THE DARTMOUTH INSTITUTE
FOR HEALTH POLICY & CLINICAL PRACTICE
Where Knowledge Informs Change

What Kind of Physician Will You Be?

Variation in Health Care and Its Importance for Residency Training

October 30, 2012

Anita Arora, MD, Geisel School of Medicine at Dartmouth Class of 2012,
Alicia True, Geisel School of Medicine at Dartmouth Class of 2015,
and the Dartmouth Atlas of Health Care

We look to you, as medical students nearing graduation, to help transform the quality and value of medical care. Your choice in a residency program will shape your care for patients for years to come and can also present opportunities to lead improvements in health care. Surely, this is one of the most important decisions you will make in your career.

Residency program reputation, location, and training curriculum are obviously major factors in your ranking of programs. It is also important to know that each teaching hospital has its own style and culture of practice that represents a hidden training curriculum. This Dartmouth Atlas report will help you understand these less visible hospital characteristics that can have profound effects on how you care for patients.

The report first provides background on health care variation and then presents information about specific teaching hospitals. (Information for nearly all teaching hospitals can be found at www.dartmouthatlas.org.) When you read the report, we would encourage you to consider the current problems and future opportunities in health care, and how your training can help you become a leader in tomorrow's health care system.

With very best wishes to our future physicians,

Wiley "Chip" Souba, MD, ScD, MBA
Vice-President for Health Affairs at Dartmouth College
and Dean of the Geisel School of Medicine at Dartmouth

John E. Wennberg, MD, MPH
Founder and Director Emeritus of the Dartmouth Institute for Health Policy and Clinical Practice

David C. Goodman, MD, MS
Director of the Center for Health Policy Research,
The Dartmouth Institute for Health Policy and Clinical Practice

Executive Summary

For more than 20 years, the *Dartmouth Atlas of Health Care* has used Medicare data to understand differences in medical care across U.S. hospitals and regions. The Atlas project has uncovered marked variations in resource utilization and health care spending. It has demonstrated that increased utilization and spending do not always lead to higher quality care or better outcomes. It has also shown that many patients receive care that they would not want if they were better informed about the full range of treatment options.

This report is part of a new effort to provide medical students with information about the patterns of care provided by teaching hospitals with residency training programs. Most fourth-year medical students consider the reputation and training curriculum of the institution as well as their own geographical and lifestyle preferences when choosing a residency program. This report offers medical students new ideas and information to help guide their choice. It shines a light on hospital characteristics that are often invisible but are part of the hidden training curriculum that can affect a lifetime of practice. These include how aggressively physicians at each hospital treat chronically ill patients at the end of life, and the frequency with which patients undergo surgery when other treatment options are available. The authors of this report (who are physicians in training) believe that the wise use of health care resources and respect for patient preferences are just as important as learning to work up a patient.

Understanding these patterns of care is particularly important for tomorrow's doctors in order to practice successfully in the new environment created by health care reform. The nation can no longer afford unrestricted growth in health care costs and health care systems that provide low quality and inefficient care. Teaching hospitals vary widely in their performance, and medical students should consider the advantages of training in hospitals that already deliver high-value health care. At the very least, they should be aware of the practice styles of residency programs they are considering ranking highly in the Residency Match.

Differences in patterns of care can be understood through three categories of medical care variation defined at the Geisel School of Medicine at Dartmouth: effective care, supply-sensitive care, and preference-sensitive care. **Effective care** refers to services that are of proven value and have no significant tradeoffs; the benefits of the services so far outweigh the risks that all suitable patients should receive them**. Supply-sensitive care** represents services for which the supply of physicians and other resources—such as hospital beds—strongly influences the amount of care delivered. **Preference-sensitive care** comprises care for conditions for which there is more than one treatment option, each with its own benefits and tradeoffs. For these conditions, patients' preferences should—but often do not—guide decision-making. Variations in the way teaching hospitals utilize supply-sensitive and preference-sensitive services are an important driver of spending differences across the United States. Beyond cost considerations, variation in all of these categories is an important factor in the quality of patient-centered care. This report will help fourth-year

medical students to identify the hospitals with exemplary practice patterns and to be aware of training hospitals that have room to improve.

This report uses Dartmouth Atlas data to show the variation in medical care for Medicare beneficiaries among academic medical centers rated by *U.S. News and World Report* as the best hospitals for clinical excellence in 2012-13[1] (see Appendix B for more information on this list). The report also includes several other notable teaching hospitals for a total of 23 medical centers reflecting a wide range of practice styles.[2] Together, these hospitals represent approximately 17 percent of all primary residency slots in 2012[3] and are home to some of the largest and most popular training programs. The Dartmouth Atlas web site (www.dartmouthatlas.org) has additional data for nearly all other U.S. teaching hospitals.

The report is divided into three sections. The first section reports on care provided in the last six months of life, which reflects the way that physicians at different institutions approach end-of-life care for chronically ill patients. The second section describes preference-sensitive care and uses regional surgical procedure rates to demonstrate the inconsistency in the use of different treatment options. The final section presents patient care quality indicators submitted by each hospital to the U.S. Department of Health and Human Services.

Understanding variations in the way care is delivered by these institutions is important because it affects residency training and, thus, the way residents in a given program will practice as physicians. The report demonstrates that hospitals providing higher intensity care are not necessarily providing higher quality or better patient experiences. Hence, training at hospitals with less intensive utilization patterns may better prepare residents to provide higher quality care that respects patient preferences. Medical students and residents can also use this resource to learn and question the practice patterns at academic institutions where they are currently training.

Variation in End-of-Life Care and the Management of Chronic Illness

For chronically ill patients near the end of life, the amount of care provided varies markedly from one teaching hospital to the next. Each of these hospitals has a unique pattern of care provided to chronically ill patients; these care patterns are an important part of the training environment for residents. Fourth-year medical students may want to consider these practice styles carefully when choosing a residency program.

Table 1 reveals the wide variation in the use of physicians, hospital beds, and hospice among the 23 hospitals, which are ranked in order from the highest Hospital Care Intensity (HCI) index to the lowest. The HCI index is a measure that combines the number of days patients spent in the hospital and the average number of inpatient physician visits during the last two years of life. The highest HCI index is more than three times greater than the lowest among these medical centers. Patients who received most of their care at Cedars-Sinai Medical Center in Los Angeles saw

Table 1. Variation in resource utilization for chronically ill patients among 23 teaching hospitals

Hospital	Hospital Care Intensity (HCI) index	Hospital days per decedent, last 6 months of life	Physician visits per decedent, last 6 months of life	Percent of deaths occurring in hospital	Percent of deaths associated with ICU admission	Percent enrolled in hospice, last 6 months of life	Percent seeing 10 or more MDs, last 6 months of life
Cedars-Sinai Medical Center	2.06	19.0	72.6	42.1	38.2	32.8	65.3
NYU Langone Medical Center	1.73	19.1	58.5	34.3	23.8	39.2	66.6
Mount Sinai Medical Center	1.50	18.3	49.1	44.8	17.0	23.1	66.3
Ronald Reagan UCLA Medical Center	1.48	16.8	49.7	44.1	40.6	34.2	62.9
New York-Presbyterian Hospital	1.37	20.2	39.1	44.2	16.2	24.5	60.9
University of Pittsburgh Medical Center	1.28	12.8	42.5	31.7	23.6	48.8	59.2
Northwestern Memorial Hospital	1.28	14.9	42.0	38.4	29.1	44.2	62.8
Massachusetts General Hospital	1.19	15.5	34.7	34.4	17.9	44.9	59.9
Cleveland Clinic	1.12	16.0	35.3	35.4	26.2	46.2	60.4
Hospital of the University of Pennsylvania	1.08	14.7	30.6	26.0	19.8	57.9	61.7
University of Michigan Medical Center	1.07	14.3	30.8	22.8	11.9	59.1	60.8
Brigham and Women's Hospital	1.06	14.9	31.5	34.6	19.4	41.5	61.5
Johns Hopkins Hospital	1.01	13.6	23.4	30.2	19.9	49.4	45.7
Indiana University Health (Clarian Health)	0.96	12.6	30.3	26.2	21.2	51.2	57.0
Barnes-Jewish Hospital/Washington Univ.	0.95	14.1	28.9	31.4	17.8	48.7	52.9
UCSF Medical Center	0.92	13.2	28.3	37.8	22.7	39.0	53.4
Duke University Medical Center	0.87	13.6	24.2	30.7	22.1	47.9	54.8
Vanderbilt University Medical Center	0.80	11.5	26.6	25.9	21.1	56.3	56.3
University of Washington Medical Center	0.78	11.3	22.6	30.2	20.5	46.9	53.1
Stanford Hospital and Clinics	0.78	11.4	27.0	38.0	33.1	44.2	53.1
St. Mary's Hospital, Mayo Clinic	0.70	9.9	21.3	22.8	16.8	44.7	52.4
Scott & White Memorial Hospital	0.62	8.9	19.8	24.9	15.7	58.1	42.5
University of Utah Health Care	0.62	8.6	19.7	23.2	17.0	55.0	47.2
United States average	1.00	11.8	33.7	28.3	18.2	47.9	49.5

The highest value for each measure is highlighted. Data for 236 teaching hospitals are available at www.dartmouthatlas.org.

physicians almost four times as frequently in their last six months of life compared to those who received most of their care at Scott & White Memorial Hospital in Temple, Texas. More than twice the percentage of patients treated at the University of Michigan Medical Center was enrolled in hospice in the last six months of life compared to those treated at New York-Presbyterian Hospital.

Data used in this report

The first section of this report deals with the treatment of patients at individual hospitals. The study population includes fee-for-service Medicare beneficiaries who died in 2010 and who were hospitalized for a chronic illness at least once during their last two years of life. This cohort was restricted to patients with at least one of nine chronic illnesses associated with high mortality rates: malignant cancer/leukemia, chronic pulmonary disease, coronary artery disease, congestive heart failure, peripheral vascular disease, severe chronic liver disease, diabetes with end organ damage, chronic renal failure, and dementia. Patients were assigned to the hospital they used most frequently during their last two years of life. If there was a tie between hospitals, the patient was assigned to the hospital associated with the last inpatient admission prior to death.

Among the variables for which the Dartmouth Atlas provides hospital-specific data, we chose those that would have the most relevant implications for a resident's training. These include:

Hospital Care Intensity index: The index combines two measures: the number of days patients spent in the hospital and the average number of physician visits they experienced as inpatients during the last two years of life.

Hospital days per patient, last six months of life: All days that a patient spent in acute care general hospitals during the last six months of life.

Physician visits per patient, last six months of life: All physician visits during the patient's last six months of life, no matter where the visits occurred (in or out of the hospital).

Percent of deaths occurring in hospital: The percent of patients assigned to the hospital that died in a hospital. The denominator is all deaths, no matter where they occurred.

Percent of deaths that included an ICU admission: The percent of patients assigned to the hospital that died in a hospital and whose final admission included at least one stay in an intermediate- or high-intensity ICU. The denominator is all deaths, no matter where they occurred.

Percent enrolled in hospice during the last six months of life: The percent of patients admitted into hospice during the last six months of life. Hospice is end-of-life care provided to patients who are expected to live six months or less. Pain and other symptoms of the patient's illness are treated to provide increased quality of life. Hospice care can occur at home, at an outpatient hospice center, in a hospital, or at a skilled nursing facility. These data include hospice care occurring in any of these settings.

Percent seeing 10 or more physicians during the last six months of life: The percent of patients who saw 10 or more physicians in their last six months of life. A high rate reflects a willingness to refer patients to other physicians and may suggest fragmented care.

All of these variables were adjusted for age, sex, race, and primary chronic diagnosis.

The variations in hospital days and physician visits are also shown in Figures 1 and 2. In these charts, the 23 hospitals are displayed as red dots on a background of 236 teaching hospitals throughout the nation. These charts demonstrate that the 23 medical centers reflect the variation in care present at teaching hospitals nationwide.

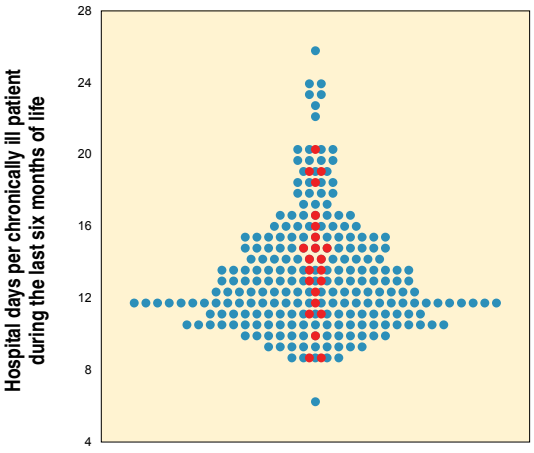


Figure 1. Average number of hospital days per chronically ill Medicare patient during the last six months of life among patients receiving most of their care at teaching hospitals (2010 deaths)

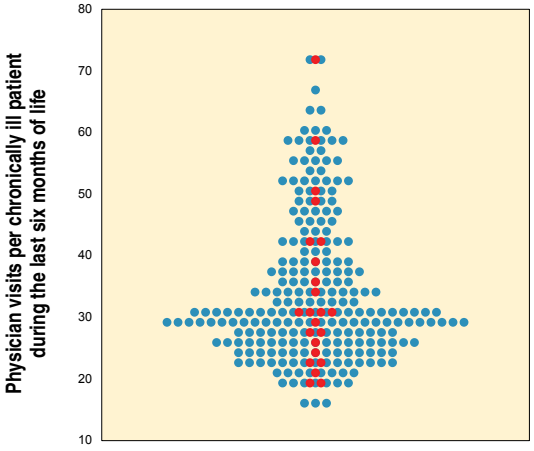


Figure 2. Average number of physician per chronically ill Medicare patient during the last six months of life among patients receiving most of their care at teaching hospitals (2010 deaths)

Why is there variation in the care provided by academic medical centers?

All of these hospitals are academic medical centers affiliated with medical schools and should be exemplars of evidence-based medicine. Therefore, one would expect best practices to dictate when patients should be admitted to the hospital, how long patients should stay there, and how often they should see their physicians. If the practice of medicine varies so widely from one academic medical center to the next, they cannot all be right. For end-of-life care, the patterns of practice are based more on the accidents of local health care resource supply than on evidence; in other words, they are supply-sensitive. The degree of variation also suggests something else: that patients are receiving care and resident physicians are receiving training that reflects the local practice style of their teaching hospital.

As Figures 3 and 4 show, in areas with more hospital beds and more doctors per capita, patients spend many more days in hospitals and receive many more physician visits. Figure 3 shows the relationship between hospital beds and admissions for the 306 Dartmouth Atlas hospital referral regions (HRRs), represented by blue dots (see Appendix A for details on how the regions were created). For many medical conditions, as the number of hospital beds increases, the admission rate (represented here as the discharge rate) increases. This graph shows that the available supply of hospital beds unconsciously influences a physician's decision to admit a patient. Conversely, the red dots at the bottom of the graph show that the rate of hospitalization for hip fracture is not correlated with the supply of hospital beds. This is because admission for hip fracture is effective care; the diagnosis is certain and medical evidence shows that hospitalization is essential for good outcomes. Therefore, regardless of the supply of beds, patients with hip fractures are hospitalized.

As the 2008 *Dartmouth Atlas of Health Care* noted, "It is widely recognized that academic medical centers, particularly those associated with medical schools, have special responsibilities. They educate medical students and other health professionals, they provide postgraduate specialist training, and they play a leading role in continuing medical education. These activities constitute the clinical environments and role models that are essential for creating a professional identity, or sense of duty and standards of behavior for physicians. Academic medicine is also responsible for establishing the scientific basis of the medical care provided to aging Americans, most of whom will die from costly chronic illnesses that must be managed but cannot be cured."[4]

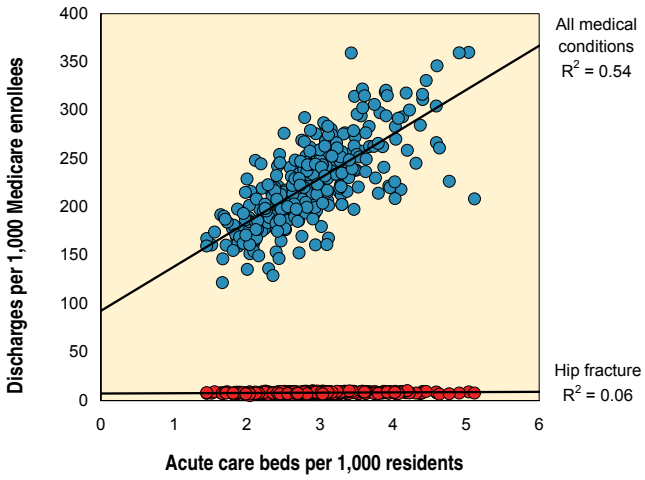


Figure 3. The relationship between the supply of hospital beds (1996) and hospital discharges per 1,000 Medicare enrollees (1995-96) among hospital referral regions

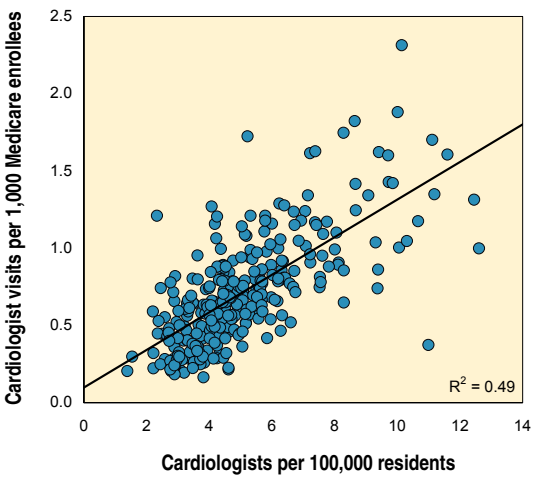


Figure 4. The relationship between the supply of cardiologists and visits to cardiologists per 1,000 Medicare enrollees among hospital referral regions (1996)

The supply of physicians also influences a patient's level of care. For example, Figure 4 shows that the number of visits patients make to cardiologists is positively correlated with the number of cardiologists in an HRR. This is because, at the regional level, cardiologists compete with each other for a fixed population of patients; therefore, the more cardiologists per capita, the smaller their patient panels, and the more frequently they see each patient. In the absence of clinical evidence surrounding the ideal frequency of physician visits for medical conditions (e.g., congestive heart failure or coronary artery disease), physicians' availability influences how often they see their patients for follow-up.

The high variation among the hospitals in Table 1 shows that clinical science to guide many types of medical care is lacking. Even the hospitals with lower utilization levels are unlikely to have a best-practice strategy regarding the allocation of resources that they could share with higher-intensity hospitals. Furthermore, physicians working within these hospitals are often unaware of nationwide differences in practice.[5] The hospitals in Table 1 ranking highest for most of the variables are located in New York City and Los Angeles, cities with high concentrations of hospitals and physicians per capita. The capacity of resources, along with established practice styles, dominates clinical decision-making and contributes to the higher utilization in these hospitals.

Why is this variation relevant to a medical student or resident?

Residents' training will be influenced by the intensity of care provided by their teaching hospital. The findings about the care of chronically ill patients near the end of life reflect a number of factors:

Organization of care and reliance on specialists: Complex patients are often cared for by multiple physicians, each having a specific set of recommendations. Primary care physicians and resident teams are frequently charged with the task of coordinating these instructions and organizing the patient's care. This is a challenging responsibility. Consider that, at NYU Langone Medical Center, almost 70 percent of chronically ill patients saw 10 or more different physicians during their last six months of life. It is difficult for both patients and providers to integrate the advice from so many physicians. Residents at hospitals where patients have multiple physicians will need to make a special effort to manage these recommendations to avoid potential consequences of fragmented or disorganized care.

The care provided at hospitals with a high percentage of patients seeing 10 or more physicians during the last six months of life is also particularly reliant on specialists. A resident at NYU Langone Medical Center will interact more frequently with specialists than a resident at Scott & White Memorial Hospital, where only 43 percent of patients saw 10 or more physicians. At NYU, a patient's care will be heavily dictated by specialists' opinions. In contrast, residents at Scott & White may be more likely to develop experience managing complex chronic illnesses, as fewer patients see multiple specialists.

Utilization of resources at end of life: When asked how they would like to spend their last six months of life, many patients prefer to be cared for in a home-like setting. However, the Dartmouth Atlas data show that, for many patients, it is not their preferences that determine how they spend the last few months of life, but the practice styles of the hospitals where they happen to receive care.

For example, patients at Cedars-Sinai Medical Center saw physicians 73 times in their last six months of life, compared to patients at University of Utah Health Care, who saw physicians 20 times during that same time period. Similarly, patients at New York-Presbyterian Hospital spent, on average, 20 days in the hospital during their last six months of life, compared to 10 days at the Mayo Clinic. These data show that Cedars-Sinai and New York-Presbyterian provide more aggressive care. It is true that more time in the hospital and more physician visits provide residents with more information, allowing a resident to be more certain about a diagnosis, treatment plan, or the stability of a patient prior to discharge. However, longer and more frequent hospital stays have their own risks of iatrogenic illness (for example, acquiring a nosocomial infection), increased financial burden, and uncoordinated care. Most importantly, for many patients with chronic illness, more hospital days do not lead to a longer or better quality of life.

Use of ICUs and reliance on hospice: Many heroic and life-saving measures occur in ICUs, where aggressive efforts are made to resuscitate patients and keep them alive. There are times, however, when these measures are more harmful than heroic—and they may be unwanted by the patient.

The percent of deaths associated with an ICU admission at Ronald Reagan UCLA Medical Center was more than three times what it was at University of Michigan Medical Center for patients dying in 2010. Days spent in an ICU are resource-intensive and often unpleasant for patients and their families. It is difficult to predict for which patients an ICU stay will be life-saving and for which patients it will be harmful. Physicians should consider and discuss with all patients, especially elderly patients, whether the possible benefits of an ICU stay outweigh the disadvantages. Some patients would prefer to be managed at home, perhaps under hospice care. In hospitals where a high percentage of deaths occur in the hospital and in the ICU, there is less emphasis on hospice care. Approximately 50 percent of patients treated at the Johns Hopkins Hospital were enrolled in hospice in their last six months of life, compared to only 23 percent of patients treated at Mount Sinai Medical Center in New York City. A Mount Sinai resident may therefore learn a higher threshold for referral of a patient to hospice or may decide to explore more aggressive treatment approaches first. Meanwhile, a Johns Hopkins resident may be better trained in having discussions with patients about their preferences for end-of-life care.

Variation in Surgical Procedures

There is a remarkably high degree of variation in rates of common surgical procedures across hospital service areas dominated by academic medical centers. Patients' chances of having prostate surgery, CABG, or vascular surgery depend as much on where they live as the medical problem that brought them to a physician. While these local practice patterns are invisible to residents, attending physicians, and patients, they reflect important differences in patient care that should be understood by medical students choosing a surgical training program.

Table 2 shows the procedure rates for the 19 HSAs associated with the 23 teaching hospitals. Each of these HSAs' rates demonstrates practice styles that influence resident training. These data reveal at least a twofold variation in rates among these HSAs for every one of the procedures listed. For some procedures, the variation was even greater. For example, the incidence of lower extremity bypass in Baltimore was five times that in Temple, Texas. The incidence of radical prostatectomy in Salt Lake City was more than three times that in San Francisco. In addition, the table demonstrates that a high frequency of one procedure in a particular region did not necessarily mean high rates for all procedures. For instance, while the rate of transurethral prostatectomy in Los Angeles was among the highest in the group of HSAs examined, the rates of hip replacement, CABG, and carotid endarterectomy

Table 2. Inpatient surgical procedure rates per 1,000 Medicare enrollees (2008-10)

Hospital Service Area (HSA)	CABG	PCI	Hip replacement	Knee replacement	Back surgery	Carotid endarterectomy	Lower extremity bypass	TURP for BPH (males)	Radical prostatectomy (males)	Cholecystectomy	Mastectomy (females)
Los Angeles, CA	1.6	6.5	2.3	5.9	4.6	0.8	0.8	3.6	1.6	3.2	0.7
San Francisco, CA	1.2	5.5	2.5	4.3	2.9	0.8	0.7	3.2	0.8	2.5	0.2
Stanford, CA	1.5	3.7	5.3	6.8	4.3	0.8	0.6	3.2		1.5	
Chicago, IL	3.1	8.0	3.3	6.3	2.9	1.4	1.1	3.6	1.3	3.4	0.9
Indianapolis, IN	3.5	9.7	4.3	9.4	4.0	2.2	1.1	1.9	1.5	2.6	0.5
Baltimore, MD	3.8	9.8	4.0	9.9	5.9	2.8	2.1	2.2	0.8	3.3	1.0
Boston, MA	2.0	5.5	3.1	5.9	2.8	1.4	0.7	4.1	1.0	2.5	0.6
Ann Arbor, MI	3.2	6.7	4.9	9.2	3.8	1.8	0.8	2.1	1.6	2.5	0.8
Rochester, MN	2.9	7.3	5.8	11.7	3.5	1.3	0.5	1.0	2.2	2.5	0.8
St. Louis, MO	3.5	8.4	3.8	10.1	4.1	1.9	1.0	2.1	1.8	3.9	0.6
Manhattan, NY	1.8	8.9	3.5	4.5	3.0	0.8	0.8	3.2	1.4	1.9	0.9
Durham, NC	2.6	4.5	3.8	8.8	5.1	1.0	0.5	3.5	2.0	2.4	0.6
Cleveland, OH	2.9	7.7	4.4	8.6	3.3	1.7	1.0	2.3	0.9	3.1	0.7
Philadelphia, PA	2.4	7.3	3.0	5.8	2.7	1.1	0.8	3.0	1.0	2.9	1.0
Pittsburgh, PA	3.4	7.6	3.9	8.1	5.2	1.4	1.0	2.7	0.8	3.5	0.8
Nashville, TN	3.8	6.9	3.5	8.1	6.3	1.6	1.2	2.0	2.4	3.1	0.4
Temple, TX	3.6	4.4	2.9	10.2	2.4	1.2	0.4	0.9	1.7	2.8	
Salt Lake City, UT	2.1	5.2	5.1	11.9	5.7	1.1	0.5	1.8	2.5	3.1	0.6
Seattle, WA	1.7	5.3	4.3	7.3	4.4	1.1	0.8	1.7	1.2	1.9	0.6
United States average	3.4	8.2	3.8	8.8	4.7	2.1	0.9	2.7	1.4	3.4	0.9

Blank cells indicate that there were not enough procedures performed in the HSA to produce statistically significant rates. The highest value for each measure is highlighted. Data for 162 HSAs containing teaching hospitals are available at www.dartmouthatlas.org.

Data used in this report

Inpatient procedure rates per 1,000 Medicare enrollees were calculated for the following procedures and averaged for the period 2008-10 at the hospital service area (HSA) level. An HSA is a grouping of ZIP codes whose residents receive most of their hospitalizations from the hospitals in that area. The 19 HSAs presented in figures and tables contain one or more of the 23 hospitals studied. Each rate includes the procedures performed at all of the hospitals in the area and not necessarily at only one hospital. Nevertheless, it is likely that the academic hospital(s) lead each region's practice pattern.

Coronary Artery Bypass Grafting (CABG)
Percutaneous Coronary Intervention (PCI)
Hip Replacement
Knee Replacement
Back Surgery
Carotid Endarterectomy
Lower Extremity Bypass
Transurethral Resection of the Prostate (TURP) for Benign Prostatic Hyperplasia (BPH)
Radical Prostatectomy
Cholecystectomy
Mastectomy for Cancer

All of these rates were adjusted for age, race, and sex (when appropriate) using the U.S. Medicare population as the standard. TURP and radical prostatectomy were restricted to males. Mastectomy was restricted to females.

were among the lowest. For the HSAs studied for this report, many procedure rates were below the national average, and, other than the rate for lower extremity bypass in Baltimore, none exceeded two times the national average rate for that procedure.

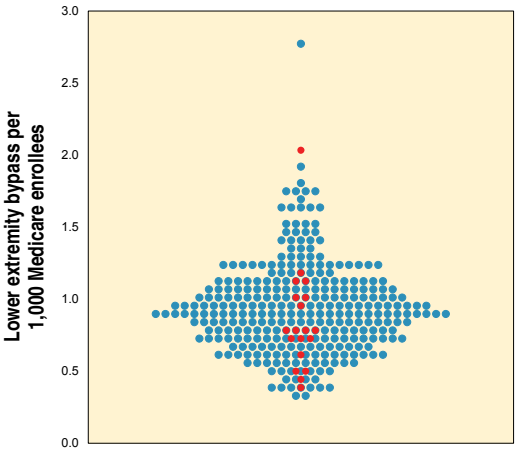


Figure 5. Lower extremity bypass per 1,000 Medicare enrollees (2008-10)

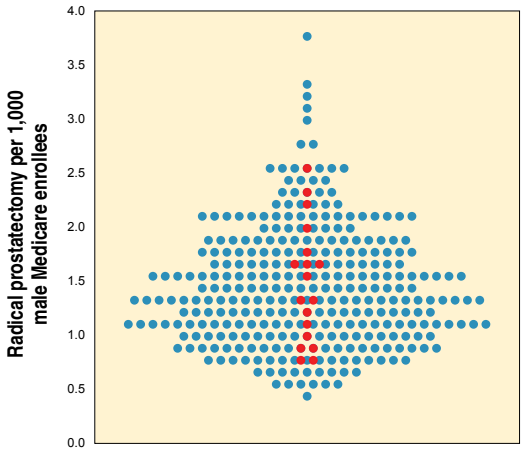


Figure 6. Radical prostatectomy per 1,000 male Medicare enrollees (2008-10)

The rates of surgery for lower extremity bypass and radical prostatectomy are shown in Figures 5 and 6. In these charts, the 19 HSAs are displayed as red dots on a background of the 306 hospital referral regions (HRRs) throughout the nation. These charts demonstrate that the 19 HSAs studied reflect the national variation in care (but to a lesser extent, with many of the HSAs exhibiting rates close to or below the national average for many surgeries).

Why is there variation in surgery rates?

The dramatic variation in procedure rates for preference-sensitive surgery in the United States cannot be explained by variation in the prevalence of diseases requiring surgical intervention. For example, there is no reason to believe that patients in Boston are at higher risk for developing benign prostatic hyperplasia and therefore require transurethral prostatectomy more than four times as often as patients in Rochester, Minnesota. Instead, variation in the rates of a given procedure reflects a lack of concrete evidence or an unsettled debate about the efficacy of the treatment. In other words, physicians often do not know the "right" rate for a procedure, and the more that surgeons disagree about the effectiveness of that procedure, the greater likelihood there is for geographic variation.[5]

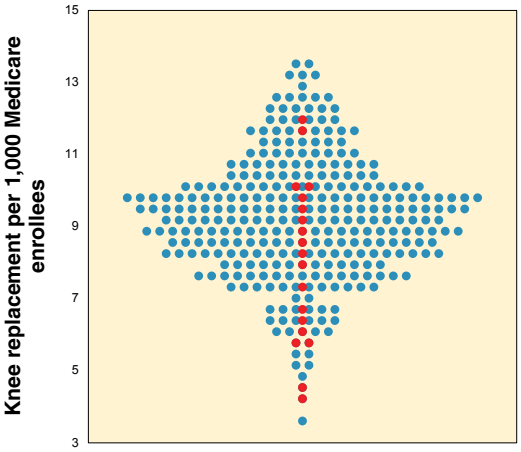


Figure 7. Knee replacement per 1,000 Medicare enrollees (2008-10)

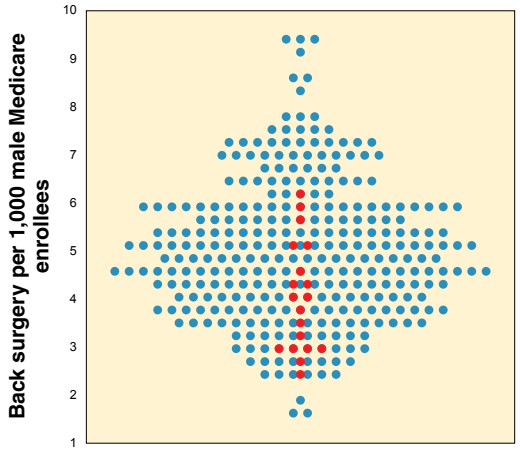


Figure 8. Back surgery per 1,000 Medicare enrollees (2008-10)

This is also demonstrated by examining rates of knee replacement and back surgery, shown in Figures 7 and 8. Conditions associated with these orthopedic procedures (for example, knee osteoarthritis or back pain due to disc herniation) can be treated in more than one way, including analgesics, physical therapy, and surgery. When there are multiple treatment options, it is no surprise that there is marked variation in procedure rates. For example, knee replacements are performed in Salt Lake City at a rate that is more than two times that in Manhattan. The only way to ensure the rate is "right" is for clinicians to fully inform patients about treatment options and to share treatment decisions, through a process known as shared decision-making.[6]

Unwarranted variation leads to differences in surgical training. An orthopedic resident trained in Salt Lake City is likely to learn a treatment style for osteoarthritis of the knee where surgery is more probable than a resident in New York City, who might more readily prescribe physical therapy or analgesics.

Why is this variation relevant to a medical student or resident?

Inadequacy of clinical guidelines: Throughout medical school and residency, young physicians learn how to diagnose illness and determine if a patient meets clinical criteria for a certain treatment. Understanding and applying clinical guidelines is the best first step in determining appropriateness for a certain procedure. However, using clinical guidelines alone may overestimate the number of patients who should receive a procedure because such guidelines do not take into account patient preferences. This was demonstrated in a study published in 2001 by Hawker et al, which examined the patient populations receiving knee and hip replacement in two Canadian regions, one with high rates of surgery and the other with low rates. They defined the population-based need for arthroplasty as those patients who met certain clinical criteria: specific symptoms and

signs of severe arthritis. These patients were then informed about the risks and benefits of the surgery through a standardized interview and were subsequently asked about their desire for surgery. Of those patients meeting the clinical criteria, only 15 percent in the high-use region and 8.5 percent in the low-use region decided to proceed with arthroplasty.[7] The study showed that evidence-based guidelines grossly overestimated the number of patients in both regions who should receive surgery. Patient preferences for arthroplasty did differ between the regions, but practice patterns did not reflect those preferences.

Delegated decision-making: Medical training teaches young physicians to make recommendations in the best interests of the patient. But many treatment options involve varying benefits and risks to the patient and tradeoffs in the patient's quality of life. These tradeoffs include recovery time, follow-up care, morbidity, and cost of care. One example is the decision between medical therapy, PCI, and surgery for stable angina due to coronary artery disease (CAD). Recent studies have shown little difference in long-term survival for the three treatments when used for the initial management of stable chronic disease.[8,9] In cases such as this, the preferences of well-informed patients may differ from each other and from their physicians. These patient preferences should guide the choice of treatment. Instead, all too often the local practice style heavily influences which procedure is performed.[5]

The "right" rate of surgery should represent all patients deemed appropriate for a procedure by the most current guidelines who also choose to have the operation based on their own preferences and values. Variation due to other causes is unwarranted and represents a misuse of care or even a medical error (operating on the wrong patient). Residents who train at hospitals that emphasize patient preferences and shared decision-making will learn to give patients the information they need to make the best decisions for their care. Formalized shared decision-making programs for patients facing health care decisions are relatively rare. Fortunately, the Center for Medicare and Medicaid Innovation recently announced a grant to fund the implementation of shared decision-making programs for hospitals in the High Value Healthcare Collaborative, which include, among others, the Mayo Clinic, UCLA Health System, and Scott & White Healthcare.[10]

What this means for surgical training: Residents will learn from physicians in teaching hospitals and will model their behaviors after their faculty. Some of the important goals of surgical training include developing operative skills, clinical judgment, and a greater understanding of the pathological basis of disease. However, most residency programs do not equip physicians to fully understand treatment choices and to elicit patient preferences. As residents work closely with supervising senior residents and attending physicians to develop their own clinical judgment, they will be influenced by the practice styles of mentors and peers. Regardless of where they train, young physicians must strive to elicit the preferences of patients in order to always perform the right procedure on the right patient at the right time.

Quality and Patient Experience

While the quality of care at academic medical centers is generally high, there is still considerable room for improvement. Medical students should look carefully at these care measures; one cannot assume that either reputation or greater intensity of care ensures better care. Table 3 shows the patient experience and quality measures for each of the hospitals studied. The percentage of patients that gave their hospital a "high" rating was above the national average for 20 of the 23 hospitals. For every hospital examined, the percentage of patients who would definitely recommend the hospital to family or friends was at or above the national average. Forty-seven of the 110 safety measures recorded for this cohort of hospitals, or approximately 43 percent, were better than the national average. Approximately 74 percent and 48 percent of the hospitals met or exceeded the national average for administration of pneumonia and influenza vaccinations respectively, and 87 percent met or exceeded the national average for smoking cessation counseling.

Data used in this report

Three sets of variables from the U.S. Department of Health and Human Services' Hospital Compare database were examined to understand the quality of care with respect to patient experience, patient safety, and processes of care at the 23 study hospitals. This information is self-reported by hospitals that volunteer to submit their data for public reporting by HHS.[11]

Patient Experience Variables: The following variables were captured by HHS through the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), a standardized survey given to a random sample of recently discharged hospital patients to gauge their perspectives. The variables represent discharge data from January 2011 to December 2011.

Rate Hospital "Highly": "Patients who gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest)."

Recommend Hospital: "The survey asked patients whether they would recommend the hospital to their friends and family."

Pain Control: "If patients needed medicine for pain during their hospital stay, the survey asked how often their pain was well controlled" and whether "hospital staff did everything they could to help patients with their pain."

Medicines Explained: "If patients were given medicine that they had not taken before, the survey asked how often staff…told what the medicine was for and what side effects it might have before they gave it to the patient."

Information About Recovery: "Patients reported whether hospital staff had discussed the help they would need at home" and whether "they were given written information about symptoms or health problems to watch for during their recovery."

Patient Safety Variables: Hospital-reported rates per 1,000 patient discharges were gathered for the following variables that represent preventable complications or hospital-acquired conditions related to inpatient hospital care. The variables represent discharge data from July 2009 to June 2011.

Severe Pressure Sores

Falls and Injuries

Blood Infection from Large Vein Catheter

Infection from Urinary Catheter

Signs of Uncontrolled Blood Sugar

Process of Care Variables: These measures of effective care were gathered for any patients for whom the recommended treatments would be appropriate. The data were extracted by each hospital from the medical records of their eligible patients and reported to HHS. Three variables regarding pneumonia management were assessed. The variables represent discharge data from January 2011 to December 2011, with the exception of the influenza vaccination rates, which were reported for October 2011 to December 2011.

Pneumonia Vaccine: The percentage of appropriate pneumonia patients who were evaluated and given a pneumococcal vaccination.

Influenza Vaccine: The percentage of appropriate pneumonia patients who were evaluated and given an influenza vaccination.

Smoking Cessation Counseling: The percentage of appropriate pneumonia patients who were assessed and given smoking cessation advice or counseling.

Table 3. Patient experience and quality data for 23 teaching hospitals

Hospital	Patient-Reported Experience					Patient Safety (per 1,000 patient discharges)					Pneumonia Process of Care		
	"High" hospital rating	Recommend hospital	Pain control	Medicine explained before given	Given info about recovery	Severe pressure sores	Falls and injuries	Blood infection from large vein catheter	Infection from urinary catheter	Signs of uncontrolled blood sugar	Pneumonia vaccine	Influenza vaccine	Smoking cessation advice
Cedars-Sinai Medical Center	77%	80%	66%	52%	81%	0.24	0.29	0.35	0.27	0.00	99%	99%	97%
NYU Langone Medical Center	64%	74%	65%	59%	80%	0.16	0.37	0.28	0.04	0.00	100%	98%	100%
Mount Sinai Medical Center	64%	70%	66%	54%	81%	0.38	0.33	0.57	0.05	0.14	98%	99%	100%
Ronald Reagan UCLA Medical Center	81%	85%	71%	58%	88%	0.71	0.79	0.71	0.47	0.24	92%	83%	85%
New York-Presbyterian Hospital	74%	80%	66%	59%	80%	0.33	0.46	0.61	0.69	0.06	92%	90%	98%
University of Pittsburgh Medical Ctr.	65%	70%	65%	57%	86%	0.16	0.74	0.87	0.29	0.02	100%	98%	100%
Northwestern Memorial Hospital	75%	80%	67%	61%	78%	0.24	0.24	0.38	0.21	0.04	99%	97%	100%
Massachusetts General Hospital	79%	89%	71%	63%	88%	0.17	0.48	0.91	0.31	0.09	96%	98%	98%
Cleveland Clinic	79%	83%	71%	63%	85%	0.69	0.27	0.47	0.81	0.22	98%	96%	100%
Hospital of the Univ. of Pennsylvania	72%	79%	71%	63%	87%	0.10	0.50	0.60	0.45	0.15	99%	86%	100%
University of Michigan Medical Center	75%	83%	69%	65%	90%	0.28	0.63	0.52	1.88	0.00	97%	89%	100%
Brigham and Women's Hospital	80%	87%	74%	63%	86%	0.00	0.48	1.09	0.61	0.27	100%	97%	96%
Johns Hopkins Hospital	77%	82%	70%	62%	86%	n/a	n/a	n/a	n/a	n/a	91%	89%	100%
Indiana Univ. Health (Clarian Health)	71%	73%	66%	58%	85%	0.06	0.45	0.37	0.17	0.06	95%	78%	99%
Barnes-Jewish Hospital/Washington Univ.	69%	77%	66%	65%	87%	0.29	0.60	0.97	0.12	0.07	92%	91%	100%
UCSF Medical Center	72%	82%	70%	66%	84%	0.12	0.49	0.74	0.49	0.00	94%	88%	100%
Duke University Medical Center	77%	84%	69%	67%	89%	0.50	0.43	0.53	0.71	0.11	100%	98%	99%
Vanderbilt University Medical Center	75%	81%	71%	64%	88%	0.53	0.22	1.18	0.57	0.09	87%	84%	99%
University of Washington Medical Ctr.	72%	79%	67%	62%	86%	0.48	0.38	1.05	2.48	0.10	97%	100%	100%
Stanford Hospital and Clinics	73%	81%	69%	64%	83%	0.11	0.45	0.28	0.34	0.11	97%	99%	98%
St. Mary's Hospital, Mayo Clinic	81%	85%	69%	70%	87%	0.03	0.46	0.86	0.86	0.12	96%	87%	100%
Scott & White Memorial Hospital	72%	77%	69%	63%	85%	0.00	0.67	0.40	0.13	0.04	96%	89%	100%
University of Utah Health Care	76%	81%	68%	62%	86%	0.17	0.77	0.34	0.43	0.00	96%	82%	100%
United States average	68%	70%	70%	62%	83%	0.14	0.53	0.37	0.36	0.06	95%	93%	98%

Hospital Compare web site accessed 10/15/12: data updated 10/11/12.
Some data submitted to HHS was based on a sample of cases from the hospital.
The Johns Hopkins Hospital was excluded from the analysis of patient safety variables due to the absence of reported data.

Is more care better?

Hospitals providing a higher intensity of care did not generally score higher on measures of patient experience, patient safety, or processes of care. Table 4 shows the relationship between each of the variables studied and the intensity of care delivered at 236 teaching hospitals around the country, as captured by the HCI index (a measure of the intensity of inpatient care). There were no significant positive relationships between hospital intensity and patient recommendations, pain control, whether medicines were explained before being given, whether information was given about recovery, or three of the five safety measures. Lower adverse events were found with higher care intensity for two of the safety measures—urinary catheter infection and uncontrolled blood sugar. There were also no significant relationships between the intensity of care provided at each hospital and the three measures of effective care for pneumonia patients. A graph of the relationship between care intensity and whether medicines were explained to patients is shown in Figure 9.

Table 4. Relationships between patient experience and quality and hospital care intensity

Variable vs. Hospital Care Intensity	Correlation Coefficient	R-Squared	P-Value
% rating hospital "highly"	-0.326	0.106	< 0.01
% who recommend hospital	-0.301	0.091	< 0.01
% with pain controlled	-0.253	0.064	< 0.01
% with medicines explained	-0.434	0.188	< 0.01
% given info about recovery	-0.542	0.294	< 0.01
Severe pressure sores per 1,000	0.194	0.038	< 0.01
Falls and injuries per 1,000	-0.006	0.000	n/s
Blood infection from large vein catheter per 1,000	0.058	0.003	n/s
Infection from urinary catheter per 1,000	-0.250	0.063	< 0.01
Signs of uncontrolled blood sugar per 1,000	-0.181	0.033	< 0.01
% given pneumonia vaccine (in pneumonia patients)	0.100	0.010	n/s
% given influenza vaccine (in pneumonia patients)	0.120	0.014	n/s
% given smoking cessation counseling (in pneumonia patients)	-0.053	0.003	n/s

Additional research studies done at the Dartmouth Institute for Health Policy and Clinical Practice have shown that higher spending and greater volume of services per patient do not necessarily improve either survival or quality of care. In a cohort study, Dr. Elliott Fisher and his colleagues studied whether patients with similar baseline health status experienced better quality, access, outcomes, or satisfaction in areas with high versus low end-of-life spending. The patient population studied consisted of patients hospitalized between 1993 and 1995 for hip fracture, colorectal cancer, or acute myocardial infarction (AMI), along with a sample of the general population from the Medicare Current Beneficiary Survey. The researchers found that patients in higher-spending regions were provided more care in the form of physician visits, hospital days, specialist consultations, and

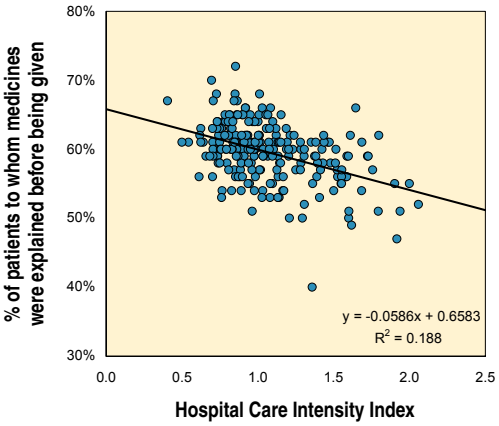


Figure 9. Relationship between the HCI index and the percentage of patients to whom medicines were explained

procedures. However, the quality of care, measured by aspirin use for an AMI and rate of influenza immunization, was the same or worse in higher-spending regions compared to lower-spending regions. Similarly, outcomes—measured by the five-year mortality rate—were slightly worse in higher-spending regions for both the colorectal cancer and AMI cohorts. Access and satisfaction with care were found to be the same between high- and low-spending regions.[12,13] Still other studies have shown Medicare spending to be inversely related to patient satisfaction.[14,15] Finally, quality and satisfaction are positively correlated, meaning that, in those hospitals with low quality measures, patient ratings are also low, and vice versa.[16]

Why do these measures of outcomes, quality, access, and satisfaction often worsen as spending and care intensity increase? A plausible hypothesis is that, as spending increases because of higher utilization of resources and the involvement of multiple physicians, care becomes more disorganized. Patients may receive more services than they need and be exposed to more medical errors, simply because they are getting more care. In addition, without effective coordination of care and informed patient choice, patient preferences may not be followed. These patterns of care are hard to see in the hospital wards and physician offices, but they are part of the learning environment for residents.

Conclusion

The United States has an extraordinarily innovative health care system with the best-trained physicians in the world. This Dartmouth Atlas report shines a light on local health care patterns at teaching hospitals and finds that they vary in technical quality, patient experiences, intensity of treatment, and the use of procedures. These differences in care can be hard to see on the ground, but are clear from the report's epidemiological analyses.

Many factors influence the decision of where to complete residency training. Dartmouth Atlas data can help guide this decision, as it provides information about how hospitals manage patients with chronic illnesses and provide discretionary procedures, both of which are critical aspects of residency training. Physicians who train at institutions with better, more patient-centered and efficient care will be better prepared to lead the transformation of health care when they are in practice. But most health care systems seek and need further improvements in care. Physicians in training can contribute to better health care by learning about improvement strategies in the following areas:

Effective care: There are many clinical situations in which there is a clear best single option for most patients. Examples include immunizations for children, the use of aspirin for patients with myocardial infarctions, and prevention of central line infections through better catheter care. Reducing variation in effective care requires re-engineering care systems through improvements of clinical microsystems. The Institute for Healthcare Improvement (www.ihi.org) has numerous programs to help clinicians and hospitals implement the very best of evidence-based medicine.

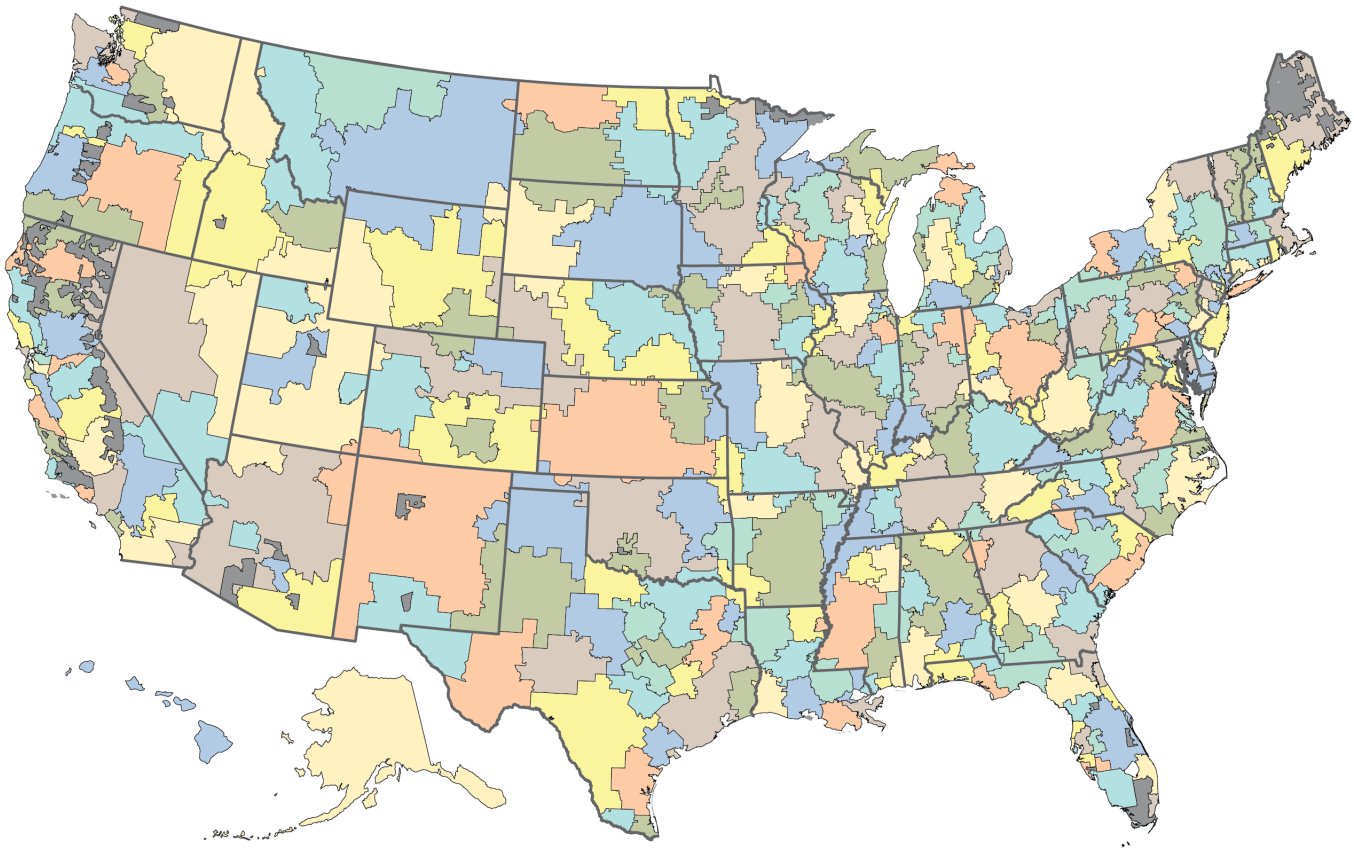
Supply-sensitive care: A large proportion of Medicare spending goes toward managing chronic illness. The way chronic illness is managed varies extensively across the country and is often influenced by resource capacity. As our country works to reform health care, an important solution will be the wise investment in future capacity, which should be adjusted for the relative size of the patient population served and not the current level of utilization of resources (since utilization is influenced by availability). In addition, an increased focus on the coordination of care by teams of health care workers within organized systems can reduce utilization to more reasonable levels while producing equal or better health outcomes. One model for improving the organization of care that is currently supported by the Affordable Care Act and the Centers for Medicare and Medicaid Services (CMS) is the Accountable Care Organization (ACO). The ACO is a provider-led organization for which reimbursements are tied to quality metrics and total cost reduction for a defined patient population. Through this model, reimbursements are decoupled from volume and intensity, allowing for increased efficiency and coordinated care. When cost savings are achieved while quality measures are met, the ACO receives a share of the cost savings.[17]

Preference-sensitive care: An important first step in addressing the variation in preference-sensitive care is making hospitals aware of their procedure rates. This alone can help to reduce overuse, as shown by an analysis conducted in Maine regarding hysterectomy rates; after the study, one hospital successfully implemented a quota on the number of procedures performed upon learning that its rates were much higher than the state average.[5] However, this does not ensure that the right patients are receiving the right treatments. As such, comparative effectiveness research should continue to be undertaken to develop evidence in support of treatment efficacy. Outcomes research that incorporates patient perceptions and values will enhance our understanding of suitability and the effects of treatments that matter most to patients. Finally, shared decision-making programs and the development and use of decision aids will ensure that patient preferences are heard and that informed patient choice, rather than physician opinion, dictates the demand for procedures.

Appendix A: Dartmouth Atlas regions

The Dartmouth Atlas project has divided the United States into 3,436 geographically distinct hospital service areas (HSAs). Medicare patients living in an HSA get the majority of their health care from hospitals within the area. These areas were defined in three steps. First, all acute care hospitals that provided care to Medicare patients in 1992 and 1993 were assigned to the town or city in which they were located, defining the initial list of HSAs. Second, the ZIP codes of patients hospitalized in 1992 and 1993 were recorded to determine the proportion of patients in that ZIP code that used each hospital. Then, each ZIP code was assigned to the hospital where the greatest proportion of residents received care. Finally, a map of the ZIP code boundaries allowed for the areas to be geographically defined. Using the HSAs, hospital referral regions (HRRs) were then defined by determining where patients in each HSA received major cardiovascular surgery and neurosurgery. First, all of the hospitals performing at least 10 major cardiovascular procedures in 1992 and 1993 were identified and located within the pre-defined HSAs, which became the candidate HRRs. Then, each of the 3,436 HSAs was assigned to the candidate HRR where the greatest proportion of their patients went for these surgical services. The HSAs using hospitals in the same candidate HRR were grouped to form 306 HRRs. These are shown below in the map of the United States.

Map A. The Dartmouth Atlas hospital referral regions



Appendix B: About the U.S. News Best Hospitals for Clinical Excellence

U.S. News and World Report publishes annual hospital rankings in 16 medical and surgical specialties to offer guidance to patients choosing where to receive their health care. Hospitals that earn a spot on the Honor Roll, the list examined for this paper, rank very highly in six or more specialties. Only academic hospitals, hospitals with a minimum specified number of beds, and/or certain medical technologies available (such as a CT scanner) were eligible to be ranked. Patient volume requirements were stipulated for each specialty. Rankings were then generated based on four criteria: reputation of the hospital amongst randomly surveyed physicians in that specialty (32.5%); patient survival based on the number of Medicare patients who died within 30 days of admission compared to the number "expected to die" given the severity of the illness (32.5%); "care-related factors" such as the supply of nursing staff and advanced medical technology (30%); and patient safety measured using six factors (e.g., bleeding after surgery) (5%). For ophthalmology, psychiatry, rheumatology, and rehabilitation, the ranking was solely based on reputation amongst surveyed physicians in that specialty.[1]

References

[1] *U.S. News & World Report.* Best Hospitals 2012-13: the Honor Roll. http://health.usnews.com/health-news/best-hospitals/articles/2012/07/16/best-hospitals-2012-13-the-honor-roll. Accessed August 17, 2012.

[2] For each program, we used data for the hospital that carries the same name as the residency program. However, it is important to note that residents in many programs rotate at more than one hospital. For example, at NYU Medical Center, residents spend the majority of their time at Bellevue, a public hospital that has lower utilization and spending patterns compared to the private hospital associated with the program. However, in this paper, we only discuss care delivered at the private hospital, NYU Medical Center.

[3] National Resident Matching Program, Results and Data: 2012 Main Residency Match[SM]. National Resident Matching Program, Washington, DC. 2012.

[4] Wennberg JE, Fisher ES, Goodman DC, Skinner JS. *Tracking the Care of Patients with Severe Chronic Illness: The Dartmouth Atlas of Health Care 2008.* Lebanon, NH. The Dartmouth Institute for Health Policy and Clinical Practice, 2008.

[5] Wennberg, John E. *Tracking Medicine: A Researcher's Quest to Understand Health Care*. New York, NY. Oxford University Press, 2010.

[6] Brownlee S, Wennberg JE, Barry MJ, Fisher ES, Goodman DC, Bynum JP. *Improving Patient Decision-Making in Health Care: A 2011 Dartmouth Atlas Report Highlighting Minnesota.* Lebanon, NH. The Dartmouth Institute for Health Policy and Clinical Practice, 2011.

[7] Hawker GA, Wright JG, Coyte PC, Williams JI, Harvey B, Glazier R, Wilkins A, Badley EM. Determining the Need for Hip and Knee Arthroplasty: The Role of Clinical Severity and Patients' Preferences. *Medical Care* March 2001;39:206-16.

[8] Boden WE, O'Rourke RA, Teo KK, Hartigan PM, Maron DJ, Kostuk WJ, Knudtson M, Dada M, Casperson P, Harris CL, Chaitman BR, Shaw L, Gosselin G, Nawaz S, Title LM, Gau G, Blaustein AS, Booth DC, Bates ER, Spertus JA, Berman DS, Mancini GB, Weintraub WS. Optimal medical therapy with or without PCI for stable coronary disease. *New England Journal of Medicine* 2007;356(15):1503-16.

[9] Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR, Mack MJ, Stahle E, Feldman TE, van den Brand M, Bass EJ, Van Dyck N, Leadley K, Dawkins KD, Mohr FW for the SYNTAX Investigators. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. *New England Journal of Medicine* 2009;360(10):961-72.

[10] High Value Healthcare Collaborative. (2012, June 18). High Value Healthcare Collaborative Receives $26 Million Health Care Innovation Grant [Press Release]. http://tdi.dartmouth.edu/press/press-releases/high-value-healthcare-collaborative-receives-26-million-health-care-innovat.

[11] Centers for Medicare and Medicaid. Hospital Compare. http://www.hospitalcompare.hhs.gov. Accessed August 17, 2012.

[12] Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder E. The implications of regional variations in Medicare spending: Part 1. Utilization of services and the quality of care. *Annals of Internal Medicine* 2003;138:273-87.

[13] Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder E. The implications of regional variations in Medicare spending: Part 2: Health outcomes and satisfaction with care. *Annals of Internal Medicine* 2003;138:288-98.

[14] Yasaitis L, Fisher ES, Skinner JS, Chandra A. Hospital quality and intensity of spending: Is there an association? *Health Affairs* 2009;28(4):w566-72.

[15] Fowler FJ Jr., Gallagher PM, Anthony DL, Larsen K, Skinner JS. Relationship between regional per capita medical expenditures and patient perceptions of quality of care. *Journal of the American Medical Association* 2008;229(20):2406-12.

[16] Wennberg JE, Bronner KK, Skinner JS, Fisher ES, Goodman DC. Inpatient care intensity and patients' ratings of their hospital experiences. *Health Affairs* 2009;28(1):103-12.

[17] Fisher ES, McClellan MB, Bertko J, Lieberman SM, Lee JJ, Lewis JL, Skinner JS. Fostering Accountable Health Care: Moving Forward In Medicare. *Health Affairs* 2009;28(2):w219-31.

[18] Gawande, Atul. "The Cost Conundrum." *The New Yorker.* June 1, 2009.

[19] Gawande, Atul. "The Cost Conundrum (*)" *The New Yorker.* December 6, 2010.

[20] Marder WD, Carls GS, Ehrlich E, Fabius R. "Geographic Variation in Spending and Utilization Among the Commercially Insured." White Paper. Thomson Reuters, July 27, 2011.

[21] Ong MK, Mangione CM, Romano PS, Zhou Q, Auerbach AD, Chun A, Davidson B, Ganiats TG, Greenfield S, Gropper MA, Malik S, Rosenthal JT, Escarce JJ. Looking forward, looking back: Assessing variations in hospital resource use and outcomes for elderly patients with heart failure. *Circulation Cardiovascular Quality and Outcomes* 2009;2(6):548-57.

[22] Wennberg JE. "Can the Tuck Student-Consultant Help Reduce Unwarranted Variation?" Presentation to Tuck Business School students, October 12, 2011.

[23] Wennberg JE. "The Mysteries of Supply-Sensitive Care." Presentation to The Dartmouth Institute for Health Policy and Clinical Practice students, October 20, 2011.

The Dartmouth Atlas Project works to accurately describe how medical resources are distributed and used in the United States. The project offers comprehensive information and analysis about national, regional, and local markets, as well as individual hospitals and their affiliated physicians, in order to provide a basis for improving health and health systems. Through this analysis, the project has demonstrated glaring variations in how health care is delivered across the United States.

The Dartmouth Atlas Project is funded by a broad coalition of funders, led by the **Robert Wood Johnson Foundation.** Other major sources of funding include the **National Institute of Aging, California Healthcare Foundation, United Healthcare Foundation,** and the **WellPoint Foundation.**

The Dartmouth Atlas
The Dartmouth Institute
for Health Policy and Clinical Practice
Center for Health Policy Research

Contact: Eva Fowler
202-261-2868 voice
202-331-7207 fax

www.dartmouthatlas.org

10302012.dap2.0

The Dartmouth Atlas Working Group

Leadership

Elliott S. Fisher, MD, MPH, Dartmouth Atlas Co-Principal Investigator
David C. Goodman, MD, MS, Dartmouth Atlas Co-Principal Investigator
Jonathan S. Skinner, PhD, Senior Scholar
John E. Wennberg, MD, MPH, Founder of the Dartmouth Atlas
Kristen K. Bronner, MA, Managing Editor

Senior Authors and Faculty

John Erik-Bell, MD
Shannon Brownlee, MS
Julie P.W. Bynum, MD, MPH
Chiang-Hua Chang, PhD
Scott Chasan-Taber, PhD
Philip P. Goodney, MD, MS
Nancy E. Morden, MD, MPH
Thérèse A. Stukel, PhD
James N. Weinstein, DO, MS

Analytic and Administrative Staff

Elisabeth L. Bryan, BS
Thomas A. Bubolz, PhD
Donald Carmichael, MDiv
Julie Doherty, BA
Jennifer Dong, MS
Daniel J. Gottlieb, MS
Jia Lan, MS
Martha K. Lane, MA
Stephanie R. Raymond, BA
Sandra M. Sharp, SM
Jeremy Smith, MPH
Yunjie Song, PhD
Dean T. Stanley, RHCE
Andrew W.J. Toler, MS
Stephanie Tomlin, MPA
Abigail Underhill, AS
Rebecca Zaha, MPH
Weiping Zhou, MS

Design and Production

Jonathan Sa'adah and Elizabeth Adams