the change from fee for service to a prospective payment system and the reimbursement cuts of the Balanced Budget Amendment. Unfortunately, it is not as simple as supply-side fee cutting because of volume offset. For example, Christensen[10] demonstrated internists respond to lower reimbursement by seeing more patients.

Demand-side factors require more investigation. For instance, socioeconomic factors may explain some of the variation.[33] It is imperative that a better understanding of demand with population-based studies on disease prevalence precede any regulatory policy. Disease severity, or case mix, is also a key component of outcome and utilization, and is rarely accounted for with current techniques.

PROFILING

The term "physician profiling" is used to describe two scenarios. In one sense, it is used to refer to the dissemination of medical malpractice claims against physicians to the public. Alternatively, it is used to describe data collection on individual providers' patients. Massachusetts was the first state to pass legislation making information publicly available to consumers about physician practices including education and training information, and malpractice settlements.[41] Many states have now followed this trend.

With respect to area variation research, physician or provider profiling refers to the analysis of patient data.[36] This is area variation analysis at the individual provider level. Given that physicians are responsible for the majority of decisions regarding hospital resource allocation,[13] profiling has the potential to influence medical decision-making. This micro approach has the potential to improve on one of the weaknesses of area variation analyses, namely, the ecologic fallacy.

Provider profiling has been offered as a method of reducing variation, lowering cost, and improving quality.[43] These claims are similar to those made by the managed care industry in the past. In fact, the managed care industry is a proponent of these physician profiling programs. Surveys have demonstrated up to 80% of group practices with capitated patients profile their providers.[23] Length of stay has become a common profiling target; in fact, the average length of stay in the United States is shorter than in any other industrialized nation.[36]

Profiling has been used effectively in at least one area of orthopedics to establish a designation of "center of excellence" for total joint replacement.[2] However, it has been shown physicians can "game" the system by altering patient selection (avoiding complicated cases) rather than their practice style.[23] Therefore, insurers that use profiling might unintentionally pass the problem of adverse selection onto the provider, which could serve to undermine the doctor-patient relationship and potentially serve as a barrier to care for patients with more severe or complicated conditions.

Profiling has the potential to be overly intrusive to orthopedic surgeons. Statewide hospital discharge data are available in more than 30 states.[25] For instance, in 1979, the New York State Department of Health joined with the health-care industry and established the Statewide Planning and Research Cooperative System (SPARCS). This database tracks all hospitalizations and ambulatory surgery with unique patient identifiers and physician license numbers. Databases such as these offer an opportunity to address some of the weaknesses of existing area variation studies in orthopedics by allowing for micro studies at the physician level. However, it could potentially be abused if used to generate physician report cards. Consequences of a poor profile can potentially include the loss of managed care contracts and admitting privileges.[4]

Many providers are cynical of profiling policy because it is viewed as potentially punitive.[49] Many orthopedic surgeons in New York State may not realize all of their admissions, readmissions, and operative procedures are tracked (although not with perfect accuracy) and the volume of many common procedures they performed in 2001 can be accessed on the Internet by following the "more is better" link at the Center for Medical Consumers' Web site (http://www.medicalconsumers.org/#MainIndex). These data, physician demographics, and disciplinary history are currently available for New York State. The potential for health regulatory policy that uses these data is not inconceivable.

Physician profiling is still in its infancy, and the reliability of existing profiling systems is unknown.[23] The myriad of limitations of profiling are yet to be reconciled with its regulatory potential. Accurate profiling is difficult because claims data are imperfect, as estimates of incorrect diagnostic coding range from 10% to 30%.[1] Physicians' patient-mix varies appreciably with regard to care-seeking behavior, patient expectations, and types and severity of illness.[1]

POLICY

A new medical care paradigm is evolving that will have implications on the trillion dollar US health-care economy.[7] The government is already intensely involved in most facets of the health-care system in the United States.[46] It is clear that payers, both public and private, are interested in area variation, with their motive being containment of escalating health-care costs. However, the average orthopedic surgeon's understanding of area variation is likely limited, and it is doubtful whether surgeons realize the potential threat this movement could have on their autonomy. The fact that the managed care industry is particularly attracted to this area of research is not surprising, and the orthopedic community should heed this warning.

Historically, the managed care industry has not been successful at improving quality or managing care, but has succeeded in managing costs. Hasty decisions based on incorrect conclusions from area variation studies could lead to policy initiatives that fail to achieve the desired effect and have negative repercussions on the quality of care. The orthopedic community should embrace profiling and exploit its strengths to improve patient care. Ignoring this emerging paradigm could have devastating consequences in the form of rate setting and practice guidelines that are not evidence-based. It is potentially hazardous to implement practice guidelines based on area

variation analyses.[47] Policy aimed at rate setting is also premature because it is still unclear what rate is right. Wennberg et al[60] suggested the professional uncertainty hypothesis should change the focus of health policy away from unnecessary intervention and support initiatives on reducing variation in medical decision making.

There is concern that there may be an overall physician surplus, including too many specialists.[15,27,44] To this end, the American Orthopedic Association (AOA) and the American Academy of Orthopaedic Surgeons (AAOS) have focused their attention on workforce policy. Both organizations have commissioned the RAND Corporation to study the orthopedic workforce. However, estimating the health-care workforce is difficult.[28] Furthermore, these estimates are based on self-reports, which are notoriously inaccurate. Weinstein et al[52] argued that if these factors are taken into account, there is no excess workforce. Many believe the manpower issue is more theoretical than actual, and policy should not focus in this area.

The problem with the demand estimates is that current utilization is an imperfect proxy for need. There are few population-based studies in orthopedics on incidence and prevalence of musculoskeletal diseases. The lack of these data not only makes estimating demand for services difficult, but also weakens the inferences that can be drawn from the area variation literature.

SUMMARY

It is clear that small area variation exists in orthopedics, but there is still much to learn. Given the many unanswered questions regarding area variation, regulatory policy at this time would be premature. The biggest piece of the puzzle that needs to be solved is the influence of disease prevalence and severity. While it seems unlikely this will explain all of the variation, it is equally unlikely that musculoskeletal diseases are distributed evenly across geopolitical boundaries, hence, it likely accounts for some of the observed variation. More patient-level studies need to be conducted in non-Medicare populations. For example, the extent to which area variation exists in sports medicine and knee surgery for younger patients is unknown.

Profiling is likely here to stay. In accord, it should be exploited by the orthopedic community for its strengths while keeping in mind its limitations. Orthopedic surgeons should be at the forefront of this research and consequently influential in its evolution rather than have the managed care industry or government dictate policy.

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