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GEOGRAPHIC VARIATION IN THE SUPPLY AND UTILIZATION OF HOSPITAL SERVICES: ECONOMIC MOTIVES AND POLICY IMPLICATIONS

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AMSE Dissertation

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Title: Geographic variation in the supply and utilization of hospital services: economic motives and policy implications

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Table of Contents

Introduction and overview

Economic theory holds that competitive market forces should efficiently allocate scarce resources. But, in 1963, Kenneth Arrow identified multiple distortions in healthcare services delivery market that may impede efficient allocation of resources if there is no intervention.[1] In this dissertation work, we sought to explore inefficiencies associated with deficiencies in regulation, which might be expressed through geographic variation in health services utilization.

Geographic variation in healthcare has long been studied: in France, in the late 1800s, Emile Durkheim studied variation in mental health diagnoses;[2] in England in the 1930s, J Alison Glover studied variation in tonsillectomy rates;[3] and in the United States, since the 1970s, Jack Wennberg has studied variation in use of a variety of healthcare services.[4,5] In North America, several explanations for geographic variation in service utilization have been proposed: high supplies of providers or other healthcare resources,[5-12] physician practice patterns and preferences,[13-17] over-testing and over-diagnosis,[18-20] and regional characteristics[21] have all been implicated. Further, the predominance of a fee-for-service based reimbursement system, lack of use of informed patient decision-making, lack of consensus around acceptable practices, and absence of centralized planning are implicated in the geographic variation in the rates of use of hospitalization and elective surgery that underlies the variation in healthcare costs.[11,12,22,23]

Work in the US on geographic variation has resulted in three conceptual types of healthcare services, all of which demonstrate geographic variation:[11,12]

1. ***Effective care*** is care for which there is evidence of effectiveness; essentially everyone for whom such care is indicated should get it. Reports in the US indicate that only about half of the eligible population for which effective care

might be indicated actually get it;[24] however, there is considerable variation in performance across the US.[25]

2. ***Preference sensitive care*** comprises treatments that involve treatment significant tradeoffs affecting the patient's quality and/or length of life.[26] Examples include common elective surgical procedures such as hip replacement surgery, knee replacement surgery, back surgery, and prostate surgery. Decisions about these interventions should reflect patients' personal values and preferences, and, therefore should drive their per-capita utilization. However, physician practice patterns and preferences,[13-17] over-testing and over-diagnosis,[18-20] regional characteristics,[21] and lack of informed patient decision-making (coupled with lack of physician consensus around best practices) have all been implicated in variation associated with utilization of preference sensitive care.[11,12,22,23] There is evidence that incorporating patient preferences into healthcare decision making markedly reduces rates of health service utilization for preference-sensitive conditions (and, perhaps geographic variation in use of that care);[27,28] however, resource supply also can impact utilization of preference-sensitive conditions.[29-31]
3. ***Supply sensitive care*** refers to services where the supply of a specific resource has a major influence on utilization rates;[32] supply-sensitive care accounts for more than half of Medicare spending in the US.[33] Here, examples include office visits (that are higher in regions with a higher per-capita physician supply)[34,35] and admission rates (that are higher in regions with a higher per-capita hospital bed supply).[29-31] Interestingly, many studies have shown that admission for Ambulatory Care Sensitive Conditions (ACSCs) – conditions where earlier intervention or access to care in ambulatory settings might have precluded a

need for hospitalization – are somewhat different: per-capita admissions for ACSCs are ***inversely*** associated with per-capita supply of primary care providers.[36-48] In sum, this research suggests that resource supply should be just right to maximize access and minimize overuse: inadequate supply of primary care might lead to overuse of hospitalization for ACSCs while excess supply of hospital beds or providers might lead to overuse of outpatient visits and hospitalization (including, potentially, hospitalization for ACSCs). Therefore, we chose to complement our exploration of the relationship between resource supply and several preference sensitive conditions with an exploration of the relationship between resource supply and admission for ACSCs, a supply sensitive condition.

While these conceptually different types of healthcare services has been well described in the US, geographic variation in use of a variety of healthcare services in other OECD countries has only more recently been robustly studied.[49] In these examinations, explanation of the substantial variation that has been found has been inconsistent, piecemeal, without national coverage, and rarely based on a theoretical construct.[50] A study using 1988 data from 11 developed countries found a strong relationship between the supply of surgeons and the rate of back surgery and that rates in the United States were dramatically higher than in other countries.[51] In France, studies of geographic variation in health services utilization have been limited to an examination of variation in the incidence of inflammatory bowel disease,[52] variation in use of anxiolytics and hypnotics in southeastern France,[53] and variation in the rate of hip fracture within the Picardy region of France.[54] Most recently, IRDES investigators in France who completed initial broad analyses of variation in overall healthcare utilization called for further work 'to develop a better understanding of the causes and consequences for these variations in different types of care'.[55]

We were interested in exploring two broad areas.

In the first area of exploration, we were interested in examining hospital utilization for preference sensitive conditions,[26] which theoretically should only reflect the healthcare demands of the population. However, as mentioned above, differences in the supply of healthcare resources (such as per-capita hospital beds or physicians) has been seen as a cause of geographic variation. Particularly because physicians set the threshold for – and are necessary for – hospital admission, the concept of 'supplier induced demand',[56] where service providers can also influence the consumption of resources, has been theorized as a contributor to geographic variation. To explore the possibility of supplier-induced demand for preference sensitive conditions in France, we sought to evaluate geographic variation in admission for common elective surgical conditions – a type of preference sensitive care – and to understand French results in the context of international comparisons. By defining admissions in a common manner, we were able to compare rates of and measures of geographic variation in admissions for these conditions to those in published reports from the US and the UK. [57,58]

For several of these preference sensitive conditions, we also sought to explore France's unique form of hospital regulation and the potential impact of recent policy changes designed to promote hospital competition. France's hospital system consists of a combination of for-profit and not-for-profit hospitals and planning for both types of hospitals is regulated by the central government in concert with regional health agencies (ARS) with expansion of either sector being reviewed and approved or denied by the public authority (the ARS and the Ministry of Health). French citizens may use any hospital that they want, with services funded by the compulsory national healthcare insurance scheme.

For-profit hospitals account for about 15% of all inpatient beds[59] and focus on elective surgical care.[60]

The study of the for-profit and not-for-profit hospital sectors in France is particularly relevant right now for two reasons. First, since 1996, for-profit hospitals in France have been paid through a prospective payment system; however, in an effort to make the hospital sector more competitive, since 2008, not-for-profit hospitals have also been reimbursed for non-mental health hospital care services through a prospective payment system (the T2A system).[60] Second, the role of for-profit hospitals is also likely to increase as a result of the 2009 Hôpital, Patients, Santé et Territoires Act that introduces the possibility that for-profit hospitals might perform public service duties by contract, especially those usually performed by not-for-profit hospitals and suspected to be expensive, such as teaching, research, and emergency care.

Studies in the US indicate that for-profit hospitals have higher margins than not-for-profit hospitals (and increase margins of not-for-profit hospitals when such hospitals are converted to for-profit status);[61,62] for-profit hospitals generate higher margins by minimizing staff[63,64] and maximizing revenue.[65] However, concerns over for-profit hospitals include the possibility that their revenue maximizing behaviors, attitudes, and objectives might lead to overuse of healthcare.[66]

Given there recent policy changes in France and the concerns raised in the US regarding for-profit hospital motives, we sought to determine whether there might be evidence of supplier-induced demand for certain preference-sensitive surgical interventions in the for-profit sector in France. Further, we wanted to compare reimbursement provided to for-profit and not-for-profit hospitals in France for a variety of preference-sensitive surgical interventions, and determine whether there was evidence of 'upcoding' to maximize revenue among for-profit hospitals in France.

In the second area of exploration, we sought to determine whether there was a relationship between supply of a healthcare resource was related to a supply sensitive condition; therefore, we studied admissions for ACSCs. Often referred to as preventable admissions, hospitalizations for ACSCs have been used as an indicator of access to and quality of primary care. In the US, factors associated with higher rates of ACSC hospitalization include a low primary care physician supply, high unemployment rates, and a higher proportion of the population who are uninsured.[67,68] National or regional studies of ACSC hospitalizations have been conducted in a variety of countries;[36-48] with the exception of a study of cantons in Switzerland,[69] these studies invariably found substantial geographic variation and found that higher rates of ACSC conditions were found in regions with lower incomes and less access to primary care. Because admissions for ACSCs are considered preventable and a waste of healthcare resources, in Britain, management of ACSCs to become one of the top ten priorities for Britain's National Healthcare System.[46] In Brazil, targeted efforts to expand primary care access (with the hope of reducing ACSC hospitalization rates) indeed reduced hospitalizations for ACSCs between 1999-2007.[45] While a study of three metropolitan regions in France found an association between lower supply of primary care physicians and higher rates of admission for a limited number of ACSCs,[48] an examination of geographic variation in rates of hospitalization for ACSCs across all of France, the costs of those hospitalizations, and a comparison of rates in France to those in other countries has not been conducted.

For all of this work, we used established 'small-area variation' techniques,[4] and applied them to the study of admission for several elective 'preference-sensitive' surgical procedures and ACSCs in France. In all, we conducted four studies:

Study 1: Geographic variation in rates of common surgical procedures in France in 2008-2010 and comparison to the US and Britain. Here, we wanted to determine the degree to which rates of hospitalization for elective surgeries (where higher rates are generally associated with greater supplies of healthcare resources) show geographic variation, how rates vary with ecological factors (including measures of income, income disparity, and healthcare resource availability), and how rates and measures of geographic variation compare to those in other countries. This study provided us a sense of the magnitude of the problem.

Study 2: Geographic variation in admissions for knee replacement, hip replacement, and hip fracture in France: evidence of supplier-induced demand in for-profit and not-for profit hospitals. Here, we wanted to explore whether there is evidence for supplier-induced demand associated with higher rates of admission for hip and knee replacement surgery (a subset of elective surgeries), overall, and within the for-profit and not-for-profit hospital sectors. This study constituted a special case, wherein we examined the roles of the for-profit and not-for-profit hospital sectors in France, explicitly searching for evidence of supplier induced demand in either sector.

Study 3: Characteristics and patterns of elective admissions to for-profit and not-for-profit hospitals in France in 2009 and 2010**.** Here, we wanted to determine whether there might be discrepancies in coding practices for elective surgeries between for-profit and not-for-profit hospitals, with the possibility that one sector or the other 'upcodes' to maximize revenues. Again, this work more explicitly was examining the roles of the for-profit and not-for-profit hospital sectors, and was exploring the possibility of supplier induced demand in one sector or the other.

Study 4: Rates of admission for ambulatory care sensitive conditions in France in 2009-2010: trends, geographic variation, costs, and an international comparison. Here, we wanted to determine the degree to which hospitalization for ambulatory care sensitive conditions (where higher rates are generally associated with failure of outpatient care or reduced access to primary care physicians) show geographic variation, determine whether rates vary with ecological factors (including measures of income, income disparity, and healthcare resource availability), determine how rates compare to those in other countries, and calculate how much money admissions for ACSCs costs French taxpayers. This study provided a sense of the magnitude of the problem for a supply-sensitive condition and explored the relationship, on a national level, between primary care physician supply, hospital bed supply, and admission rates for ACSCs. While we recognize that the area of inquiry in this final paper was broad and, therefore, necessitated several sub-analyses (analysis of frequencies and rates of admission, costs of those admissions, and international comparisons), we wanted to conduct a similar exploration to what we chose to explore in the first several papers that examined preference sensitive conditions.

In essence, by performing the two broad areas of study, we sought to examine two areas of healthcare service 'waste' or 'overuse': admissions that might have been avoided had shared decision-making processes been in place to counteract supplier-induced demand;[56,70] and admissions that might have been avoided had better ambulatory care services been provided, and therefore potentially reflected inadequate resources for care provision.[71] Importantly, we wanted to determine French policymakers might divine different approaches to addressing the two different forms of overuse that we examined.

Summary of methods used

While each of the studies is examined in detail below, here we provide an overall summary of the methods used in each study. To study variation in the rates of admission for elective surgeries and ACSCs, we used a dataset of all discharges from public and private sector French hospitals in 2008 through 2010 that we obtained from the Agence Technique de l'Information sur l'Hospitalisation.[72] From this dataset, we identified each admission's primary ICD-10 coded diagnosis. To study admissions for preference-sensitive elective surgeries, we used these ICD-10 codes and the French Classification Commune des Actes Médicaux system that classifies hospital interventions[74] to create similar cohorts to those used by the Dartmouth Atlas project.[75] To study ACSCs, we used a published ICD-10 code to ACSC crosswalk[73] and followed the British system of aggregating admissions for ACSCs to acute, chronic, and vaccination-preventable categories;[43] because we were interested in admissions for other defined ACSCs, we also examined admissions for alcohol related ACSCs and for 'other' ACSCs that were defined by Freund et al.[73] For both aspects of this work, because demographics vary by region, we used the same indirect method[76] used by the Dartmouth Atlas Project in the US and the King's Fund in the UK[57] and age- and sex-specific department-level population estimates from the French census[77] to calculate age- and sex-adjusted hospitalization rates for 94 geographically-defined "departments" in mainland France.

Using these age- and sex-adjusted rates, we calculated four established measures of geographic variation that allow for comparison across geographic settings and countries.[57,58,78]

A brief elaboration on these four measures follows:

1. The extreme ratio, which is calculated by dividing the highest geographic rate by the lowest and represents the range of absolute service utilization levels.

2. The interquartile ratio, which is calculated by dividing the rate at the 75th percentile by that at the 25th percentile and shows the relative variation in service utilization after removing the most extreme values.
3. The coefficient of variation, which is the ratio of the standard deviation to the mean and represents a normalized version of dispersion.
4. The systematic component of variation (SCV), which shows the non-random part of variation in rates by distinguishing the systematic variation between areas from the random variation within areas.[78] As is common practice, we multiplied SCV times 10 to generate the variable SCVx10.

For the first three measures examined, higher numbers all indicate greater levels of geographic variation; however, these measures do not specifically address the non-random aspects of geographic variation and they may be influenced by extreme values. The SCV measure addresses both of these issues: an SCV x 10 greater than 5 indicates high variation; that greater than 10, very high variation.

While different geographic sizes might lead to different measures in the extreme ratio, the interquartile ratio, and the coefficient of variation (because smaller geographic areas are likely to show more extreme values as opposed to larger geographic areas), the SCV x 10 adjusts for the different sizes of geographic areas, allowing for international comparisons.[78] Because the different measures we calculated are commonly presented in geographic variation work, we present them here; however, the key measures of that we used for international comparisons were SCV x 10 (for preference-sensitive surgical conditions) and national utilization rates (for ACSCs).

We compared rates of admission and measures of geographic variation for elective surgeries and ACSCs in France to those of other countries, as reported in the literature. We also used ordinary least squared and spatial regression analytic techniques[79,80] to determine whether ecological factors or resource supplies were associated with age- and sex-adjusted rates of admission for ACSCs or elective surgery. Spatial regression methods capture and manage spatial dependency in observations, avoiding the potential statistical problems inherent in geographic data analysis (spatial autocorrelation in data can produce unstable parameters and unreliable significance tests, if not corrected).[81]

To compare results of for-profit and not-for-profit hospitals, we used an established methodology[82] to categorize hospitals into two groups which are the basis for reimbursement: for-profit hospitals, and not-for-profit hospitals (which included public sector and private not-for-profit hospitals). To calculate costs of care provided in aggregate and by the different types of hospitals, we applied the year-specific for-profit or not-for-profit (depending on in which type of hospital the admission occurred) DRG-like Groupe Homogène des Malades (GHM) -specific mean total (including physician services) reimbursement rate that we obtained from the Agence Technique de l'Information sur l'Hospitalisation[72] to each hospitalization and summed costs, as necessary, to for-profit or not-for-profit hospitals and years. For our exploration of hospital-sector specific supplier-induced demand, for hip replacement surgery, knee replacement surgery, and hip fracture, we calculated age- and sex-adjusted admission rates to for-profit and not-for-profit hospitals for each department. We chose hip and knee replacement surgery to study as a subset of elective surgeries because they are increasingly common procedures in the US[83,84] and the rates of hip replacement surgery in France are about 1.5 times higher than those in the US while the rates of knee replacement surgery in France are about ½ the US rates;[85] for both of these procedures, rates are increasing. Further, these surgeries are considered 'preference sensitive' care in that their use is marked by physician uncertainty as to care management[58,70] and can be subject to physician influence[17] as well as the supply of health resources;[32] overuse of such care leads to inefficient healthcare delivery and waste.[86] Finally, we compared coding practices of for-profit and not-for-profit hospitals to search for any evidence of 'upcoding'.

Our choice of countries was largely based on whether publicly available data were available for those countries. Because geographic variation in health services utilization has been most consistently researched in the US over the past forty years,[4-23] and has only much more recently been examined using similar methods in other OECD countries,[49,50] our international comparisons naturally used US data for comparison. Nonetheless, for our analysis of ACSCs, we also found comparators in the literature for a variety of other countries,[36-48,69] although some of these data were quite dated. Where we found interesting international comparisons in individual studies, we considered whether aspects of healthcare delivery design in each country might have been, at least theoretically, associated with the results we found.

When we considered reasons for the differences that we found when conducting international comparisons, we included structural differences in healthcare delivery systems in France, the US, UK. France has a global budget, centralized hospital planning process, and compulsory insurance scheme. In the US, during the time of study, there was no compulsory insurance scheme (although many US studies of geographic variation examine older Medicare beneficiaries, the very large majority of whom have healthcare insurance); nonetheless, despite regional 'certificate of need' programs, hospital supply is largely market driven and regulated, but not centrally planned. The UK falls somewhere in the middle, where, during the time of the study, healthcare 'trusts' compete with one another and make market-driven decisions regarding healthcare resource development (including building hospitals), but there is a compulsory insurance scheme.

Summary of findings

While each of the studies is examined in detail as a separate chapter below, here we provide an overall summary of the findings in each study. Overall, we found that France indeed exhibits geographic variation in hospitalization for preference-sensitive elective surgeries and ACSCs.

In the first area of inquiry, we found that per-capita rates of preference sensitive surgical conditions were generally increasing over the time period examined, but the systematic component of variation was generally decreasing, which indicates a regression to the mean.[85] Less frequently performed procedures, and those with less evidence of utility (like CABG, spine surgery, and radical prostatectomy), showed the highest degrees of geographic variation, possibly reflecting that there was physician uncertainty as to the utility of these procedures. France generally had lower rates of admission for these elective surgeries than did the US, and France generally demonstrated lower measures of geographic variation in rates than either the US or the UK.

For hip and knee replacement surgery, we found that there was no overall national relationship between bed or orthopedic surgeon supply and procedure rates; however, we did find a relationship between having more for-profit hospital beds per capita and admission rates to for-profit hospitals, suggesting some supplier-induced demand in that hospital sector.[87]

In addition, we found that most of these preference-sensitive elective surgeries occur in for-profit hospitals and admissions to for-profit hospitals generate lower expenditures and shorter lengths of stay.[88] Further, we found some evidence that for-profit hospitals 'upcode' for some elective procedures (suggesting revenue maximization) and 'downcode' in others, also suggesting supplier-induced demand (evidenced by over-admission of low risk, low complexity interventions). Therefore, despite an appearance of efficiency in for-profit hospitals, costs associated with potential overuse of elective procedures might offset any cost-savings generated from the markedly lower reimbursement rate per admission in for-profit hospitals. Further study in this area is needed, particularly as our analysis was predicated on the assumption that not-for-profit hospitals have appropriate coding patterns and because we were able to assess neither appropriateness of admissions for the procedures nor their outcomes.

In our second area of inquiry, we found that rates of admission for ACSCs varied across France, regionally, and were generally higher in France than in other countries.[89] Higher rates of admission for ACSCs in France were associated with lower incomes, greater local income disparities, and higher per capita hospital beds, but not with the supply of physicians. Overall, admissions for ACSCs cost French taxpayers 4.755 billion euros in 2009 and 5.066 billion euros in 2010 and they consumed 7.86 and 8.74 million bed days of care, respectively. The consumption of bed days of care equivalent to one 255 bed hospital operating at full capacity in each of the 94 departments that we examined. This suggests some level of supplier-induced demand in admission for ACSCs in France. Perhaps France has gone beyond the tipping point, and, at least at a national level, has an adequate supply of primary care providers but too many beds. Further research is required to definitively conclude this, however.

Overall, our findings suggest that France, with its centralized hospital planning structure, might be more effective than the US or the UK in restraining the supply of healthcare resources that otherwise might generate supplier-induced demand; this centralized structure suggests, as well, an opportunity to work effectively with high outliers to improve performance. That admissions for ACSCs consume so many resources suggests that policymakers might look to reduction of those admissions to reduce expenditures, particularly as France had relatively high rates of admission for ACSCs when compared to other countries. Finally, as French policymakers are assuming that competition between for-profit and not-for-profit hospitals might reduce costs, they should be concerned that we found evidence of supplier-induced demand in for-profit hospitals and that, should that demand result in unnecessary overuse of elective care, and potential cost savings generated by competition might be offset by overuse of care.

Summary of overall conclusions and future directions

That we found geographic variation in hospitalization for preference sensitive elective surgical procedures and ACSCs in France is not surprising; more disconcerting, perhaps, to policymakers is that the rates of hospitalization for most elective procedures and ACSCs is increasing and that these admissions might unnecessarily be consuming scarce resources (in the case of ACSCs, due to failure of outpatient care; in the case of elective surgeries, due to competition-stimulated supplier-induced demand). In this work, we have provided a baseline of rates and measures of geographic variation that can be used to assess the impact of policy interventions in the future. Particularly as a key policy in French healthcare appears to be to expand the use of for-profit hospitals, given our findings, it will be important to ensure that this policy actually saves French taxpayers money as opposed to costs them. Our findings, particularly those suggesting some evidence of supplier induced demand in the for-profit sector, suggest that policymakers should conduct an annual exploration of variation in admission for these causes, compare findings to those of prior years, identify outliers for intervention, and assess of the effectiveness of those interventions. Further, by engaging with other countries to understand geographic variation in these and other aspects of healthcare delivery, France might improve the outcomes of its service population, the efficiency of its own healthcare system, and that of other countries.

Chapter 1: The magnitude of the problem for surgical preference-sensitive care: *Geographic variation in rates of common surgical procedures in France in 2008-2010 and comparison to the US and Britain.*

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Executive summary

Geographic variation in use of elective surgeries has been widely studied in the US, where over-utilization is incentivized. We wanted to explore recent trends in the geographic variation of common surgical procedures in France - where a global budget, centralized planning process, and compulsory insurance scheme are in place - and to compare measures of variation there to those in the US and Britain. For 2008-2010, we calculated French age- and sex-adjusted per capita utilization rates and four measures of geographic variation for hip fracture admission (which is standard treatment and shows minimal geographic variation across countries) and 14 elective surgical procedures. We found substantial geographic variation in age-sex adjusted per capita admission rates for elective procedures: radical prostatectomy, spine surgery, and CABG showed the greatest variation, while hip fracture, colectomy, and cholecystectomy showed the least. Among older patients, most French admission rates were lower than those seen in the US. In general, measures of geographic variation were lower in France than those reported in the US or Britain. French policymakers could use analyses of geographic variation in service utilization to inform policy, to identify areas for intervention, or to measure the effectiveness of efforts designed to reduce variation in care.

Introduction

Studied for over 150 years, geographic variation in population-based rates of health service utilization provides opportunities for policymakers to take action: if high variation is due to restricted access in some places, access could be improved; if it is due to overuse, incentive reform or practice standardization might unleash scarce resources and improve the efficiency of healthcare systems.[11,90]

Geographic variation in health services utilization among developed countries has uncovered widespread variation in rates of virtually every procedure studied.[50,51] But it is possible that the construct of national healthcare services might influence the degree of geographic variation in health services utilization observed in a country. The predominance of a fee-for-service based reimbursement system that incentivizes over-utilization, lack of use of informed patient decision-making, and lack of consensus around acceptable practices have all been implicated in the high level of geographic variation in US surgical procedure rates.[11,23,58] In Britain, where a free, universal, and nationally-funded healthcare system is supplemented by 'private health insurance' that provides access to elective care in the private sector,[91] rates of common surgical procedures also show substantial variation across competing and relatively autonomous Primary Care Trusts,[57] similar in magnitude to that seen in the United States during the same period.[58] In France, where access to healthcare is provided through compulsory insurance that can be used in private and public hospitals (the size and makeup of both sectors are regulated by the central government in concert with regional health agencies),[60] national examinations of geographic variation in health services utilization have been limited to the incidence of inflammatory bowel disease,[52] in the use of cesarean section,[82,92] and in general practitioners' antibiotic prescribing practices.[93,94]

No studies have systematically examined trends in per capita use of common surgical procedures in France, no studies have examined geographic variation of such procedures in France, and no studies have compared established measures of geographic variation in French procedure rates to those in other countries. To fill this knowledge gap, and to begin an exploration of whether health system constructs might be related to geographic variation in elective procedure rates, we used data on French admissions from 2008-2010 to compute rates of common procedures, to calculate established measures of geographic variation in France, and to compare French results to published results for the US and Britain.

Methods

Data sources, sample definition, and variables

We obtained data on all discharges from public and private sector French hospitals in 2008 - 2010 from the Agence Technique de l'Information sur l'Hospitalisation.[72] These included a unique hospitalization number, a unique patient anonymous identifier, hospitalization characteristics (the identity and location of the hospital, and length of stay), and patient characteristics (age, gender, procedure codes, primary and secondary diagnostic codes, number of diagnoses, and the district in which the patient lived). We examined fourteen elective surgical procedures that have been shown to demonstrate differing degrees of geographic variation in the United States.[3,4,11,57,58,78,82,95-97] We also examined admission for hip fracture because it is common practice to admit patients to the hospital for hip fracture in France[54] and, therefore, should show little geographic variation; for the same reason, it has been so used in studies of geographic variation in the United States.[11,12]

To allow for international comparisons, we used ICD-10 diagnoses and the French Classification Commune des Actes Médicaux system that classifies medical interventions[74] to create similar cohorts to those used by the Dartmouth Atlas project.[75] The definitions that we used and those used for examination of variation in the United States are shown in **Table 1**, on the following page, which also provides the total number of these procedures completed in mainland France in 2008 to 2010.

Table 1. Surgical procedures examined, how they have been defined by the Dartmouth Atlas Project in the United States for the Medicare population using ICD-9 procedure and diagnostic codes, how we defined them using French procedure and ICD-10 codes, and the total number of procedures in France for patients aged 45-99 (and other age ranges, as specified) in 2008-2010.

Procedure	**Dartmouth Atlas definitions**[75]	**Classification Commune des Actes Médicaux** [74] **and ICD10 definitions**	**Number in France 2008-10**
Tonsillectomy*	Not available	FAFA001-FAFA015 Diagnoses excluded: No cancer (C or D codes) Diagnoses included: otitis media (H65-66 series), chronic rhinitis (J31) or tonsillitis and tonsil hyperplasia (J35)	383,093
Admission for hip fracture	Any hip fracture	ICD10 DX code S72.0-S72.9	275,120
Percutaneous Coronary Interventions (PCI)	Any PCI, balloon or otherwise, stent or no, no diagnostic restrictions	DDAF001 – DDAF010	263,375
Hip replacement	Any hip replacement (except if concurrent hip fracture)	NEKA001-022	250,932
Cholecystectomy**#	Any laparoscopic cholecystectomy, total or partial, no diagnostic restrictions	HMFA001-008, HMFC001-005	219,281
Knee replacement	Any knee replacement	NFKA001-009	179,313
Caesarian section***	Not available	JQGA002-005	159,663
Total Hysterectomy**#	Not available	JKFA002, JKFA004-007, JKFA013, JKFA015, JKFA018, JKFA020, JKFA021, JKFA023, JKFA025, JKFA026, JKFA027, JKFA028, JKFC003, JKFC005	144,457
Transurethral Resection of the Prostate (TURP)	Any transurethral prostatectomy	JGFA014-JGFA016	130,826
Spine surgery**#	Any spine surgery, including with implants; excluding cancers, infections, fractures, repairs Diagnosis must include spondylosis, nerve root compression, disc disease, pain, kyphosis, scoliosis, spondylolisthesis, spondylolysis in any region; spinal stenosis in non-cervical areas	LFCA001-LFCA005, LFDA001-014, LFFA001-014, LFMA001, LFPA001-003 Diagnoses excluded: no cancer (C or D series) no ongoing infections (I series), and no traumas (S series) Diagnoses included: Spondylosis (M47 series), Nerve root compression (M50 and G55 series), Disc disease (M51 series), Neuritis and pain (M54 series), Kyphosis and Scoliosis (M41 and M42 series), Spondylolysthesis & spondylolysis (M43 series), and Stenosis (M48 and M99 series).	113,711
Colectomy	Any colectomy with colon cancer diagnosis	HHFA001-002, HHFA004-006, HHFA008-011, HHFA014 -018, HHFA020-026, HHFA028-031 with diagnosis in C18, C19, C20, D01, D12, or D37 series	72,307
Carotid endarterectomy (CEA)	Any carotid endarterectomy	EBFA002-EBFA003, EBFA005-EBFA006, EBFA008-EBFA010, EBFA012-017	37,551
Radical prostatectomy	Radical prostatectomy by any approach	JGFA006, JGFA011	26,023
Coronary artery bypass grafting (CABG)	Any CABG, No diagnostic restrictions	DDMA003-009, DDMA011, DDMA013, DDMA015-037	22,690

* only ages 0-17 evaluated
** a third age range of 35-44 was also evaluated
*** only ages 18-44 evaluated

Analytic methods

Calculation of utilization rates. Because demographics vary by region, we used the same indirect method[76] used by the Dartmouth Atlas Project in the US and the King's Fund in the UK[57] to calculate age- and sex-adjusted utilization rates for 94 geographically-defined "departments" in mainland France; we obtained age- and sex-specific department-level population estimates from the French census.[77] For each department, year and type of admission examined (save tonsillectomy and caesarean section), we calculated rates for two age groups: 45-64 and 65-99. We also examined younger age groups for cesarean section (18-44), tonsillectomy (0-17), and three procedures that are relatively common in the 35-44 year old age group: cholecystectomy, hysterectomy, and back surgery. As France does not collect information on race, we could not adjust for geographic differences in race prevalence.

Measures of geographic variation

For 2008, 2009, and 2010, for each procedure and age group examined, we report age- and sex-adjusted national per capita rates and four established measures of geographic variation that allow for comparison across geographic settings and countries:[57,58,78]

1. The extreme ratio, which is calculated by dividing the highest geographic rate by the lowest and represents the range of absolute service utilization levels.
2. The interquartile ratio, which is calculated by dividing the rate at the 75th percentile by that at the 25th percentile and shows the relative variation in service utilization after removing the most extreme values.
3. The coefficient of variation, which is the ratio of the standard deviation to the mean and represents a normalized version of dispersion.

4. The systematic component of variation (SCV), which shows the non-random part of variation in rates by distinguishing the systematic variation between areas from the random variation within areas; to make international comparisons, we also calculated the SCV across 2008-1010. As is common practice, we multiply SCV time 10; an SCVx10 greater than 5 indicates high variation; that greater than 10, very high variation.[78]

From first to last, these measures are increasingly conservative and more stable over time.

International comparisons

To compare the systematic component of geographic variation in France to that in the US or Britain, we obtained SCVx10 values for most procedures that we examined from published reports.[57,58] We obtained per capita procedure rates from the US for 2008-2010 from a published report;[58] those for Britain have not been published.

Human subjects approval

The Institutional Review Board at Dartmouth College approved this study (CPHS number 24085). In France, the study and its use of anonymized data was approved by the French National Union of Regional Health Observatories (Fédération Nationale des Observatoires Régionaux de la Santé) and the French IRB (Commission Nationale Informatique et Libertés, National Committee for Data Files and Individual Liberties) (CNIL authorization number 1180745).

Results

French department level per-capita utilization rates varied considerably, according to the procedure examined (**Table 2** on the following page). Rates of most procedures were substantially lower in younger age groups, except for spine surgery (which showed the opposite trend) and hysterectomy (which peaked among women aged 45-64). Over time, rates of hysterectomy, CABG, radical prostatectomy, and tonsillectomy declined somewhat for all age groups examined; those of cholecystectomy, hip fracture, hip and knee replacement, PCI, and cesarean section increased.

Table 2. 0.
variation across
ps examined
(bottom).

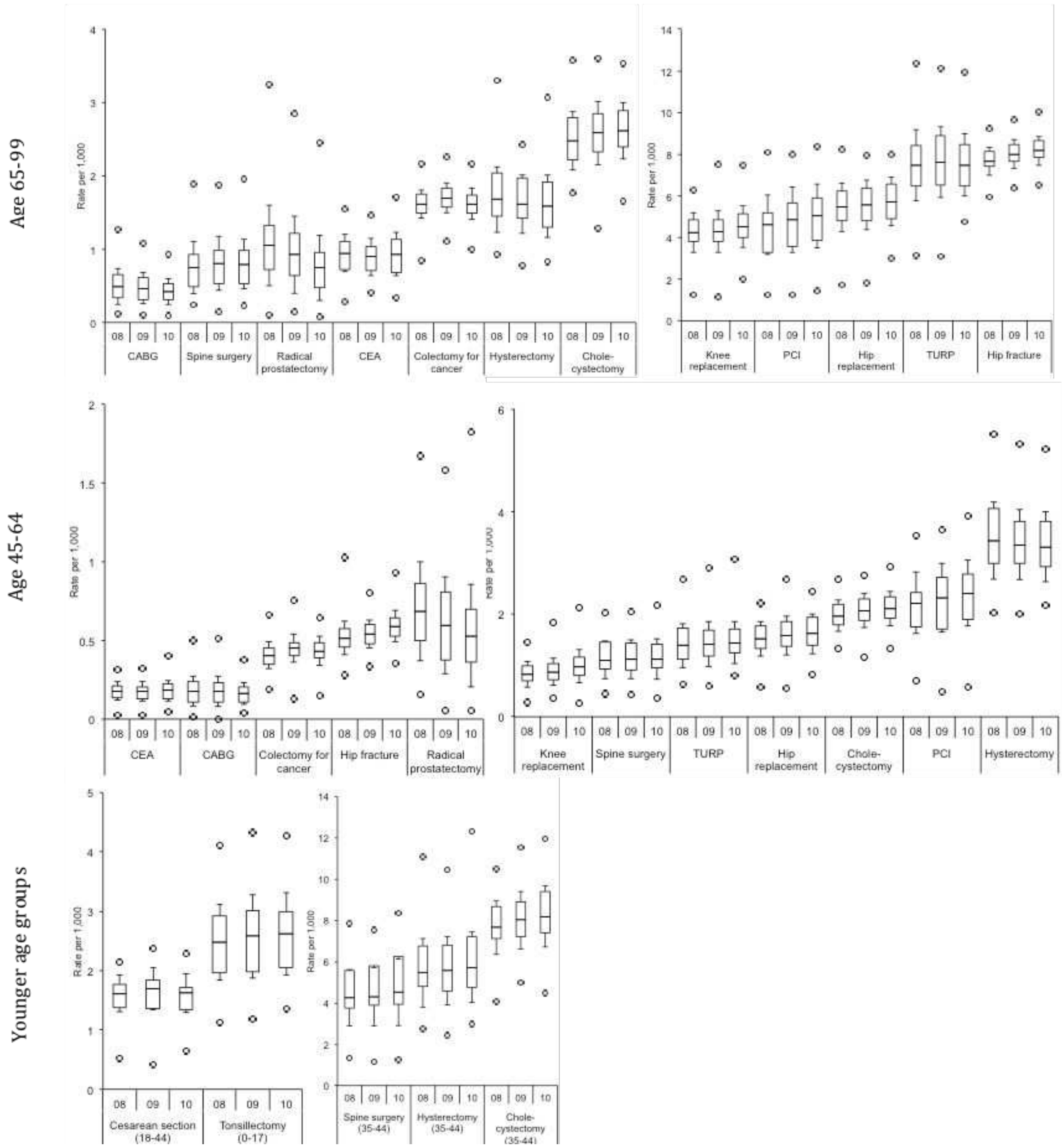
		Hip fracture			Colectomy for cancer			Cholecystecomy			TURP			Hysterectomy			Hip replacement		
	Year	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Age 65 and older	National average rate per 1,000	7.65	8.01	8.17	1.61	1.70	1.62	2.48	2.58	2.61	7.49	7.63	7.49	1.68	1.61	1.58	5.47	5.57	5.73
	Extreme ratio	1.55	1.51	1.54	2.54	2.04	2.18	2.02	2.79	2.14	3.92	3.93	2.51	3.54	3.13	3.70	4.79	4.42	2.64
	Interquartile ratio	1.09	1.11	1.10	1.17	1.17	1.16	1.26	1.22	1.21	1.30	1.36	1.30	1.41	1.39	1.47	1.30	1.32	1.34
	Coefficient of variation	0.09	0.09	0.09	0.12	0.12	0.13	0.16	0.16	0.15	0.22	0.22	0.20	0.26	0.24	0.26	0.21	0.21	0.20
	SCV(x10)	0.64	0.62	0.62	1.10	1.02	1.29	2.13	2.56	1.77	5.30	4.93	3.53	5.24	5.32	5.55	5.39	5.54	4.45
	SCV(x10) across years		0.56			0.84			1.89			4.14			4.51			4.65	
Age 45 to 64	National average rate per 1,000	0.52	0.54	0.59	0.41	0.45	0.43	1.96	2.07	2.11	1.39	1.41	1.45	3.43	3.35	3.31	1.52	1.58	1.62
	Extreme ratio	3.62	2.39	2.63	3.49	5.75	4.31	2.01	2.35	2.19	4.24	4.95	3.86	2.72	2.65	2.42	3.93	4.75	2.93
	Interquartile ratio	1.26	1.26	1.21	1.28	1.21	1.25	1.23	1.22	1.22	1.55	1.41	1.38	1.36	1.28	1.30	1.32	1.34	1.38
	Coefficient of variation	0.20	0.16	0.17	0.21	0.20	0.21	0.15	0.16	0.16	0.30	0.30	0.27	0.21	0.20	0.20	0.22	0.24	0.24
	SCV(x10)	2.43	1.48	1.92	3.55	3.38	4.05	2.08	2.50	2.21	7.72	7.35	5.70	4.18	3.77	3.37	5.21	6.47	5.69
	SCV(x10) across years		1.31			2.32			2.04			5.96			3.42			5.32	

		Knee replacement			CEA			PCI			CABG			Spine surgery			Radical prostatectomy		
	Year	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Age 65 and older	National average rate per 1,000	4.23	4.29	4.52	0.95	0.89	0.93	4.61	4.85	5.04	0.49	0.46	0.42	0.75	0.81	0.80	1.05	0.93	0.75
	Extreme ratio	5.02	6.60	3.72	5.38	3.53	5.00	6.44	6.32	5.84	11.00	10.28	9.43	7.70	12.35	8.51	29.27	20.37	33.13
	Interquartile ratio	1.28	1.28	1.28	1.53	1.47	1.69	1.58	1.57	1.53	1.94	1.97	1.72	1.89	1.87	1.83	1.86	1.91	2.01
	Coefficient of variation	0.22	0.23	0.22	0.28	0.30	0.33	0.33	0.34	0.32	0.49	0.45	0.41	0.49	0.47	0.43	0.51	0.54	0.57
	SCV(x10)	6.55	6.96	5.09	8.68	9.77	11.54	12.20	15.87	12.60	27.91	21.86	17.72	21.39	22.41	16.89	29.07	30.72	33.97
	SCV(x10) across years		5.59			8.83			12.09			18.08			18.24			28.92	
Age 45 to 64	National average rate per 1,000	0.82	0.88	0.98	0.18	0.18	0.18	2.22	2.32	2.41	0.18	0.18	0.16	1.11	1.12	1.13	0.69	0.60	0.53
	Extreme ratio	5.35	5.14	7.99	12.48	12.85	9.13	5.07	7.40	6.79	40.14	∞	8.84	4.57	4.77	5.99	10.85	29.40	35.58
	Interquartile ratio	1.44	1.45	1.42	1.52	1.62	1.69	1.39	1.58	1.47	2.22	2.12	1.88	1.58	1.59	1.48	1.73	2.13	1.92
	Coefficient of variation	0.29	0.30	0.32	0.33	0.38	0.38	0.28	0.30	0.28	0.53	0.55	0.42	0.31	0.32	0.33	0.45	0.51	0.57
	SCV(x10)	8.39	8.66	9.80	11.12	16.80	12.25	8.98	12.71	9.83	40.45	41.70	15.25	10.59	10.87	12.08	20.63	32.42	31.88
	SCV(x10) across years		8.38			10.75			9.05			21.91			10.99			24.31	

		Age 35-44									Age 18-44			Age 0-17		
		Cholecystecomy			Hysterectomy			Spine surgery			Cesarean section			Tonsillectomy		
Younger age groups		2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
	National average rate per 1,000	1.46	1.56	1.60	2.45	2.38	2.28	1.37	1.36	1.30	4.82	4.80	4.90	9.48	9.36	9.19
	Extreme ratio	2.58	2.32	2.66	4.05	4.29	4.12	5.77	6.44	6.65	4.03	5.61	3.54	3.62	3.65	3.13
	Interquartile ratio	1.22	1.24	1.27	1.41	1.48	1.51	1.48	1.49	1.58	1.29	1.35	1.28	1.48	1.52	1.46
	Coefficient of variation	0.17	0.17	0.18	0.29	0.29	0.28	0.29	0.30	0.32	0.20	0.23	0.21	0.26	0.28	0.27
	SCV(x10)	2.19	2.34	2.51	7.12	7.30	6.46	10.61	11.01	12.70	5.26	7.83	6.08	7.11	8.48	7.77
	SCV(x10) across years		2.11			6.16			11.20			5.94			7.57	

How procedure- and age-specific per-capita utilization rates (and the variation in those rates) changed across the three years examined can be seen in **Figure 1**, below.

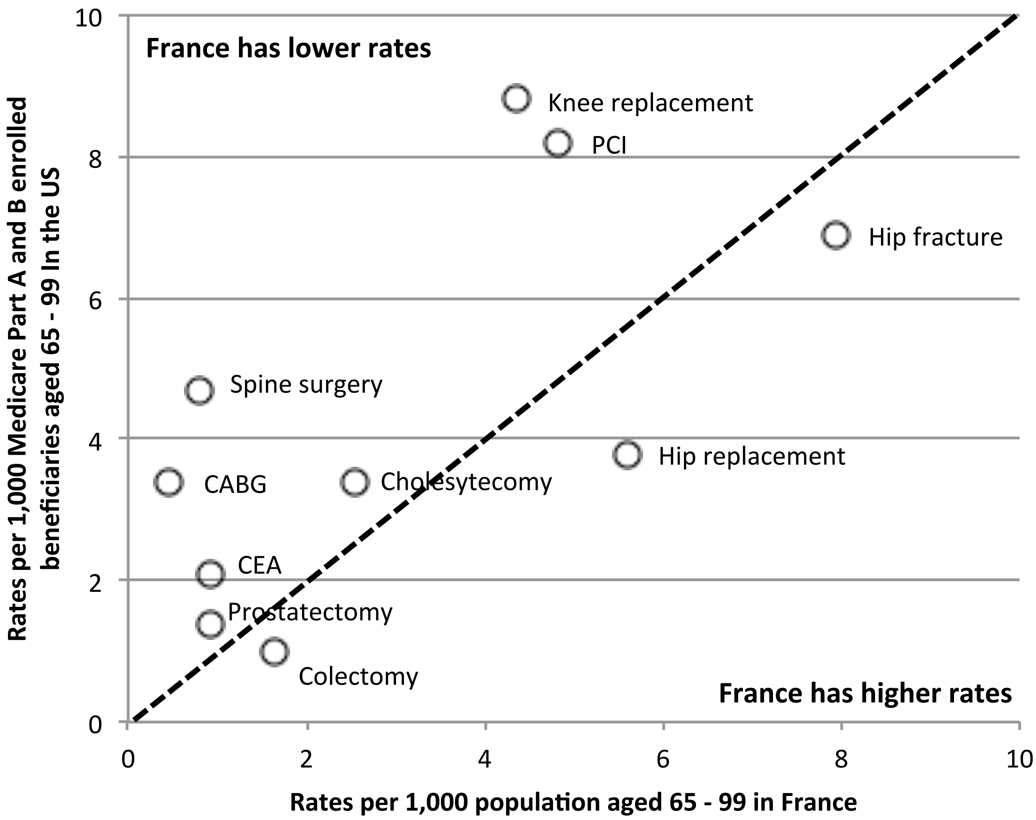
Figure 1. Graphical representation of variation in rates of elective surgical procedures in France, in 2008, 2009, and 2010, for different age groups, organized by increasing overall per capita utilization rates. The horizontal bars show the national average rate, the box plot shows the 25th and 75th ation from the mean, and the
open markers show the high and low rates at the department level.



As expected, hip fracture admission rates for older patients demonstrated the least geographic variation, regardless of the measure used. Some procedures demonstrated much more geographic variation than others, and the degree of geographic variation differed depending on the age group examined. Radical prostatectomy and CABG surgery showed the greatest variation on virtually every measure of variation, while colectomy and cholecystectomy showed the least. As expected, SCVx10 and the coefficient of variation were more stable across years than the extreme or the interquartile ratios.

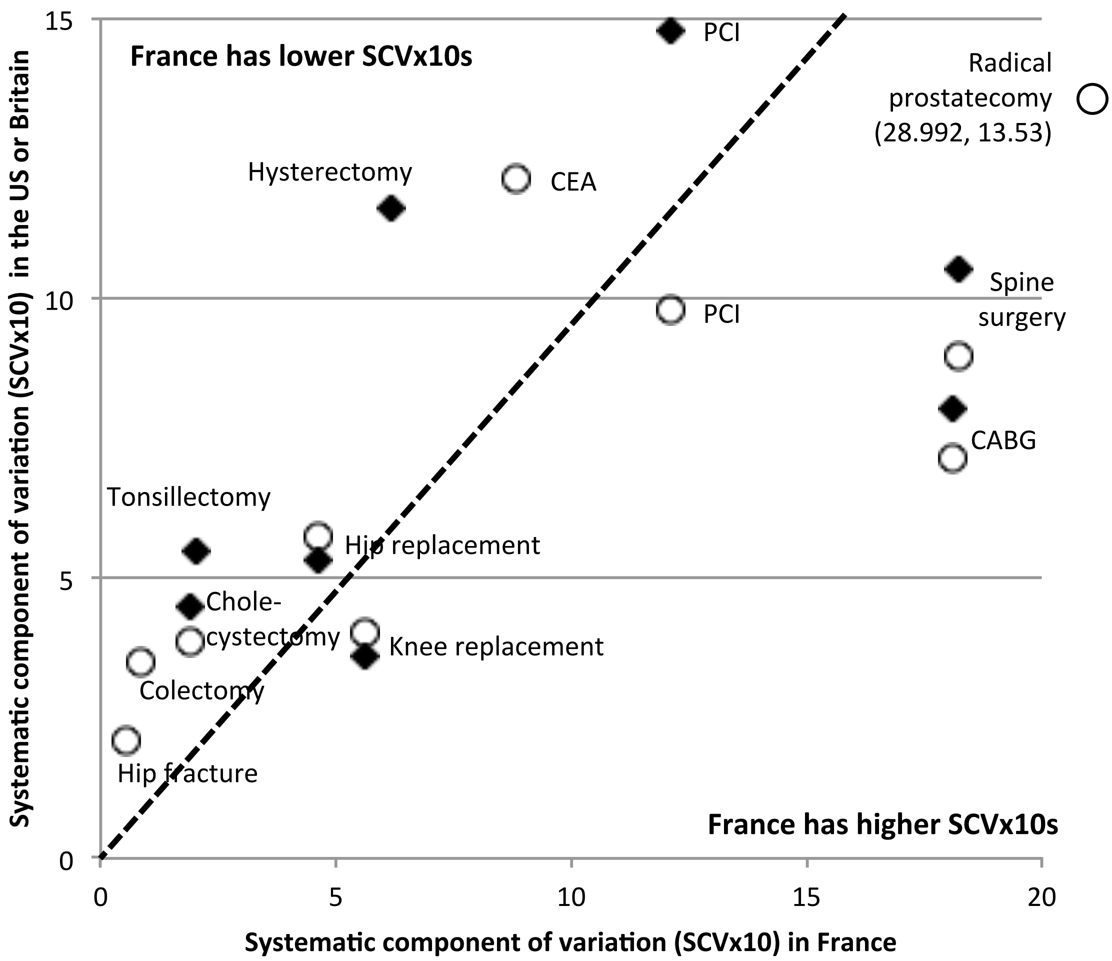
For the 65 to 99 year old age group, with the exceptions of colectomy and hip replacement, per capita rates of the elective procedures that we examined and for which US per capita rates were available were lower in France than in the US (**Figure 2**).

Figure 2. Comparisons of per capita age-sex adjusted utilization rates of selected procedures among populations aged 65-99 in France and the US, 2008-2010. The dotted line indicates where equivalent rates might lie; points to the left of the line indicate that France has a lower rates, and those to right indicate that France has higher rates.



Hip fracture rates in France were modestly higher than those in the US. French SVCx10s were lower than US or British ones for hip fracture, colectomy, cholecystectomy, tonsillectomy, hip replacement, hysterectomy, CEA and PCI (in Britain); they were higher for knee replacement, PCI (in the US), spine surgery, CABG, and radical prostatectomy (**Figure 3**).

Figure 3. Comparison of systematic component of variation (SCVx10) for selected procedures in France for 2008-2010, the US for 2008-2010, and Britain for 2009-2010. Open markers represent US data, closed markers represent British data, and both are shown in relation to French data. The dotted line indicates where equivalent SCVx10s might lie; points to the left of the line indicate that France has a lower SCVx10 than its comparison, and those to right indicate that France has a higher SCVx10.



Conclusions

We used small area variation analysis to examine age- and sex-adjusted population based rates of admission for hip fracture and fourteen common elective surgical procedures in France in 2008, 2009, and 2010. We found substantial geographic variation in health services utilization for these conditions. In addition, we found that, for seven of the nine elective surgical procedures for which comparable data were available, per capita utilization rates were lower in France than in the US. Where US rates were higher, they were substantially so: about twice the rate for knee replacement, PCI, and CEA; about five times the rate for spine surgery; and about 7 times the rate for CABG. Variation in French rates of radical prostatectomy, spine surgery, and CABG was very high; however, that for the other procedures examined tended to be lower than those seen in the US or Britain.

That French patients tend to use most elective procedures less frequently than their US counterparts might be explained, in part, by the structure of France's national healthcare system which includes centralized planning, budgeting, and allocation of healthcare resources as well as a standardized fee schedule for hospitalization and physicians. In addition, cultural factors might be at play: French patients and physicians may simply have less enthusiasm than their United States counterparts for many of the procedures we examined.[17,98,99] However, that hip replacement surgery rates in France are about 50% higher than US rates while knee replacement rates in France are about 50% lower than US rates suggests that cultural issues regarding the appropriateness of use might be at play for both patients and providers. And while patients in France may have less access to care than those in the US, a factor that might result in lower utilization rates,[100] it is equally likely that these elective procedures are overused in the US.[11]

France's lower measures of geographic variation could suggest that French physicians have greater consensus on the efficacy of the interventions that we examined than their US or British counterparts; alternatively, France's centralized planning of hospital capacity might restrict bed supply and thereby reduce geographic variation in those procedures. Regardless, French policymakers might use information on geographic variation to identify national practice patterns that warrant intervention. For instance, increasing geographic variation in service delivery might suggest increasing lack of consensus around the appropriateness of the intervention, whether overall rates are stable (as we found in colectomy and CEA), decreasing (as with hysterectomy in older women or radical prostatectomy in older men), or increasing (as with cesarean section). Similarly, examination of trends over time might heighten concern for spine surgery (where there is substantial variation in rates, but the per capita rates have remained stable), as opposed to CABG and radical prostatectomy (which showed considerable decreases in rates and variation over time). Ongoing measurement of geographic variation in service utilization would allow French policymakers to track the effectiveness of efforts designed to reduce variation in care (such as the current effort to transition some inpatient procedures to ambulatory ones)[101]or to monitor the impact of policy changes (such as France's 2009 Hôpital, Patients, Santé et Territoires Act which provides incentives for greater competition between for-profit and public sector hospitals) on geographic variation in care.

Our study has several limitations. First, we did not have access to clinical data that could have helped determine whether the admissions that we examined were warranted. Studies in North America suggest that a relatively high proportion of some procedures, like hip and knee replacement surgery, is neither wanted nor needed by patients;[17,28] however, another study found only mixed evidence of an association between geographic variation and overuse of healthcare services, including carotid endarterectomy.[102] Second, we did not consider differences in demand for healthcare services, such as measures of economic or social depravation. While such measures have been associated with different rates of myocardial infarction,[103] inflammatory bowel disease,[104] and heat-wave-related mortality[105] in France, they are not traditionally examined in studies of geographic variation in the US. Third, we could not examine outcomes; those living in countries with higher rates of surgery may or may not have better health outcomes than those who do not. Finally, we examined only selected procedures; findings may not hold for other elective or non-elective procedures.

Despite these limitations, our study suggests that higher levels of centralized control over bed supply might be associated with reduced geographic variation in the use of elective surgical procedures. Further work could improve appropriate use of scarce resources, encourage adoption of rational practice patterns, and monitor the impact of changes in health policy.

Appendix: Spatial regression models

The problem

We define “spatial autocorrelation in a variable” when observations that are geographically more proximate to one another have related values. One of the basic assumptions in classical ordinary least squared (OLS) regression is independence of observations. If this assumption does not hold, and there is spatial autocorrelation, for a simple estimated OLS model, $Y=X\beta + \varepsilon$, we face inaccurate estimates of the coefficients (β), and the error term (ε) may not be independent and identically distributed (iid). In particular, the error term will contain spatial dependencies whereas it should be indistinguishable from random noise.

Two solutions

Facing spatial dependencies, econometricians propose two solutions: i) The simultaneous autoregressive (SAR) lag model and ii) the spatial error term model:

i) The simultaneous autoregressive (SAR) lag model,[106,107] which is similar to an OLS model in which a spatially lagged dependent variable W.Y is introduced to control for spatial autocorrelation:

$$Y = \rho WY + X\beta + \varepsilon;\ with\ \varepsilon \approx Normal(0,\sigma^2)$$

where ρ corresponds to a spatial autoregressive parameter that determines the size and nature (positive or negative) of spatial autocorrelation and W to a spatial weight matrix that defines neighboring.

ii) The spatial error model,[106,107] which is similar to an OLS model in which a spatially auto-correlated error term ε is introduced to control for the spatial autocorrelation:

$$Y = X\beta + \varepsilon \, with \, \varepsilon = \lambda W \varepsilon + u; \, u \approx Normal(0, \sigma^2)$$

where ε is a vector of spatially auto-correlated error terms, λ corresponds to a spatial autoregressive parameter and W to the spatial weight matrix, and u is a vector of iid errors

For the two cases, the matrix W can be defined in various manners. In the paper, we used 'first-order Queen-based contiguity' matrix, wherein immediately adjacent departments are the basis for the spatial matrix W; however, we confirmed results using the 'Main cities distance' and the 'Barycentric distance' methods, wherein the bases for the matrices are the distances between the main cities and the Barycenters of each department.

Model selection

There is no clear device for choosing solution i rather than solution ii (although the error-term model is more adapted when there is systematic spatial bias in the residuals, not in the dependent variables.[107,108]) In all cases, the strategy is first to test whether the spatial regression dominates the classical OLS regression. To this end, the solution i) (spatial lag) is easier to implement, as a simple heteroskedasticity test and a Likelihood Ratio Test on ρ are sufficient (a statistically significant $\rho \neq 0$ indicates that proximal geographic regions influence one another in the values of the dependent variable, an assumption that we find believable given the dependent variable that we are modeling).

Chapter 2: Illustration of a special case, with an inquiry into the role of the for-profit and not-for-profit hospital sectors: some evidence of supplier-induced-demand in the for-profit sector: *Geographic variation in admissions for knee replacement, hip replacement, and hip fracture in France: evidence of supplier-induced demand in for-profit and not-for profit hospitals.*

Published as: Weeks WB, Jardin M, Dufour J, Paraponaris A, Ventelou B. Geographic variation in admissions for knee replacement, hip replacement, and hip fracture in France: evidence of supplier-induced demand in for-profit and not-for profit hospitals. Medical Care 2014; 52(10): 909-917. PMID 25215648.

Executive summary

We sought to determine whether there was evidence of supplier-induced demand in mainland France, where healthcare is mainly financed by a public and compulsory health insurance and provided by both for-profit and not-for-profit hospitals.

Therefore, using a dataset of all admissions to French hospitals for 2009 and 2010, we calculated department-level age- and sex-adjusted per capita admission rates for hip replacement, knee replacement, and hip fracture for two age groups (45-64 and 65-99 years old to for-profit and not-for-profit hospitals. We used spatial regression analysis to examine the relationship between ecological variables, procedure rates, and supply of surgeons or sector-specific surgical beds. We found that the large majority of hip and knee replacement surgeries were performed in for-profit hospitals while the large majority of hip fracture admissions were to not-for-profit hospitals; nonetheless, we found approximately twofold variation in per capita rates of hip and knee replacement surgery in both age groups and settings. Spatial regression results showed that, among younger patients, higher incomes were associated with lower admission rates; among older patients, higher levels of reliance on social benefits were associated with lower rates of elective surgery in for-profit hospitals. While overall surgical bed supply was not associated with admission rates, for-profit- and not-for-profit-specific bed supply were associated with higher rates of elective procedures within a respective hospital type. We found evidence of supplier-induced demand within the French for-profit and not-for-profit hospital systems; however, these systems appear to complement one another so that there is no overall national supplier-induced effect.

Introduction

In the United States, over forty years of research on geographic variation in healthcare utilization and costs by the Dartmouth Atlas Project has documented substantial variation in utilization of health services among Medicare beneficiaries and that use of some types of care is associated with the supply of specialty physicians and hospital beds per capita.[5,11,12] The predominance of a fee-for-service based reimbursement system, lack of use of informed patient decision-making, and absence of centralized planning are implicated in the geographic variation in the rates of use of hospitalization and elective surgery that underlies the variation in healthcare costs.[11,12] Geographic variation in health services utilization among OECD countries has uncovered widespread variation, but does not use a common theoretical construct or attempt to explore causes or outcomes of that variation.[50] Other studies of geographic variation outside of the US have been limited. A study using 1988 data from 11 developed countries found a strong relationship between the supply of surgeons and the rate of back surgery and that rates in the United States were dramatically higher than in other countries.[51] In France, studies of geographic variation in health services utilization have been limited to an examination of variation in the incidence of inflammatory bowel disease,[52] variation in use of anxiolytics and hypnotics in southeastern France,[53] and variation in the rate of hip fracture within the Picardy region of France.[54]

Because its hospital system consists of a combination of for-profit and not-for-profit hospitals, France offers a unique environment in which to examine the relationship between supply of hospital resources and geographic variation in healthcare service utilization. Planning for all hospitals – both for-profit and not-for-profit – is regulated by the central government in concert with regional health agencies. Requests for expanding or building a new hospital – whether made by a for-profit or not-for-profit entity – are reviewed and approved or denied by the Ministry of Health; in mainland France, 94 geographically defined provinces or 'departments' are overseen by 21 geographically defined regional health offices that enforce policies and plans developed in coordination with the Ministry of Health. For-profit hospitals account for about 15% of all inpatient beds[59] and focus on elective surgical care;[60] since 1996, for-profit hospitals in France have been paid through a prospective payment system.

French citizens may use any hospital that they want, with services funded by the compulsory national healthcare insurance scheme. But the French hospital system is becoming more market oriented: since 2008, not-for-profit hospitals have also been reimbursed for non-mental health hospital care services through a prospective payment system (the T2A system) that consists of regionally adjusted 'medical actively-based payments' (roughly, a DRG-type of payment schedule), supplemental fees based on activities that take place during the hospitalization, and additional payments for expensive drugs and medical devices.[60] Because it introduces volume-based incentives for not-for-profit hospitals, this transition toward a DRG-style payment system is considered a step toward a market-based system based on yardstick competition.[109] Further, the role of for-profit hospitals is also likely to increase as a result of the 2009 Hôpital, Patients, Santé et Territoires Act that introduces the possibility that for-profit hospitals might perform public service duties by contract, especially those usually performed by not-for-profit hospitals and suspected to be expensive, such as teaching, research, and emergency care.

Given the potential for an even larger role for for-profit hospitals in the French healthcare system, we wanted to explore whether the regional supply of for-profit and not-for-profit hospital beds in France might be associated with geographic variation in the rate of admissions for knee replacement surgery, hip replacement surgery, and hip fracture. Findings of a relationship between supply of for-profit beds and increased rates of elective procedures would suggest that French policymakers should be somewhat cautious in expanding the role of for-profit hospitals too quickly; at a minimum, they should consider monitoring these for-profit hospitals for appropriateness of care. We chose hip and knee replacement surgery because they are increasingly common procedures in the US[83,84] and, from a research standpoint, have the advantage of being discrete, elective procedures that require hospitalization. Further, these surgeries are considered 'preference sensitive' care in that their use is marked by physician uncertainty as to care management[58,70] and can be subject to physician influence[17] as well as the supply of health resources;[32] overuse of such care leads to inefficient healthcare delivery and waste.[86] Because it is common practice to admit patients to the hospital for hip fracture in France,[54] we used admission for hip fracture as a "non-elective" control for these preference-sensitive elective procedures: it has been so used in the United States where it shows no association with supply of healthcare resources.[11,12]

Methods

Data sources, sample definition, and variables

We obtained datasets that capture all discharges from for-profit and not-for-profit French hospitals in 2009 and 2010 from the Agence Technique de l'Information sur l'Hospitalisation.[72] These included a unique hospitalization number, a unique patient anonymous identifier, hospitalization characteristics (the identity and location of the hospital, length of stay, and number of surgical beds), and patient characteristics (age, gender, primary and secondary diagnostic codes, number of diagnoses, and the district in which the patient lived). We limited our analysis to hospitals in and patients from the 21 regions in mainland France (excluding Corsica) that are further subdivided into 94 departments.

We analyzed admissions for two elective orthopedic procedures and hip fracture. Using the French system that classifies medical interventions[110] to identify admissions for these procedures and diagnoses, we examined all total hip replacement surgeries, defined by admission for procedure codes NEKA010, NEKA012, NEKA014, NEKA016, NEKA017, NEKA020, or NEKA021. Similarly, we examined all total knee replacement surgeries, defined by admission with procedure codes of NKFA006, NKFA007, NKFA008, or NFKA009. We confirmed that each patient who had one of these procedures had a concurrent diagnosis of hip osteoarthritis (an ICD-10 diagnostic code between M170 –179) or knee osteoarthritis (an ICD-10 diagnostic code between M160 – M169), respectively. Finally, we identified admissions for hip fracture by using ICD-10 codes S7200, S7210, S7220, S7230, S7240, S7280, and S7290. We limited our analysis to patients who were aged 45 to 99, which eliminated about 0.5% of total cases.

We obtained information on the supply of surgical beds from the 2010 annual survey of French hospitals.[111] After aggregating these to the departmental and regional levels, we categorized these beds by the type of hospital in which they were located: those located in for-profit hospitals, and those located in not-for-profit hospitals (which included government- and organization-funded not-for-profit hospitals).[82] For each procedure type we determined which patients lived in the same region or department wherein their admission occurred. Using Dartmouth Atlas methods,[112] we used these data to reassign beds to the region or department where the patient lived (see the example at the end of this chapter).

We obtained information on the number of orthopedic surgeons by department in 2012 from "Eco-Santé 2013"[110] and used the same methods that we used to reassign beds to reassign doctors.

Analytic methods

Calculation of utilization rates. Because demographics vary by region, we used an indirect method[76] to adjust for age and gender, using age- and sex-specific French national rates as the standard rates; France does not collect information on race, so we could not adjust for geographic differences in prevalence of races. We obtained age- and sex-specific population estimates for 2009 from the French census[77] that we then aggregated into age and sex strata for the purposes of adjustment and rate calculation, using five-year increments for ages 45-89, and a ten-year increment for ages 90-99. To calculate rates at the geographic level, we used this age- and sex-adjusted number of cases for each type of admission as the numerator and age-specific regional or departmental population as the denominator. For each department, year and type of admission examined, we calculated rates for those completed in for-profit and in not-for-profit hospitals for two age groups: 45-64 and 65-99.

Using reallocated orthopedic surgeons, overall surgical hospital beds, for-profit surgical hospital beds, and not-for-profit surgical hospital beds in the numerator and age-specific departmental populations in the denominator, we calculated the per-capita supply of these healthcare resources. We explored the relationship between utilization rates and departmental differences in several departmental level ecological variables that we obtained from the Association Nationale des Directeurs d'Action Sociale et de Santé des Conseils généraux,[113] including the proportion of those who were aged 15 to 64 but not participating in the workforce for a variety of reasons, population density, the proportion of older citizens who are enrolled in the ASPA subsidy program (a social program for aged people whose income is below a minimum level), and the department level median income and inter-decile income ratio (90th percentile income level/10th percentile income level). We performed spatial regression analyses, which accounts for the values in adjacent areas using three forms of proximity metrics between the departments[79,80] with age- and sector-specific procedure-specific admission rates as the dependent variable and ecologic variables and per-capita resource supply as independent variables. We report results that used first-order 'Queen-based contiguity' matrix, wherein immediately adjacent departments are the basis for the spatial matrix W used; however, we confirmed results using the 'Main cities distance' and the 'Barycentric distance' methods, wherein the bases for the matrices are the distances between the main cities and the barycenters of each department, respectively. We calculated the Likelihood Ratio Test for spatial lag dependence to determine whether spatial regressions were preferable to simple ordinary least squared regressions: a statistically significant Likelihood Ratio test indicates that proximal geographic regions influence one another.

Human subjects approval

Thee Institutional Review Board at Dartmouth College approved this study (CPHS number 24085). In France, the study and its use of anonymized data was approved by the French National Union of Regional Health Observatories (Fédération Nationale des Observatoires Régionaux de la Santé) and the French IRB (Commission Nationale Informatique et Libertés, National Committee for Data Files and Individual Liberties) (CNIL authorization number 1180745).

Results

In 2009 and 2010, French patients aged 45 – 99 had 138,199 admissions for knee replacement, 169,156 admissions for hip replacement, and 169,387 admissions for hip fracture in hospitals located in mainland France (**Online supplement tables 1a, 1b, and 1c on the following pages**).

Online supplement tablesp replacement surgery (1b), and hip fracture (1c): number of events, mean patient age, gender, mean number of recorded diagnoses (N DX, including primary diagnoses), mer knee and hip replacement surgeries), and mean length of stay (LOS), for patients who were aged 45-99 at the time of admission. P-values for comparisons of overall for-profit sector to not-for-profit sector results are shown at the bottom of the tables; **bold text** notes the that one sector has a statistically higher value (at p<0.05) within the region.

Online supplement table 1a. Knee replacement surgery.

Region in which hospitalization took place	In for-profit sector						In not-for-profit sector					
	N	Mean age	% Male	Mean N DX	Mean N PX	Mean LOS	N	Mean age	% Male	Mean N DX	Mean N PX	Mean LOS
Ile de France	13,806	70.7	31%	**3.60**	**10.18**	9.73	3,818	**72.2**	29%	3.26	5.27	9.69
Champagne-Ardennes	2,740	**70.9**	34%	**4.83**	**8.61**	10.59	595	69.5	33%	2.73	6.07	**11.41**
Picardie	1,480	70.1	35%	**4.98**	**10.67**	9.52	1,351	70.0	34%	4.00	6.07	**10.26**
Haute-Normandie	3,197	70.6	**35%**	3.21	**11.13**	**10.23**	460	69.5	27%	3.20	5.97	9.62
Centre	4,193	71.6	37%	**3.34**	**10.15**	9.77	1,196	71.6	33%	3.02	5.35	**11.07**
Basse-Normandie	1,918	71.3	37%	**5.08**	**10.48**	8.58	942	72.0	35%	2.63	7.13	**9.83**
Bourgogne	3,486	70.4	**38%**	**5.16**	**11.39**	9.71	1,673	**71.3**	34%	3.61	6.58	**10.98**
Nord-Pas de Calais	6,689	**69.5**	**31%**	4.06	**8.88**	9.03	3,697	68.2	28%	**6.00**	7.40	**10.21**
Lorraine	3,610	70.3	34%	4.82	**11.45**	9.93	3,578	70.5	33%	**5.24**	5.71	**10.43**
Alsace	1,477	69.7	34%	**3.96**	**9.83**	**10.27**	4,210	**70.9**	33%	2.75	9.07	9.29
Franche-Comté	2,063	70.9	36%	4.05	**9.23**	8.82	818	70.7	35%	3.71	6.07	**10.44**
Pays de la Loire	5,553	71.3	39%	**3.51**	**8.88**	9.12	2,326	**71.9**	40%	3.16	6.06	9.06
Bretagne	4,999	**71.6**	39%	**3.92**	**7.81**	9.13	1,880	70.7	38%	2.73	5.61	**9.75**
Poitou-Charentes	3,703	71.8	39%	**3.86**	**10.80**	9.65	829	71.5	38%	2.83	5.49	9.77
Aquitaine	5,190	**72.2**	41%	**4.12**	**8.53**	9.99	2,792	71.2	40%	3.74	4.47	**10.87**
Midi-Pyrénées	4,568	71.3	39%	3.78	**10.13**	9.10	2,293	**72.0**	40%	3.83	7.53	**10.16**
Limousin	1,561	71.7	40%	2.84	**10.56**	9.68	673	71.8	38%	**3.26**	7.45	**11.73**
Rhône-Alpes	7,639	70.9	**38%**	**4.59**	**9.69**	9.19	7,331	71.2	36%	3.28	6.58	**9.59**
Auvergne	2,740	70.9	40%	**4.62**	**10.33**	9.94	772	70.6	37%	1.82	3.48	9.88
Languedoc-Roussillon	4,003	71.1	40%	**3.82**	**9.60**	8.81	2,639	70.9	38%	2.43	6.14	**9.80**
PACA	6,846	71.8	**38%**	3.57	**8.24**	9.00	2,854	71.6	33%	**4.30**	5.88	**9.21**
National totals and averages	91,461	71.0	**36%**	**3.99**	**9.67**	9.47	46,727	71.0	35%	3.62	6.37	**9.95**
P value (FP vs. NFP)		0.38	<0.001	<0.001	<0.001	<0.001						

Online supplement table 1b. Hip replacement surgery.

Region in which hospitalization took place	In for-profit sector						In not-for-profit sector					
	N	Mean age	% Male	Mean N DX	Mean N PX	Mean LOS	N	Mean age	% Male	Mean N DX	Mean N PX	Mean LOS
Ile de France	17,075	69.6	41%	2.87	**9.46**	**9.17**	6,039	**70.3**	39%	2.91	5.75	8.82
Champagne-Ardennes	3,509	70.1	45%	**4.23**	**8.98**	9.81	705	70.1	44%	3.27	6.27	**11.48**
Picardie	2,455	**70.4**	44%	**4.19**	**9.56**	9.65	1,764	69.5	43%	3.61	5.67	9.86
Haute-Normandie	4,046	69.9	44%	2.63	**8.94**	8.80	920	69.0	40%	**3.18**	5.79	**9.36**
Centre	5,440	70.9	46%	2.93	**9.60**	9.12	2,095	71.6	46%	2.97	5.18	**10.58**
Basse-Normandie	3,496	70.8	46%	**4.40**	**9.39**	8.37	1,582	71.2	48%	2.62	6.42	**10.01**
Bourgogne	3,768	70.3	48%	**4.34**	**9.57**	9.50	2,109	**71.4**	48%	3.55	6.64	**10.66**
Nord-Pas de Calais	8,229	**69.5**	38%	3.56	**8.23**	8.73	3,961	67.9	37%	**4.13**	6.95	**9.45**
Lorraine	3,315	69.8	44%	4.23	**10.51**	8.95	3,285	69.6	42%	**5.05**	6.61	**9.46**
Alsace	1,070	67.7	**52%**	**3.26**	**9.34**	9.16	3,754	**69.0**	46%	2.50	8.29	8.92
Franche-Comté	1,889	70.6	47%	3.59	**8.25**	9.29	1,130	70.2	48%	3.49	6.17	**10.39**
Pays de la Loire	7,738	70.4	46%	2.91	**8.02**	8.84	3,639	70.9	48%	3.00	6.54	**9.28**
Bretagne	7,544	70.4	44%	**3.28**	**7.69**	8.87	3,956	70.3	43%	2.83	5.63	**10.24**
Poitou-Charentes	4,331	70.7	46%	**3.37**	**10.52**	9.03	1,306	70.9	49%	2.88	6.68	**10.35**
Aquitaine	6,064	70.8	46%	3.72	**8.38**	9.38	3,274	70.2	46%	3.57	4.77	**10.91**
Midi-Pyrénées	4,806	70.1	46%	3.36	**9.57**	8.59	2,630	**70.9**	45%	**3.58**	7.02	**10.37**
Limousin	1,959	70.7	48%	2.57	**8.87**	8.84	874	71.6	46%	**2.89**	7.51	**11.07**
Rhône-Alpes	8,935	70.1	46%	**4.03**	**9.73**	9.01	8,759	**70.5**	46%	3.11	6.08	**9.55**
Auvergne	3,318	70.5	48%	**3.83**	**10.04**	9.62	1,362	71.2	47%	2.22	4.43	**11.12**
Languedoc-Roussillon	3,974	70.3	46%	**3.45**	**9.20**	8.85	2,747	70.3	45%	2.37	6.73	**10.31**
PACA	7,076	71.1	42%	3.10	**8.01**	8.76	3,223	70.8	43%	**3.75**	5.83	**9.56**
National totals and averages	110,037	70.2	44%	**3.42**	**9.04**	9.03	59,114	70.3	44%	3.24	6.24	**9.81**
P value (FP vs. NFP)		0.36	0.41	<0.001	<0.001	<0.001						

Online supplement table 1c. Hip fracture.

Region in which hospitalization took place	In for-profit sector					In not-for-profit sector				
	N	Mean age	% Male	Mean N DX	Mean LOS	N	Mean age	% Male	Mean N DX	Mean LOS
Ile de France	11,598	80.6	27%	4.94	13.11	10,232	**81.1**	27%	**5.70**	12.95
Champagne-Ardennes	768	80.3	26%	6.66	11.74	3,082	80.3	28%	6.36	**13.92**
Picardie	450	79.9	27%	**7.77**	11.25	4,271	80.1	29%	6.02	**12.62**
Haute-Normandie	833	80.6	25%	4.42	14.27	2,429	80.0	26%	**5.70**	15.28
Centre	1,523	81.9	26%	5.11	12.29	3,558	81.3	28%	5.01	12.62
Basse-Normandie	305	78.8	27%	**7.54**	10.93	3,011	**81.1**	29%	5.50	**14.25**
Bourgogne	1,129	81.1	23%	**8.13**	12.67	3,912	82.0	27%	6.28	12.85
Nord-Pas de Calais	1,969	79.3	26%	5.68	12.71	7,827	78.8	28%	5.63	12.31
Lorraine	672	79.7	30%	6.23	12.13	7,096	80.4	27%	6.60	12.80
Alsace	2,265	79.7	29%	5.74	**13.95**	3,383	79.7	30%	5.50	11.45
Franche-Comté	166	77.9	28%	6.11	11.08	2,364	**80.9**	27%	**8.29**	**16.77**
Pays de la Loire	1,994	81.0	27%	4.77	11.32	7,233	81.2	27%	4.82	11.18
Bretagne	1,272	80.9	24%	**6.13**	12.01	8,434	80.6	**28%**	4.89	12.51
Poitou-Charentes	1,216	81.3	24%	**6.17**	**11.79**	5,183	82.0	27%	4.77	10.65
Aquitaine	3,233	**82.2**	25%	6.09	11.75	7,928	80.2	26%	**6.97**	**13.68**
Midi-Pyrénées	2,800	81.6	26%	**6.14**	12.19	7,901	81.9	28%	5.53	**12.82**
Limousin	171	80.4	26%	**6.03**	12.48	2,347	**82.5**	27%	4.03	13.96
Rhône-Alpes	3,365	80.6	24%	**7.40**	13.63	14,529	80.6	**28%**	5.76	**14.33**
Auvergne	1,212	81.6	23%	**6.12**	13.64	2,811	81.3	**27%**	5.14	**14.88**
Languedoc-Roussillon	2,529	81.3	25%	**5.37**	12.08	6,477	81.1	**29%**	4.39	12.43
PACA	4,671	81.7	25%	5.07	10.33	11,238	81.2	**28%**	5.22	**11.86**
National totals and averages	44,141	80.9	26%	**5.68**	12.43	125,246	80.8	**28%**	5.59	**12.92**
P value (FP vs. NFP)		0.078	<0.001	0.004	<0.001					

Approximately 2/3 of admissions for knee and hip replacement took place in for-profit hospitals, while almost ¾ of admissions for hip fracture took place in not-for-profit hospitals; however, the relative proportion of admissions to for-profit and not-for-profit hospitals varied considerably by region. Across admission types, patients admitted to for-profit hospitals experienced shorter lengths of stay, had more listed diagnoses, and, for hip and knee replacement admissions, had more procedures performed; these measures, too, varied by region.

Population characteristics and the supply of healthcare resources varied across departments and regions, as well (**Table 1 on the following page**).

Table 1. Population size, population characteristics, and per-capita allocated supply of surgeons and beds by region.

Region in which patient lives	Regional population by age group		Population characteristics									Per-capita allocated supply of surgeons and beds		
	N Age 45-64	N Age 65-99	Mean age		Percent male		Pop density /km²	2007 median income (€)	Inter-decile income ratio	Non-workforce participants in the working age population (%)	ASPA per 100 aged 65+	Orthopedic surgeons per 100,000	Not for profit surgical beds per 1,000	For profit surgical beds per 1,000
			Ages 45-64	Ages 65-99	Ages 45-64	Ages 65-99								
Ile de France	2,867,587	1,477,612	53.8	75.6	48.3%	40.8%	6,779	20,889	6.9	18.6%	38.4	12.69	2.55	1.54
Champagne-Ardennes	356,847	226,598	54.2	75.8	49.3%	40.8%	56	16,661	5.0	25.7%	14.9	9.99	1.56	1.85
Picardie	501,315	286,929	54.0	75.7	49.6%	41.2%	105	16,791	5.0	23.9%	12.8	10.94	1.27	0.65
Haute-Normandie	479,705	289,889	54.1	75.8	48.9%	40.3%	166	17,226	4.9	25.0%	7.0	8.98	1.09	1.45
Centre	677,188	473,138	54.3	76.1	49.2%	42.3%	91	17,424	4.3	29.1%	22.1	8.64	1.12	1.32
Basse-Normandie	394,833	276,778	54.2	76.0	49.4%	40.8%	94	16,406	4.4	29.0%	12.1	8.57	1.69	1.25
Bourgogne	451,998	329,015	54.4	76.1	49.4%	41.4%	55	17,082	4.4	29.6%	15.0	10.79	1.54	1.51
Nord-Pas de Calais	1,013,154	579,446	54.0	75.7	48.6%	38.3%	364	15,213	6.2	22.6%	9.3	9.62	2.08	1.58
Lorraine	629,354	392,519	53.9	75.5	49.3%	40.9%	130	16,771	4.9	24.1%	13.8	9.56	2.15	1.17
Alsace	482,726	285,750	53.8	75.3	49.9%	41.4%	221	18,836	4.7	23.2%	6.9	10.64	3.29	0.35
Franche-Comté	305,558	199,836	54.2	75.7	49.5%	42.1%	94	17,122	4.4	26.1%	16.5	9.26	1.82	0.94
Pays de la Loire	906,459	603,883	54.1	76.0	49.2%	41.4%	124	16,998	4.0	27.2%	19.5	9.12	1.25	1.39
Bretagne	834,732	587,435	54.2	75.9	49.3%	40.2%	108	17,418	4.1	28.2%	16.4	8.82	1.64	1.24
Poitou-Charentes	483,110	361,853	54.4	76.2	49.0%	42.6%	70	16,549	4.5	30.9%	18.8	9.12	1.11	1.11
Aquitaine	869,052	622,080	54.3	76.1	48.4%	41.7%	97	17,358	4.7	28.7%	28.8	10.39	1.71	1.59
Midi-Pyrénées	757,851	545,762	54.1	76.2	49.1%	42.4%	108	17,332	4.9	28.0%	56.0	10.33	1.37	1.50
Limousin	207,665	169,221	54.4	76.5	49.4%	41.6%	51	16,619	4.6	33.5%	20.9	7.60	1.97	1.50
Rhône-Alpes	1,558,437	986,077	54.1	75.6	48.9%	41.9%	234	18,226	4.8	24.2%	34.1	11.34	2.14	1.31
Auvergne	375,058	273,157	54.4	76.1	49.5%	40.9%	59	16,562	4.5	30.1%	23.2	9.04	1.42	1.59
Languedoc-Roussillon	695,468	509,634	54.4	75.8	48.0%	42.6%	123	15,720	6.7	28.6%	36.9	11.26	1.66	1.47
PACA	1,289,918	953,321	54.3	75.8	47.7%	41.8%	263	17,260	6.5	27.3%	41.2	12.25	1.47	1.43
Overall	16,138,015	10,429,929	54.3	75.8	48.8%	41.3%	1,409	17,770	5.4	25.2%	26.8	10.55	1.82	1.37
Range Low			53.8	75.3	47.7%	38.3%	51	15,213	4.0	18.6%	6.9	7.60	1.09	0.35
Range High			54.4	76.2	49.9%	42.6%	6.779	20,889	6.9	33.5%	56.0	12.69	3.29	1.85

We found substantial variation in the proportion of males in the older population, population density, median income, inter-decile income ratio, labor force participation rate and proportion of older citizens who participated in the ASPA social welfare program. The density of orthopedic surgeons and not-for profit surgical beds varied approximately threefold; that of for-profit surgical beds varied about six-fold.

Figure 1, below, shows department level rates of admission for knee replacement surgery, hip replacement surgery, and hip fracture to for-profit and not-for-profit hospitals. Variation in sector-specific rates is evident, as is the complementary relationship between for-profit and not-for-profit hospitals hip and knee replacement surgery rates: where department level admission rates to for-profit hospitals are high, those to not-for-profit hospitals tend to be low, and vice versa. However, overall per-capita admission rates to for-profit hospitals for these elective surgeries were much higher than that to not-for-profit hospitals. This relationship is not nearly as strong for hip fracture, where overall admission rates to not-for-profit hospitals are invariably higher than to for-profit hospitals. Because Ile de France has a high concentration of hospital beds in both sector and serves as a national referral center, departments that form this region are highlighted in the figure; their elimination from the analysis makes the complementary nature of for-profit and not-for-profit hospitals more impressive.

Figure 1. Scatterplots of 2010 department-level rates of admission for knee replacement surgery (top), hip replacement surgery (middle), and hip fracture (bottom) in not-for-profit (y-axis) and for-profit (x-axis) hospitals, for patients aged 65 and older. Red dots indicate departments in the Ile de France region. Respectively, correlation between not-for-profit and for-profit rates are -0.62, -0.60, and -0.34 when Ile de France is included; they are -0.73, -0.71, and -0.31 when Ile de France is excluded ($p<0.001$ for all hip and knee replacement; $p=0.004$ for hip fracture including Ile de France and $p=0.001$ excluding Ile de France,).

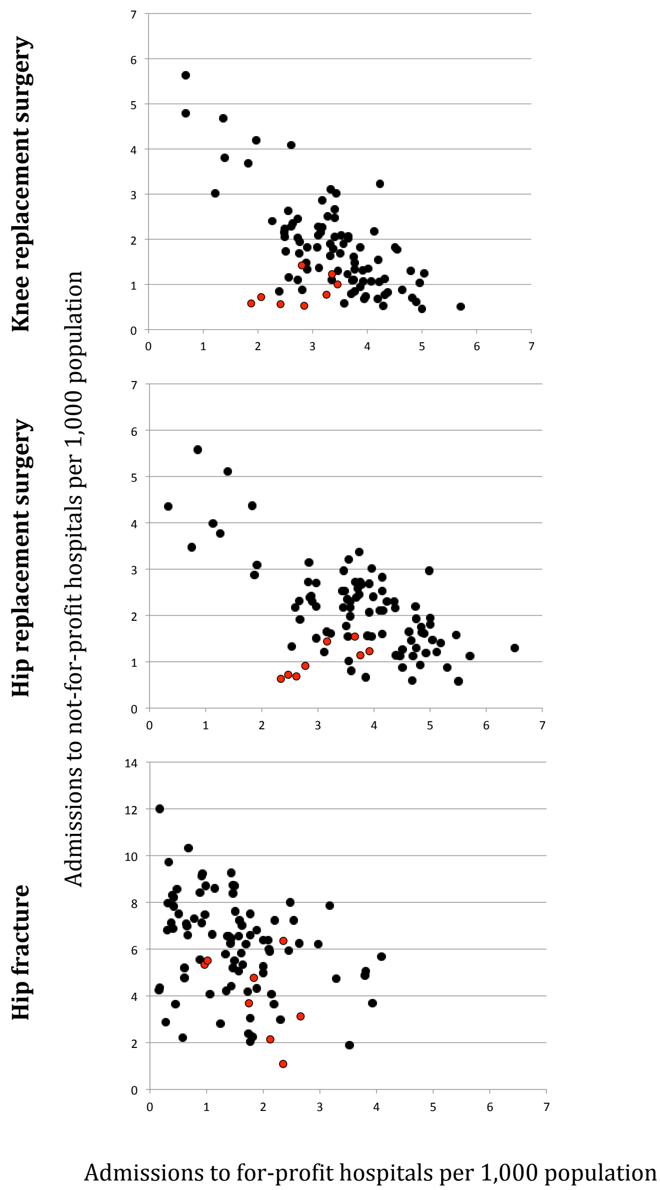


Figure 2, below, on the following page shows maps of age- and sex-adjusted admission rates for total knee replacement and total hip replacement for patients aged 65-99 in 2010, overall, to for-profit hospitals, and to not-for-profit hospitals. Substantial geographic variation is evident, as is the fact that rates of admission to for-profit hospitals greatly exceed those to not-for-profit hospitals. Per-capita rates of hip replacement surgery were higher centrally and to the northeast; those of knee replacement surgery are higher in the northwest and southeast. Generally, where admission rates for a particular procedure are higher in for-profit hospitals, they are lower in not-for-profit hospitals.

Figure 2. Geographic variation in rates of admission **per 1,000 people** aged 65 to 99 in surgery,
overall (top), in for-profit hospitals (middle), and in not-for-profit hospitals (bottom). in each panel; **the shading is based on rate quintiles.**

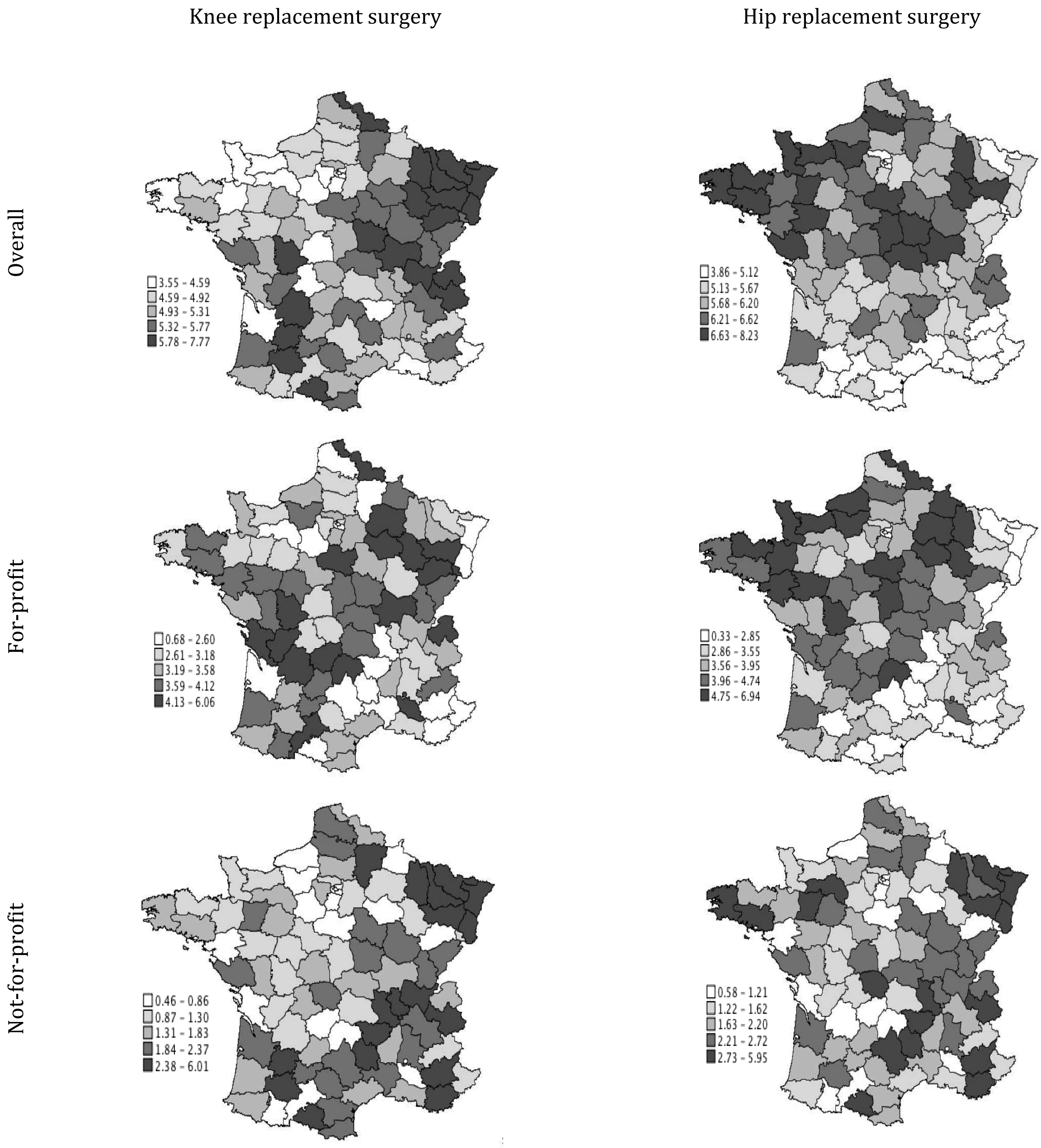


Table 2 shows results of the Queen-contiguity spatial regression analysis for hospital-type-specific elective procedure rates. In most of regressions predicting for profit procedure rates, clear evidence of spatial dependence indicated that **adjacent** departments did influence one another.

Table 2. Results of spatial regression analysis **at the department level** that used the Queen-contiguity method showing coefficients predicting hospital-type-specific rates of knee replacement surgery, hip replacement surgery and hip fracture for two age groups. Bold y cells indicate p>0.10 and parenthesis show p-values when
p>0.001 and <0.1. Overall age-specific surgical bed supply per capita is not statistically significantly associated with overall age-specific rates of admission.

		Age 45-64						Age 65-99					
		2009			2010			2009			2010		
		Knee replace	Hip replace	Hip fracture	Knee replace	Hip replace	Hip fracture	Knee replace	Hip replace	Hip fracture	Knee replace	Hip replace	Hip fracture
Predicting for-profit procedure rates	Age specific orthopedic surgeon supply per capita	-0.126 (0.058)	-0.132 (0.095)				!		-0.211 (0.047)				
	Population density x 100,000		3.314 (0.040)		2.563 $ (0.079)	2.826 $ (0.087)	0.043 $ (0.019)		15.084 (0.005)			9.525 (0.066)	
	Median income x 10,000	-0.412 (0.011)			-0.545 (0.002)	-0.323 $ (0.100)							1.233 (0.054)
	Inter-decile income ratio									0.214 (0.078)			0.267 (0.050)
	Among those 65 and older, enrolled in ASPA	*				-0.050 (0.021)			-0.178 (0.011)		-0.120 $ (0.073)	-0.216 (0.001)	
	Non-workforce participants in the working age population (%)												
	For-profit surgical bed supply per capita x 1,000	**8.508**	**14.478**	**1.870**	**9.146**	**13.875**	**2.574**	**18.362**	**22.462**	**16.581**	**18.411**	**22.004**	**18.939**
	Not-for-profit bed supply per capita x 1,000	**-6.304**	**-8.691**	-0.994 (0.005)	**-6.886**	**-7.440**	-1.179 (0.004)	**-13.343**	**-14.176**	**-7.257**	**-11.992**	**-12.082**	**-8.047**
	Spatial lag term	0.293 (0.017)	0.336 (0.003)	0.246 (0.060)	**0.400**	**0.471**		0.219 (0.072)	0.391 (0.005)	0.236 (0.055)	0.291 (0.013)	**0.465**	
	LR statistic of spatial dependence test	4.793 (0.029)	7.206 (0.007)	3.088 (0.079)	9.183 (0.002)	**14.892**		3.069 (0.080)	7.758 (0.005)	3.204 (0.073)	5.195 (0.023)	**18.594**	
	Model adjusted r-square	0.385	0.540	0.279	0.412	0.408	0.301	0.463	0.595	0.443	0.463	0.635	0.448
Predicting not-for-profit specific procedure rates	Age specific orthopedic surgeon supply per capita						*	0.174 (0.062)			0.235 (0.024)	0.184 (0.088)	
	Population density x 100,000	-2.357 (0.043)	-3.073 (0.039)		-1.983 (0.077)	-3.966 (0.014)	-3.419 (0.006)	-13.951 (0.005)		-26.972 (0.030)	-16.311 (0.003)	-9.396 (0.087)	-30.512 (0.039)
	Median income x 10,000	-0.309 (0.024)	-0.405 (0.023)	-0.237 (0.057)	-0.323 (0.016)	-0.362 (0.058)	-0.317 (0.030)						
	Inter-decile income ratio								-0.303 (0.024)			-0.264 (0.059)	
	Among those 65 and older, enrolled in ASPA												0.379 (0.049)
	Non-workforce participants in the working age population (%)									-11.772 (0.085)			-15.593 (0.058)
	For-profit surgical bed supply per capita x 1,000	**-7.128**	**-13.610**	-2.415 (0.073)	**-6.560**	**-13.673**	-1.106 (0.053)	**-18.069**	**-18.758**	**-28.107**	**-18.510**	**-18.342**	-24.699 (0.002)
	Not-for-profit bed supply per capita x 1,000	**6.175**	**11.651**	2.684 (0.016)	**5.954**	**12.719**	-3.947 (0.013)	**13.543**	**13.634**	11.812 (0.028)	**15.999**	**14.824**	11.865 (0.065)
	Spatial lag term	**0.379**			**0.506**			0.303 (0.007)			0.294 (0.008)		
	LR statistic of spatial dependence test	10.626 (0.001)			**21.594**			7.792 (0.005)			7.237 (0.007)		
	Model adjusted r-square	0.447	0.545	0.135	0.528	0.533	0.245	0.303	0.505	0.263	0.519	0.496	0.223

How other models examined differ from the Queen-contiguity Model

* p<0.10 in the Main Cities Distance spatial regression method
$ p>0.10 in the Baycentric distance spatial regression method
! p<0.01 in the Baycentric distance spatial regression method

However, with the exception of knee replacement, these geographic relationships were not evident when predicting not for profit procedure rates. We found no evidence of influence of adjacent departments when examining hip fracture rates, save for a modest influence in for profit hospitals in 2009, as the spatial lag term, when statistically significant, was systematically positive. The independent variables explained a large part of the variance in hip and knee replacement surgery rates for both age groups and for both types of hospitals. In general, admission rates to for-profit hospitals were positively, and those to not-for-profit hospitals were negatively, associated with population density. Across hospital types, higher admission rates were associated with lower median income levels. Among older patients, greater income disparities were associated with higher rates of admission for hip fracture to for-profit hospitals, but lower rates of admission for hip replacement to not-for-profit hospitals; further, for this age group, higher rates of admission for hip fracture to not-for-profit hospitals was associated with lower rates of non-participation in the workforce. For all age groups and admission types, hospital-type-specific bed supply variables were consistently the most important explanatory variables. Overall age-specific surgical bed supply was not statistically significantly associated with overall age-specific rates of admission for any of the three procedures we examined.

Conclusions

We used small area variation analysis and spatial regression to examine age- and sex-adjusted population based rates of admission to for-profit and not-for-profit hospitals for knee replacement surgery, hip replacement surgery, and hip fracture in France in 2009 and 2010. Across two age groups, we found substantial geographic variation in patient demographics, population characteristics, supply of healthcare services, and rates of admission for these conditions. While we found a strong correlation between hospital-type specific procedure rates and supply of hospital-type-specific surgical beds, we did not find correlation between overall procedure rates and overall surgical bed supply: the for-profit and not-for-profit hospital appeared to act in a complementary fashion to provide the two elective surgeries we examined. Nonetheless, we still found twofold geographic variation in overall rates of admission for these procedures. For some procedures, we also found evidence that higher levels of income disparity and lower income levels were associated with lower rates of elective surgery. Finally, the positive spatial correlation in neighboring departments that we found systematically in the rate of hip and knee replacement in for profit hospitals and in the rate of hip replacement in not for profit hospitals suggests that the independent variables that we examined, including bed supply, positively influence proximal departments.

Our results have several implications for policymakers who are considering expansion of the role of for-profit hospitals in France. First, while for-profit hospitals have higher overall admission rates for the elective procedures we examined, the sectors appear to complement one another: where there are relatively lower rates of admission to not-for-profit sector hospitals, the for-profit sector has higher rates of admission. However, our study suggests that such complementarity might not hold for non-elective procedures, like hip fracture. Further, that the substantial geographic variation in admission rates remains explained by the hospital-type-specific bed supply, and that hospital-type-specific rates are explained in part by income disparity, suggests that the substitution is not perfect from a social welfare standpoint. Indeed, the two sectors may target different markets, with the not-for-profit hospitals providing care to the less wealthy and for-profit hospitals to the wealthy or those with supplemental insurance. Our analysis also suggests that for-profit hospitals may be more efficient at the level of the admission, in that they have shorter lengths-of-stay and, although having fewer surgical beds per capita, they provided about twice as many of these procedures when compared to not-for-profit hospitals. This may be a result of for-profit hospitals' focus on elective procedures[60] and much longer experience with a DRG-type of reimbursement mechanism, which may have given them a competitive 'first-mover advantage'[114] over not-for-profit hospitals as they now grapple with new forms of reimbursement. However, it also appears that for-profit hospitals provide considerably more procedures and diagnose patients with more conditions per admission than do not-for-profit hospitals, which, to the degree the procedures or admissions are inappropriate, may suggest that for-profit hospitals are inefficient at the level of the population.

Our study has several limitations. First, in the absence of clinical data, we were not able to determine whether the admissions that we examined were warranted. Studies in North America suggest that a relatively high proportion of hip and knee replacement surgery is neither wanted nor needed by patients.[17,28] Second, we could not examine outcomes; those living in departments with higher rates of surgery may or may not have better health outcomes than those who do not. Third, we examined only three procedures; findings may not hold for other elective or non-elective procedures. Finally, for-profit and not-for-profit hospitals might target different patient populations; however, to the extent that we could, we incorporated such patient differences into the analysis. Nonetheless, further information on patient characteristics might improve the performance of our models.

Despite these limitations, our study demonstrates a substantial degree of geographic variation in a country with compulsory health insurance and suggests that volume-based incentives may encourage supplier-induced demand, particularly in the for-profit hospital sector where overall rates of the elective surgeries we examined were so much higher. While our study also suggests that national oversight might encourage for-profit and not-for-profit hospitals to work in a complementary fashion to provide healthcare services, policymakers might be concerned that overall rates of admission might increase should competition - or the proportion of for-profit supply - be further accelerated; any cost-savings generated by more competition might be offset by unnecessary overuse of care, stimulated by providing financial incentives for elective admissions. Finally, our study supports the notion that healthcare practices vary by geography, and that, when it comes to use of medical services, geography – even on a global scale – appears to be destiny.

Chapter 2 appendix: example of bed reassignment

In 2009 and 2010, hospitals in the Ain department (department 01) used 349 surgical beds to provide 22,287 bed days of care for 2,293 patients aged 45 – 99 who obtained one of the conditions we examined. Although 19,798 bed days of care were consumed by 2,044 patients who lived in Ain, the balance of patients lived in 20 different French departments; for example, 94 patients from the neighboring Jura department (department 39) consumed 843 bed days of care in Ain hospitals getting these procedures. Those 843 bed days represented 3.13% of all 26,940 bed days of care for these conditions that were provided to patients who lived in Jura, a department with 238 surgical beds. Therefore, we reallocated 7.4 surgical beds from Ain to Jura for the purposes of determining bed supply for Jura patients. However, 1,290 patients who lived in Ain obtained procedures outside of Ain, consuming a total of 22,913 bed days of care, 13,141 of which were obtained in Rhône (department 69). Using its 3,121 surgical beds, Rhône hospitals provided 167,484 bed days of care for 4,954 of these procedures in 2009-2010. Therefore, we reallocated 7.8% of these beds, or 244.88 surgical beds from Rhône to Ain. After allocation from and to other French departments, we calculated that Ain had an adjusted supply of 673 surgical beds, while Jura had an adjusted supply of 318 surgical beds, and Rhone had an adjusted supply of 2,288 surgical beds.

Chapter 3: Examination of differences in resource utilization, patient characteristics, and coding practices in the for-profit and not-for-profit hospital sectors: more evidence of supplier-induced-demand in the for-profit sector: *Characteristics and patterns of elective admissions to for-profit and not-for-profit hospitals in France in 2009 and 2010*

Second revision under review at Social Science and Medicine as: Weeks WB, Jardin M, Paraponaris A. Characteristics and patterns of elective admissions to for-profit and not-for-profit hospitals in France in 2009 and 2010.

Executive summary

In the mid 2000s, in an effort to increase competition among hospitals in France – and thereby reduce per-admission hospital care costs –French policymakers implemented a prospective payment system and created incentives to promote use of for-profit hospitals. But such policies might incentivize 'upcoding' to higher-reimbursed procedures or, alternatively overuse of preference-sensitive elective procedures, captured by greater proportions of lower-reimbursed procedures; either of these market responses might offset anticipated cost savings. To explore either possibility, we sought to examine the relative use and costs of admissions for ten common preference-sensitive elective surgical procedures to not-for profit and for-profit hospitals in 2009 and 2010. For each reason for admission, we compared for-profit and not-for-profit hospitalization characteristics and mean per-admission reimbursement; further, we examined relative rates of lower- and higher-reimbursed procedures in for-profit and not-for-profit hospitals. We found that, particularly given their relatively small number of beds, for-profit hospitals capture a large portion of market for the elective surgeries we examined. Our findings suggest that for-profit hospitals in France provide more efficient care – with shorter lengths of stay and lower reimbursements per admission, a finding that is substantiated after adjustment for patient demographics, hospital characteristics, and patterns of admission to different reimbursement categories. We found some evidence of coding inconsistencies across for-profit and not-for-profit hospitals. While French for-profit hospitals appear to provide more efficient care than French not-for-profit hospitals, we found some evidence of supplier-induced demand in the for-profit sector. Future work should examine of changes in relative use and billing practices of for-profit and not-for-profit hospitals for elective surgeries in France, whether there are hospital-sector specific differences in the degree to which these elective surgeries are warranted, and whether admissions to for-profit and not-for-profit hospitals in France have different outcomes.

Introduction

The French healthcare system consists of a mixture of for-profit hospitals (operated by individuals and corporations) and not-for-profit hospitals (operated by the state or by not-for-profit organizations). French citizens may use any hospital that they want, with services funded by the compulsory national healthcare insurance scheme. For-profit hospitals account for about 15% of all inpatient beds [115] and focus on providing elective surgical care, [60] but planning for all hospitals – both for-profit and not-for-profit – is regulated by the central government in concert with regional health agencies.

Policymakers are using two methods to make the French hospital system more market oriented. First, since 2008, all not-for-profit hospitals have been fully subject to reimbursement through a prospective payment system that consists of a DRG-type payment schedule that is adjusted based on length of stay, specific activities that take place during the hospitalization, use of expensive drugs and medical devices, and the region in which the hospital is located.[60] While for-profit hospitals have been subject to prospective payment in France for longer, this transition toward a universally applied payment system is considered a step toward a market-based system based on yardstick competition.[109] Second, the 2009 Hôpital, Patients, Santé et Territoires Act provides incentives for greater use of for-profit hospitals by introducing the possibility that they might perform public service duties by contract, especially those usually performed by not-for-profit hospitals and suspected to be expensive, such as teaching, research, and emergency care. This Act is anticipated to increase competition between for-profit and not-for-profit hospitals for such services.

While increased competition is hoped to help contain healthcare costs, it might result in unintended consequences that accelerate them. Two US studies have found no differences in pricing behavior between not-for-profit and for-profit hospitals, [116,117] but another found that for-profit hospitals are more likely than not-for-profit hospitals to engage in 'upcoding' of inpatient surgical procedures into higher-reimbursed procedure codes in order to maximize revenues. [118] We were concerned that increased competition might lead to greater use of elective surgical interventions for preference sensitive conditions (where multiple treatment options generally include conservative management as well as surgical interventions); such conditions are marked by physician uncertainty as to care management, [58,78] can be subject to physician influence, [17] and can lead to inefficient healthcare delivery and waste.[86] Overuse might be revealed in greater use of lower-reimbursed procedure codes.

To explore the roles of for-profit and not-for-profit hospitals in providing elective surgical care in France, we examined how frequently for-profit and not-for profit hospitals are used for common preference-sensitive elective surgeries in France and whether patient characteristics, hospitalization characteristics, and use of high or low reimbursement codes for such elective surgeries differed in for-profit and not-for-profit hospitals.

Methods

Data sources, sample definition, and variables

We obtained data on all discharges from for-profit and not-for-profit French hospitals in 2009 and 2010 from the Agence Technique de l'Information sur l'Hospitalisation (ATIH).[72] These included a unique hospitalization number, a unique patient anonymous identifier, hospitalization characteristics (the location and type of hospital (not-for-profit or for-profit), and length of stay), and patient characteristics (age, gender, procedure codes, primary and secondary diagnostic codes, number of diagnoses, and the DRG-like Groupe Homogène des Malades (GHM) on which reimbursement is based). Following an established methodology,[82] we examined two categories of hospital: for-profit and not-for-profit (which included public sector and private not-for-profit hospitals). We chose this method because this differentiation determines reimbursement, which is substantially differently for performing the same procedure: in particular, most physician compensation is embedded in reimbursement provided to not-for-profit hospitals, but in for-profit settings, the physician component of reimbursement is separately identified. We obtained GHM-specific mean per-admission reimbursement rates for admissions to for-profit and not-for-profit hospitals in 2009 and 2010 from ATIH; these reimbursement rates provide a 'standardized' reimbursement rate for all French hospitals that reflects different utilization and practice patterns without being confounded by different wage rates and can therefore be used for national comparisons. We limited our analysis to hospitals in and patients from the 21 regions in mainland France (excluding Corsica).

We examined admissions for ten elective surgical procedures that treat preference-sensitive conditions that show geographic variation in the United States[11,58,96] and for which adequate reimbursement data were available. Admissions for these procedures were defined by the French system that classifies medical interventions,[74] ICD-10 codes, and surgical procedure codes. For tonsillectomy, we limited our analysis to ages 0-17 as older age groups used different procedure codes; for the other procedures, we examined all adult patients aged 18-99. For each of these reasons for admission, there were at least two procedure categories that reflect case difficulty and differed in reimbursement. The admissions that we studied, the CCAM and ICD-10 definitions that we used, and the identification and number of the procedure codes that we examined are shown in **Table 1**, on the following page.

Table 1ure
of procedures in
each reimbursement category.

Reason for admission	CCAM and ICD10 definitions	Included procedure codes in order of increasing cost (number of procedures) [120] [120]
Tonsillectomy in patients aged 0-17	FAFA001-FAFA015 Diagnoses included: otitis media (H65-66 series), chronic rhinitis (J31) or tonsillitis and tonsil hyperplasia (J35) Diagnoses excluded: No cancer (C or D codes)	03C14J (71,318) 03C101 (64,437) 03C121 (8,453)
Percutaneous Coronary Interventions (PCI) without MI	DDAF001 – DDAF010	05K061 (89,543) 05K062 (20,044) 05K063 (3,111)
Cholecystectomy (non acute)	HMFA001-008, HMFC001-005	07C141 (97,009) 07C142 (11,726)
Total Hysterectomy for non-malignancies	JKFA002, JKFA004-007, JKFA013, JKFA015, JKFA018, JKFA020, JKFA021, JKFA023, JKFA025, JKFA026, JKFA027, JKFA028, JKFC003, JKFC005 Diagnoses excluded: No cancer (C or D codes)	13C031 (59,378) 13C032 (8,235)
Carotid endarterectomy (CEA)	EBFA002-EBFA003, EBFA005-EBFA006, EBFA008-EBFA010, EBFA012-017	01C061 (17,125) 01C062 (6,234)
Primary hip replacement	NEKA001-022	08C481 (90,566) 08C482 (48,695) 08C483 (8,653)
Primary knee replacement	NFKA001-009	08C241 (64,227) 08C242 (44,453) 08C243 (5,594)
Transurethral Resection of the Prostate (TURP)	JGFA014-JGFA016	12C041 (46,491) 12C042 (25,786) 12C043 (8,368)
Radical prostatectomy	JGFA006, JGFA011	12C111 (11,782) 12C112 (3,324)
Spine surgery	LFCA001-LFCA005, LFDA001-014, LFFA001-014, LFMA001, LFPA001-003 Diagnoses excluded: no cancer (C or D series) no ongoing infections (I series), and no traumas (S series) Diagnoses included: Spondylosis (M47 series), Nerve root compression (M50 and G55 series), Disc disease (M51 series), Neuritis and pain (M54 series), Kyphosis and Scoliosis (M41 and M42 series), Spondylolysthesis & spondylolysis (M43 series), and Stenosis (M48 and M99 series).	08C271 (59,985) 08C272 (7,442) 08C273 (1,130)

Analytic methods

We examined the relative use of for-profit and not-for-profit hospitals for these procedures and compared characteristics of patients using (age, gender, and number of secondary diagnoses), and admissions to (length of stay and costs), either type of hospital. We used Student's T-test to compare continuous variables and the chi-square test to compare categorical variables. We examined several categories of costs, including clinical and direct costs (which include the staffing costs), structural costs (which includes a financing and a building component), physician reimbursement (which is very low for not-for-profit hospitals as the large majority of those costs are embedded in the clinical and direct cost categories), and the total cost of each admission.

Because for-profit and not-for-profit hospitals are paid different amounts for the same procedures, we also calculated a 'counterfactual' total cost of each admission. We did this by applying reimbursement rates for the other type of hospital (i.e., we applied not-for-profit reimbursement rates to for-profit admission codes). In effect, this gives an estimate of the mean cost per admission had the same mix of reimbursement codes occurred in the other setting.

To determine whether there were differences in the relative rates of lower- or higher-reimbursed procedure codes in the two types of hospitals, we calculated the relative risk that for-profit hospitals had a higher proportion of the lowest- and highest-reimbursement procedures for each type of admission. Finally, we performed an ordinary least squared regression analysis wherein the dependent variable was the natural log of the cost of the admission and the independent variables included patient age, patient gender, length of stay, number of secondary diagnoses, reimbursement code mix, and whether the admission was in a for-profit or not-for-profit hospital.

Human subjects approval

The Institutional Review Board at Dartmouth College approved this study (CPHS number 24085). In France, the study and its use of anonymized data was approved by the French National Union of Regional Health Observatories (Fédération Nationale des Observatoires Régionaux de la Santé) and the French IRB (Commission Nationale Informatique et Libertés, National Committee for Data Files and Individual Liberties) (CNIL authorization number 1180745).

Results

The number of admissions, mean patient age, mean length of stay, mean number of secondary diagnoses, and proportion of admissions that were male patients varied considerably across the 10 reasons for admission that we examined (**Table 2, top**).

Table 2nsillectomy, where patients were aged 0-17) to not-for-profit (NFP)
and for-profit (FP) hospitals in France in 2009 and 2010: the number of admissions; demographics of the hospitalized patients and their stays (mean age, length of stay, number of secondary diagnoses, and proportion of admissions that were male patients); and mean reimbursement values for these admissions (total clinical and direct reimbursement, structural reimbursement, physician reimbursement, total reimbursement per admission, and counterfactual total reimbursement per admission to NFP and FP hospitals).

	Tonsillectomy		**Percutaneous coronary intervention without myocardial infarction**		**Cholecystectomy**		**Hysterectomy**		**Carotid endarterectomy**		**Hip replacement**		**Knee replacement**		**Transurethral resection of the prostate**		**Radical prostatectomy**		**Spine surgery**	
	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP	NFP	FP
N	45,637	98,571	59,863	52,835	52,284	56,451	34,921	32,692	11,027	12,332	57,979	89,935	44,563	69,711	30,365	50,280	5,232	9,874	23,530	45,027
Demographics																				
Mean age	4.79 (0.015)	4.57 (0.010)	66.45 (0.048)	67.62 (0.049)	52.04 (0.74)	52.01* (0.68)	51.64 (0.062)	52.52 (0.065)	71.56 (0.094)	72.33 (0.085)	68.21 (0.050)	69.11 (0.037)	70.49 (0.044)	70.91 (0.034)	71.05 (0.054)	70.93* (0.042)	63.21 (0.86)	63.58* (0.63)	47.64 (0.092)	47.28* (0.065)
Length of stay	0.83 (0.004)	0.63 (0.003)	3.58 (0.012)	3.48 (0.011)	3.28 (0.010)	3.16 (0.007)	4.87 (0.015)	5.05 (0.010)	5.65 (0.028)	5.31 (0.024)	9.36 (0.015)	8.84 (0.010)	9.71 (0.17)	9.40 (0.012)	5.56 (0.020)	5.44 (0.013)	8.70 (0.37)	8.81* (0.24)	5.20 (0.020)	4.38 (0.011)
Number of secondary diagnoses	0.85 (0.004)	0.73 (0.002)	3.56 (0.013)	3.51* (0.013)	1.08 (0.008)	1.12* (0.006)	1.56 (0.010)	1.97 (0.010)	4.11 (0.037)	4.37 (0.035)	1.99 (0.011)	2.35 (0.008)	2.52 (0.016)	2.93 (0.010)	1.93 (0.013)	2.38 (0.011)	1.50 (0.38)	2.32 (0.24)	1.47 (0.013)	1.72 (0.008)
Percentage of patents who were male	56.2	56.9*	76.5	76.9*	28.3	1.12	0.0	0.0	71.9	71.8*	45.5	45.8*	34.3	36.6	100.0	100.0	100.0	100.0	56.8	57.6*
Reimbursement (€)																				
Total clinical and direct reimbursement	899 (1.14)	348 (0.37)	4732 (5.44)	3701 (2.84)	3109 (1.77)	1499 (0.74)	4089 (2.05)	2246 (1.16)	5834 (8.40)	3125 (3.62)	7406 (2.98)	5136 (0.01)	8717 (2.43)	6319 (1.02)	3339 (4.23)	1700 (1.71)	6961 (7.12)	3525 (3.58)	4348 (4.73)	1916 (1.25)
Structural reimbursement	34 (0.008)	38 (0.024)	100 (0.227)	91 (0.155)	84 (0.081)	94 (0.099)	118 (0.077)	151 (0.138)	173 (0.295)	148 (0.254)	217 (0.113)	295 (0.117)	220 (0.075)	289 (0.111)	146 (0.250)	165 (0.186)	196 (0.329)	238 (0.236)	149 (0.264)	132 (0.151)
Physician reimbursement	26 (0.017)	206 (0.089)	92 (0.025)	1561 (1.142)	59 (0.011)	673 (0.200)	18 (0.022)	728 (0.319)	153 (0.276)	1627 (1.491)	113 (0.068)	1239 (0.312)	168 (0.107)	1340 (0.307)	96 (0.056)	761 (0.423)	220 (0.420)	1558 (0.320)	35 (0.060)	730 (0.386)
Total reimbursement per admission	959 (1.16)	592 (0.47)	4923 (5.66)	5353 (4.10)	3251 (1.85)	2266 (1.02)	4225 (2.15)	3126 (1.55)	6160 (8.94)	4900 (5.35)	7736 (3.15)	6669 (1.30)	9105 (2.51)	7949 (1.33)	3581 (4.47)	2626 (2.30)	7377 (7.48)	5320 (3.84)	4532 (5.05)	2777 (1.72)
Counterfactual total reimbursement per admission	629 (0.68)	898 (0.79)	5325 (3.86)	4955 (5.95)	2282 (1.15)	3225 (1.64)	3102 (1.36)	4262 (2.45)	4906 (5.58)	6149 (8.38)	6651 (1.59)	7775 (2.62)	7896 (1.56)	9187 (2.14)	2629 (2.96)	3577 (3.48)	5269 (4.81)	7459 (6.04)	2791 (2.47)	4511 (3.51)

n values. P-values for all comparisons except those marked with an
asterisk were statistically significant at p<0.00056, the Bonferroni-adjusted statistically significant p-value given the multiple comparisons. P-values were calculated using the Student's T-test for all measures save proportion of males, where chi-square testing was used. All reimbursement differences were statistically significantly different at p<0.00001.

In most cases, when statistically significant differences were found, for-profit hospitals had shorter lengths of stay and reported a higher number of secondary diagnoses than not-for-profit hospitals. Differences in the ages or genders of patients admitted to different types of hospitals were more sporadic. For every type of admission examined, physician reimbursement was much higher to for-profit hospitals, offsetting the substantially higher clinical and direct reimbursement to not-for-profit hospitals (**Table 2, bottom**). With the exception of percutaneous coronary interventions without a myocardial infarction (PCI without MI), total reimbursement per admission to not-for-profit hospitals was considerably higher than total reimbursement per admission to for-profit hospitals. For half of the procedures examined (PCI without MI, hysterectomy, hip replacement, knee replacement, radical prostatectomy) analysis of counterfactual reimbursements suggests that not-for-profit hospitals would have been reimbursed modestly less than for-profit hospitals were actually reimbursed, had not-for-profit hospitals been paid at the for-profit reimbursement rates; these five procedures would have been reimbursed modestly more in for-profit hospitals than they actually were in not-for-profit hospitals, had for-profit hospitals been paid at the not-for-profit rates. This suggests that, for these five procedures, not-for-profit hospitals performed relatively fewer high-reimbursement procedures than for-profit hospitals. However, differences were less than 1% for all procedures except for radical prostatectomies (where for-profit hospitalization reimbursements would have been 1.1% higher than the not-for-profit reimbursements actually were) and for tonsillectomy (where for-profit hospitalization reimbursements would have been 6.4% lower than not-for-profit reimbursements actually were and not-for-profit hospitalizations would have been 6.3% more than for-profit hospitalizations actually were).

That finding is reiterated in **Table 3**, where not-for-profit and for-profit admission and reimbursement coding patterns are compared. Given the much larger number of hospital beds they have, not-for-profit hospitals capture a relatively small portion of the market for these procedures, ranging from 32% of admissions for tonsillectomy to 53% for PCI. We found statistically significant differences in coding practices across hospital types for all procedures examined save carotid endarterectomy and transurethral resection of the prostate. In aggregate, these differences suggest the possibility of overuse of admission for these procedures: the higher rate of lower reimbursed procedure codes for tonsillectomy suggest lower thresholds for admission; the lower rates of higher reimbursed procedure codes for the other elective procedures suggests the same.

Table 3. For 10 elective admissions to not-for-profit (NFP) and for-profit (FP) hospitals in France in 2009 and 2010: the total number of bursement categories; the relative proportion of NFP to FP
admissions for each of those measures; and the relative risks that FP hospitals have a higher proportion of lowest reimbursement or highest reimbursement procedures than NFP hospitals, with 95% confidence intervals.

	Tonsillectomy			Percutaneous coronary intervention without myocardial infarction			Cholecystectomy			Hysterectomy			Carotid endarterectomy		
	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All
	45,637	98,571	0.32	59,863	52,835	0.53	52,284	56,451	0.48	34,921	32,692	0.52	11,027	12,332	0.47
ursed	18,604	52,714	0.26	48,031	41,512	0.54	46,104	50,905	0.48	31,145	28,233	0.52	8,056	9,069	0.47
ursed	23,906	40,531	0.37	10,106	9,938	0.50									
ursed	3,127	5,326	0.37	1,726	1,385	0.55	6,180	5,546	0.53	3,776	4,459	0.46	2,971	3,263	0.48
		95% CI			95% CI			95% CI			95% CI			95% CI	
itals	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound
owest dures	1.312	1.283	1.342	0.979	0.951	1.008	1.023	0.984	1.063	0.968	0.925	1.014	1.007	0.950	1.067
ghest dures	0.789	0.753	0.837	0.909	0.846	0.977	0.831	0.800	0.864	1.261	1.204	1.321	0.982	0.927	1.041

	Hip replacement			Knee replacement			Transurethral resection of the prostate			Radical prostatectomy			Spine surgery		
	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All	NFP	FP	NFP: All
	57,979	89,935	0.39	44,563	69,711	0.39	30,365	50,280	0.38	5,232	9,874	0.35	23,530	45,027	0.34
ursed	36,642	53,924	0.40	27,183	37,044	0.42	17,423	29,068	0.37	4,274	7,508	0.36	20,387	39,598	0.34
ursed	18,151	30,544	0.37	15,595	28,858	0.35	9,794	15,992	0.38				2,736	4,706	0.37
ursed	3,186	5,467	0.37	1,785	3,809	0.32	3,148	5,220	0.38	958	2,366	0.29	407	723	0.36
		95% CI			95% CI			95% CI			95% CI			95% CI	
itals	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound	RR	Lower bound	Upper bound
owest dures	0.949	0.929	0.969	0.871	0.850	0.892	1.008	0.979	1.037	0.931	0.856	1.012	1.015	0.968	1.064
ghest dures	1.106	1.058	1.157	1.364	1.288	1.445	1.001	0.959	1.049	1.309	1.203	1.423	0.899	0.855	0.945

Our regression analysis indicates that, after adjustment for patient demographics and hospital stay characteristics, admission to a for-profit hospital was associated with statistically significantly lower reimbursement rates for all elective procedures examined save PCI without MI, where admission to a for-profit hospital was associated with reimbursements that were about 10% higher (**Table 4, on the following page**). For the other procedures, mean per-admission reimbursement rates ranged form 13% to 35% lower when a for-profit hospital was used. Adjustment for the distribution of cases across reimbursement categories did not markedly change results.

Table 4. For 10 elective admissions to not-for-profit (NFP) and for-profit (FP) hospitals in France in 2009 and 2010, results of the regression analyses in which the dependent variable was the log normalized total reimbursement for admission and the independent variables included whether admission was to an NFP or FP hospital as well as patient age, gender, length of stay, and number of secondary diagnoses.

	Exponentiated coefficient for admission to a FP hospital (interpreted as the ratio of total FP hospital reimbursements to total NFP hospital reimbursements)	
	Without *adjustment for distribution of reimbursement categories*	***With*** *adjustment for distribution of reimbursement categories*
Tonsillectomy	64.8%	65.8%
Percutaneous coronary intervention without myocardial infarction	110.2%	109.7%
Cholecystectomy	69.9%	70.3%
Hysterectomy	73.4%	73.4%
Carotid endarterectomy	79.8%	80.0%
Hip replacement	86.2%	86.1%
Knee replacement	87.2%	86.7%
Transurethral resection of the prostate	72.9%	73.6%
Radical prostatectomy	71.5%	71.4%
Spine surgery	61.8%	61.8%

Note: presented are the exponentiated coefficients for admission to a FP hospital obtained from two regression models that included all of the above variables, but also did not (without adjustment) and did (with adjustment) adjust for the distribution of reimbursement categories. The exponentiated value can be interpreted as the ratio of total reimbursements for a particular type of admission that were incurred for FP hospital admissions to those incurred for NFP hospital admissions after adjustment for the other variables. Only for admissions for percutaneous coronary interventions without myocardial infarction did FP hospitals have higher total costs, after adjustment. Adjustment for the distribution of reimbursement categories did not markedly change results. All values were statistically significant at $p<0.0001$.

Conclusions

We examined use of and reimbursement for admissions for 10 common elective procedures to for-profit and not-for-profit hospitals in France in 2009 and 2010. We found that relative use of, spending on, and potential savings from admissions to for-profit hospitals varied considerably depending on the reason for admission. Almost invariably, for-profit hospitals had shorter lengths-of-stay than not-for-profit hospitals. We also found that reimbursement for admissions to for-profit hospitals was almost invariably lower than for admissions to not-for-profit hospitals and that virtually none of these lower reimbursement rates were attributable to different patterns of admission to higher or lower reimbursement categories.

That for-profit hospitals had lower mean total reimbursements for 9 out of 10 of the procedures examined can be easily explained: these are the first years of implementation of the new reimbursement system in not-for-profit hospitals in France and reimbursement rates were set to reflect preexisting costs of those hospitals. One might anticipate that differences would lessen over time. Evidence of greater efficiency in for-profit hospitals might be explained, in part, by for-profit hospitals' lack of a teaching mission. Alternatively, for-profit hospitals' much longer experience with a DRG-type of reimbursement mechanism may have given them a competitive 'first-mover advantage'[114] over not-for-profit hospitals that now grapple with new forms of reimbursement. Our finding that for-profit hospitals diagnose patients with more conditions per admission than do not-for-profit hospitals suggests the possibility of cultural coding patterns that may not be associated with true illness burden, a finding that has been shown when comparing different regions in the United States.[19]

The inconsistencies that we found in procedure coding practices warrant further investigation, particularly in light of the fact that admissions to for-profit hospitals had both more diagnoses and shorter lengths of stay. Our findings could suggest overuse of for-profit hospitals for tonsillectomy, hysterectomy, radical prostatectomy, and hip and knee replacement; indeed, we have previously found some evidence of supplier-induced demand for hip and knee replacement among for-profit hospitals in France.[87] While these all combine to suggest some element of supplier-induced demand in the for-profit sector, that interpretation is predicated on the assumption that not-for-profit hospitals neither over-admit nor 'upcode'. Further investigation would require a determination of whether admissions for elective procedures – whether to for-profit or not-for-profit hospitals – were warranted. Studies in North America suggest that a relatively high proportion of some elective procedures is neither wanted nor needed by patients,[17,28] and regional variation in rates of preference sensitive elective conditions suggest longstanding, perhaps culturally determined patterns of overuse of hospitalization for these conditions.[11]

Our study has several limitations. First, a more complete comparison of the costs of for-profit and not-for-profit hospital sectors should focus on value and, therefore, include information on health outcomes.[119] We were not able to report on health outcomes or, as aforementioned, whether elective interventions that were completed were either wanted or needed. Second, we examined admissions for only 10 elective conditions; findings may not hold for other elective or non-elective procedures, as US studies indicate lack of consistency when comparing outcomes of not-for-profit and for-profit hospitals across different service offerings. [120,121] Third, we applied 'standardized' national average reimbursement to hospitalizations; application of individual hospitalization-specific reimbursement might have changed our results. Finally, we examined only two years of data soon after new reimbursement system was implemented in the not-for-profit sector; results may change with time.

Despite these limitations, our study confirms that French for-profit hospitals focus on providing elective surgery and that they appear do so more efficiently than not-for-profit hospitals; however, our results also suggest that policymakers should further explore the possibilities of up-coding and cream skimming in the for-profit sector. Future work should examine of changes in relative use of for-profit and not-for-profit hospitals for elective surgeries in France over time, geographic variation in the potential for supplier-induced demand across hospital sectors, whether there are hospital-sector specific differences in the degree to which these elective surgeries are warranted, and whether admissions to for-profit and not-for-profit hospitals in France have different outcomes.

Chapter 4: The magnitude of the problem for a supply-sensitive condition: the example of ambulatory care sensitive conditions: Rates of admission for ambulatory care sensitive conditions in France in 2009-2010: trends, geographic variation, costs, and an international comparison.

Provisionally accepted at European Journal of Health Economics as Weeks WB, Paraponaris A, Ventelou B. Rates of admission for ambulatory care sensitive conditions in France in 2009-2010: trends, geographic variation, costs, and an international comparison.

Executive summary

Admissions for ambulatory care sensitive conditions (ACSCs) are considered preventable and indicators of poor access to primary care. We wondered whether per-capita rates of admission for ACSCs in France demonstrated geographic variation, were changing, were related to ecological variables, or were comparable to those in other countries; further, we wanted to quantify the resources such admissions consume. Therefore, we calculated per-capita rates of admission for five categories (chronic, acute, vaccination preventable, alcohol related, and other) of ACSCs in 94 departments in mainland France in 2009 and 2010, examined measures and causes of geographic variation in those rates, computed the costs of those admissions, and compared rates of admission for ACSCs in France to those in several other countries. We found that the highest ACSC admission rates generally occurred in the young and the old, but rates varied across French regions. Over the two-year period, rates of most categories of ACSCs increased; higher ACSC admission rates were associated with lower incomes and a higher supply of hospital beds, but not with the supply of general practitioners. ACSC admissions cost 4.755 billion euros in 2009 and 5.066 billion euros in 2010; they consumed 7.86 and 8.74 million bed days of care, respectively. France had higher rates of ACSC admissions than most other countries examined. Because admissions for ACSCs are generally considered a failure of outpatient care, cost French taxpayers substantial monetary and hospital resources, and appear to occur more frequently in France than in other countries, policymakers should prioritize targeted efforts to reduce them.

Introduction

Geographic variation in use of healthcare resources has long been studied. In the US substantial geographic variation in utilization of services has been attributed to a fee-for-service based reimbursement system that incentivizes over-utilization, lack of use of informed patient decision-making, and lack of consensus around acceptable practices. [11,12,22,23] Explanation of geographic variation in a variety of healthcare services in other OECD countries has been inconsistent.[50] However, France has been found to demonstrate less geographic variation than the US or UK in per-capita utilization rates of common elective surgical procedures;[85] the lower variation was attributed, in part, to greater centralized planning of hospital capacity in France.

Often referred to as preventable admissions, hospitalizations for ambulatory care sensitive conditions (ACSCs) - which refer to conditions for which hospitalization is often preventable, particularly when access to primary care is adequate[73,91] - have been used as an indicator of access to and quality of primary care; . In the US, factors associated with higher rates of ACSC hospitalization include a low primary care physician supply, high unemployment rates, and a higher proportion of the population who are uninsured.[67,68] In Canada, evaluation of a limited sample of ACSCs found that higher community affluence and not living in a rural setting were associated with lower rates of admission for ACSCs.[36] An Australian study found 12-fold variation in admission rates for diabetes complications and similar variation in admission rates for asthma, influenza and pneumococcal pneumonia;[37] there, lower income, educational achievement, and self-rated health status were associated with higher rates of admission for ACSCs.[38] An evaluation of admission for several chronic ACSCs in four large Italian cities showed that poorer people, females, and older people in the sample were more likely to be admitted for ACSCs.[39] A largely observational study of patients aged 65 years old or older in 34 health districts in Madrid, Spain found that rates of preventable hospitalizations were higher for men, varied considerably, and were lower in central Madrid.[40] Wide variation in rates of admission for ACSCs was seen in Ireland, with lower rates being found in urban settings.[41] Gender and ethnicity have been associated with rates of admission for ACSCs in Singapore.[42] Overall rates of admission for ACSCs in Britain demonstrated substantial geographic variation, with lower income regions having higher rates; there, rates of admission for 'chronic' ACSCs have been stable over the last decade, but rates of admission for 'acute' and 'vaccination-preventable' ACSCs have increased,[43,44] causing management of ACSCs to become one of the top ten priorities for Britain's National Healthcare System.[46] Expansion of primary care access in Brazil reduced hospitalizations for ACSCs between 1999-2007.[45,122] When compared to unadjusted measures of rates of ACSCs in 26 cantons in Switzerland, researchers found that when they applied exclusion criteria or included of information on comorbidities and health status, adjusted rates of ACSCs declined; however, they found no relationship between access to primary care physicians and rates of ACSCs.[69]

Higher densities of specialists and generalists in Germany were associated with lower rates of hospitalization for a limited number of ACSCs, while unemployment, living in a rural setting, and the number of hospital beds per capita were associated with higher rates.[47] Finally, a study of three metropolitan regions in France found an association between lower supply of primary care physicians and higher rates of admission for a limited number of ACSCs.[48] An examination of geographic variation in rates of hospitalization for ACSCs across all of France, the costs of those hospitalizations, and a comparison of rates in France to those in other countries has not been conducted.

To address this knowledge gap, we used data on admissions to French hospitals to identify admissions for ACSCs, determine the costs of those admissions, calculate measures of geographic variation in those admissions, and discern whether a number of independent variables (including measures of local income, hospital bed capacity, and primary care physician supply) were associated with that variation.

Material and methods

Data sources, sample definition, and variables

Using a dataset of all discharges from public and private sector French hospitals in 2009 and 2010 obtained from the Agence Technique de l'Information sur l'Hospitalisation,[72] we used the primary ICD-10 coded diagnosis and a published ICD-10 code to ACSC crosswalk[73] to identify admissions for a variety ACSCs. We followed the British system of aggregating admissions for ACSCs to acute, chronic, and vaccination-preventable categories.[43] Because we were interested in admissions for other ACSCs defined by Freund et al.,[73] we also examined admissions for alcohol related ACSCs and for 'other' ACSCs. **Table 1** shows the ICD 10 definitions of categories of ACSCs that we studied.

Table 1: Categorization of admissions for ACSCs and ICD 10 codes used to identify them.

Admission for	Category of ACSC	ICD10 codes used to identify ACSCs[66]
Angina	Chronic	I20, I24.0, I24.8, I24.9
Asthma	Chronic	J45, J46
Congestive heart failure	Chronic	I11.0, I50, J81
Convulsion and epilepsy	Chronic	G40, G41, R56, O15
Chronic obstructive pulmonary disease	Chronic	J20, J41, J42, J43, J47
Diabetes complications	Chronic	E10.0–E10.8, E11.0–E11.8, E12.0–E12.8, E13.0–E13.8, E14.0–E14.8
Hypertension	Chronic	I10, I11.9
Iron-deficiency anemia	Chronic	D50.1, D50.8, D50.9
Cellulitis	Acute	L03, L04, L08.0, L08.8, L08.9, L88, L98.0
Dehydration	Acute	E86
Nonspecific gastroenteritis	Acute	K52.2, K52.8, K52.9
Kidney/urinary infection	Acute	N10, N11, N12, N13.6
Dental conditions	Acute	A69.0, K02, K03, K04, K05, K06, K08, K09.8, K09.9, K12, K13
Ear, nose and throat infections	Acute	H66, H67, J02, J03, J06, J31.2
Gangrene	Acute	R02
Nutritional deficiency	Acute	E40, E41, E42, E43, E55.0, E64.3
Pelvic inflammatory disease	Acute	N70, N73, N74
Perforated/bleeding ulcer	Acute	K25.0–K25.2, K25.4–K25.6, K26.0–K26.2, K26.4–K26.6, K27.0–K27.2, K27.4–K27.6, K280–282, K284–K286
Influenza and pneumonia	Vaccine	J10, J11, J13, J14, J15.3, J15.4, J15.7, J15.9, J16.8, J18.1, J18
Other vaccine preventable diseases	Vaccine	A35, A36, A37, A80, B05, B06, B16.1, B16.9, B18.0, B18.1, B26, G00.0, M01.4
Alcohol-related diseases	Alcohol	F10
Atrial fibrillation and flutter	Other	I47.1, I47.9, I49.5, I49.8, I49.9, R00.0, R002, R00.8
Constipation	Other	K59.0
Fractured proximal femur	Other	S72.0, S72.1, S72.2
Dyspepsia and other stomach function disorders	Other	K30, K21
Hypokalemia	Other	E87.6
Migraine/acute headache	Other	G43, G44.0, G44.1, G44.3, G44.4, G44.8, R51x

Analytic methods

Calculation of utilization rates. We used an indirect method[76] to retrospectively calculate age- and sex-adjusted department level rates of admission for ACSCs, using age- and sex-specific French national rates as standard rates. For 94 "departments" in mainland France, we calculated ACSC admission rates using this age- and sex-adjusted number of admissions as the numerator and the age- and sex-specific department-level population estimates from the French census[77] as the denominator. As France does not collect information on race, we could not adjust for geographic differences in race prevalence. Following Dartmouth Atlas methods[112] per-capita rates were calculated based on where people lived, as opposed to where they might have sought care. We calculated the annual number of admissions for ACSCs and the annual department level rate of admission for ACSCs per 1,000 people for 2009 and 2010.

Calculation of supply variables. To calculate department-specific supply of medical beds from the 2010 annual survey of French hospitals,[111] we first determined whether patients who were admitted for an ACSC lived in the same department that their admission occurred. Then, using Dartmouth Atlas methods that address the possibility that patients living in one region might seek care in another because of limited resources in their own region,[75] we used this information to reallocate beds to the region or department where the patient lived (for an example, see **Appendix**). Then, using reallocated medical hospital beds and general practitioners in the numerator and department-specific populations in the denominator, we calculated the per-capita supply of these healthcare resources at the department level. Similarly, we obtained information on the department-specific supply of general practitioners in 2010 from "Eco-Santé"[123] and used the same methods that we used to reassign beds to reallocate general practitioners.

Measures of geographic variation

For individual categories of ACSCs and all of them, together, we report age-sex adjusted national per capita rates and four established measures of geographic variation that allow for comparison across geographic settings and countries[57,58,78]:

1. The extreme ratio, which is calculated by dividing the highest geographic rate by the lowest and represents the range of absolute service utilization levels.

2. The interquartile ratio, which is calculated by dividing the rate at the 75th percentile by that at the 25th percentile and shows the relative variation in service utilization after removing the most extreme values.
3. The coefficient of variation, which is the ratio of the standard deviation to the mean and represents a normalized version of dispersion.
4. The systematic component of variation (SCV), which shows the non-random part of variation in rates by distinguishing the systematic variation between areas from the random variation within areas.[78] As is common practice, we multiplied SCV times 10.

For the first three measures examined, higher numbers all indicate greater levels of geographic variation; however, these measures do not specifically address the non-random aspects of geographic variation and they may be influenced by extreme values. The SCV measure addresses both of these issues: an SCV x 10 greater than 5 indicates high variation; that greater than 10, very high variation.

Comparison of rates across independent variables and regression analyses

We explored the relationship between admission rates for different categories of ACSCs, healthcare resources, and several departmental level independent variables that we obtained from the Association Nationale des Directeurs d'Action Sociale et de Santé des Conseils généraux,[113] including: population density, department level median income, inter-decile income ratio (the ratio of the mean highest decile income to the mean lowest decile income), and the proportion of older citizens who are enrolled in the ASPA subsidy program (a social program for aged people whose income is below a minimum level). We used spatial regression analytic techniques [79,80] to determine whether the Likelihood Ratio test for spatial lag dependence (which indicates that proximal departments influence the results of one another) was statistically significant at $p<0.05$. If it was, we used a first-order 'Queen-based contiguity matrix', wherein immediately adjacent departments are the basis for the spatial matrix, to conduct spatial regression analyses; if it was not, we performed ordinary least squared regression analysis. Using the appropriate regression techniques, we then examined relationships between the five categories of ACSC admission rates (and the total of these) as the dependent variable and independent variables and per-capita resource supply as independent variables. We used SPSS v21 (released 2012, Armonk, NY: IBM Corporation) for all comparisons save the spatial regression analyses, which used GeoDa v1.4.6 (released 2013, Tempe, AZ: Arizona State University).[124]

Calculation of costs of these admissions

France has for-profit and not-for-profit hospitals that are reimbursed differently based on a DRG-like Groupe Homogène des Malades (GHM) that is captured in the dataset that we used; the GHM reimbursement rates change yearly. As our dataset included the hospital identifier for each admission, we were able to determine which hospitals were for-profit and which were not-for-profit. We then applied the year-specific for-profit or not-for-profit (depending on in which type of hospital the admission occurred) GHM-specific mean total (including physician services) reimbursement rate that we obtained from the Agence Technique de l'Information sur l'Hospitalisation.[72] Then, we summed the overall national costs for admissions to for-profit and not-for-profit hospitals for different categories of ACSCs that occurred in mainland France in 2009 and 2010. Our dataset also included the length of stay for each admission, so we used length of stay data to determine the total number of bed days of care consumed by each category of ACSC in for-profit and not-for-profit hospitals for 2009 and 2010.

International comparisons

Prior studies of rates of admission for ACSCs have examined different age groups to calculate denominators and have used various definitions of what constitutes an ACSC to calculate numerators (**Table 2 on the following page**). To make international comparisons, we mimicked the definitions of ACSCs that were described in those studies and used the age groupings that they had used to calculate rates of externally defined ACSCs in France for 2009 and 2010 that were specific to the comparator.

Human subjects approval

In the United States, the Institutional Review Board (IRB) at Dartmouth College approved this study, determining that, because of the anonymized nature of the dataset, it was not human subjects research (CPHS approval number 24085). In France, the study and its use of anonymized data was approved by the French National Union of Regional Health Observatories (Fédération Nationale des Observatoires Régionaux de la Santé) and the French IRB (Commission Nationale Informatique et Libertés, National Committee for Data Files and Individual Liberties) (CNIL authorization number 1180745).

Table 2ountries,
ance in 2009 and
2010 (and across 2009-2010 for comparison to the UK).

Country of comparison	**United Kingdom**	**United States**	**Ireland**	**Germany**	**Brazil**	**France+**	**Canada**	**Switzer-land:**	**Spain^**	**Italy@**	**Australia~**	**Singapore**
Citation	[18]	[8, 10]	[16]	[24]	[21, 22]	[25]	[11]	[23]	[15]	[14]	[12]	[17]
Year of evaluation	**2002-13**	**Yearly**	**2005-08**	**2008**	**1999-2007**	**2004-08**	**2006-07**	**2005-06**	**2001-03**	**2000**	**1999-2000**	**1991-98**
Age group evaluated	**<100**	**65+**	**all**	**all**	**<80**	**20+**	**<75**	**<100**	**65+**	**20 - 64**	**all**	**all**
Age-sex adjusted rate/1000 (year for which calculated) **A=Acute** **C=Chronic** **V=Vaccine preventable**	**15.42** **(09/10)** **A: 6.79** **C: 6.92** **V: 1.71**	**66.6** **(2010)** **68.2** **(2009)**	**15.75** **(2008)**	**6.68** **(2008)**	**12.1** **(2008)**	**10.17** **(04-08)**	**3.51** **(06/07)**	**11.44’** **(05/06)**	**26.64’** **(01-03)**	**2.61** **(2000)**	**5.15** **(2000)**	**2.94** **(91-98)**
Comparable rates in France in 2009-10	18.72 (09/10) A: 4.93 C: 12.03 V: 1.76	49.40 (2010) 47.07 (2009)	19.01 (2010) 18.56 (2009)	9.75 (2010) 9.44 (2009)	5.51 (2010) 5.44 (2009)	11.92 (2010) 11.39 (2009)	7.58 (2010) 7.51 (2009)	19.01 (2010) 18.56 (2009)	36.25 (2010) 34.06 (2009)	4.97 (2010) 4.88 (2009)	4.46 (2010) 4.48 (2009)	7.66 (2010) 7.40 (2009)
Defined using ICD-10 codes by Freund et al in Annals of Family Practic1[7]												
Angina	Y	Y	Y	Y	Y		Y	Y		Y		
Asthma	Y	Y	Y		Y	Y	Y	Y		Y	Y	Y
Congestive heart failure	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y
Convulsion and epilepsy	Y	Y	Y				Y	Y				
Chronic obstructive pulmonary disease	Y	Y	Y		Y		Y	Y		Y		Y
Diabetes complications	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hypertension	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Iron-deficiency anemia	Y		Y					Y				
Cellulitis	Y	Y	Y			Y		Y				
Dehydration	Y	Y	Y					Y	Y			
Nonspecific gastroenteritis	Y	Y	Y					Y				
Kidney/urinary infection	Y	Y	Y			Y		Y	Y			
Dental conditions	Y		Y					Y				
Ear, nose and throat infections	Y		Y					Y	Y/			
Gangrene	Y		Y			Y		Y				
Nutritional deficiency	Y		Y					Y				
Pelvic inflammatory disease	Y		Y					Y	Y			
Perforated/bleeding ulcer	Y		Y			Y		Y	Y			
Influenza and pneumonia	Y	Y	Y			Y		Y	Y		Y	
Other vaccine preventable diseases	Y		Y			Y		Y			Y	
Alcohol-related diseases												
Atrial fibrillation and flutter												
Constipation												
Fractured proximal femur												
Dyspepsia and other stomach function disorders												
Hypokalemia						Y						
Migraine/acute headache												
					!	*			*#			

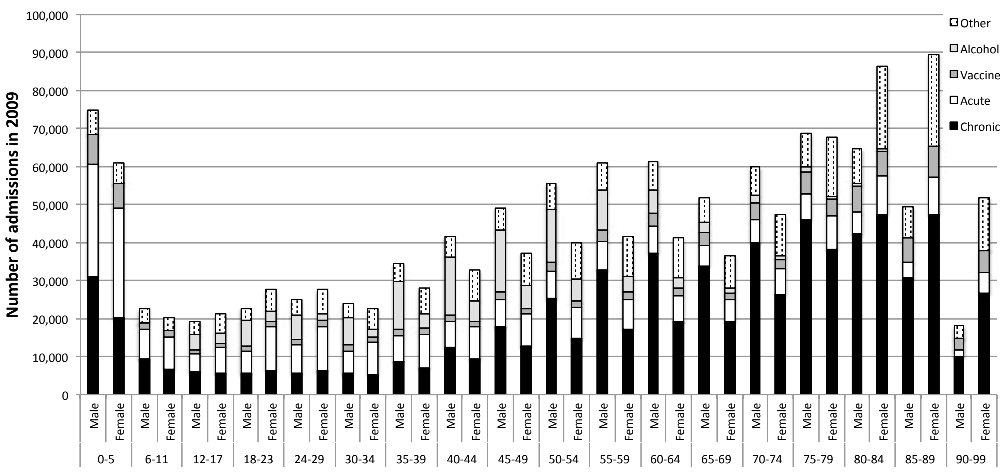
‘ Not age-sex adjusted.
~ Just Victoria was examined.
@ Just four cities were examined.
^ Just the environs of Madrid were examined.
+ Just three urban regions were examined.
: Data from four insurers were examined
/ Only some ENT admissions were examined.
*Admissions for appendicitis were also examined.
#Admissions for syphilis were also examined.
ed.

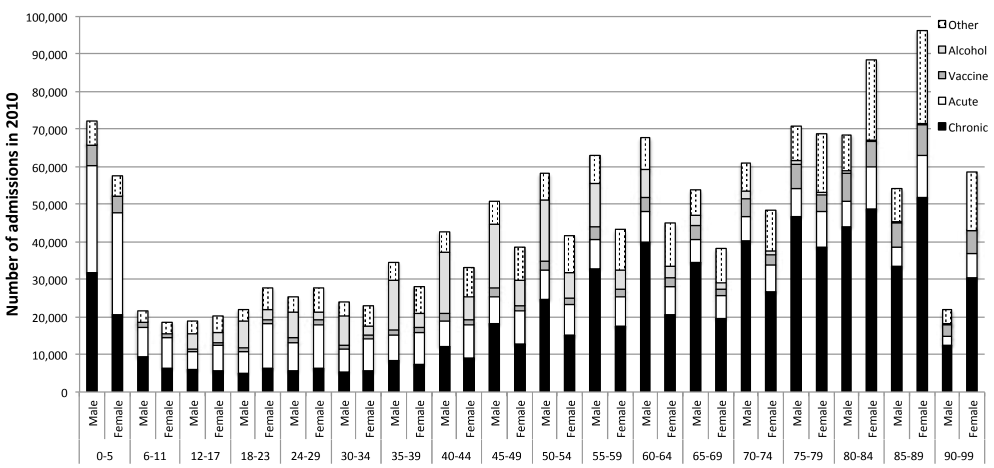
Results

Counts, rates, and measures of geographic variation

In 2009, hospitals in mainland France had 1,585,413 admissions for the ACSCs that we examined; in 2010, there were 1,635,047 such admissions, a 3.13% increase. Age group- and gender-specific counts of admissions for ACSCs in 2009 and 2010 are shown in **Figure 1a.**

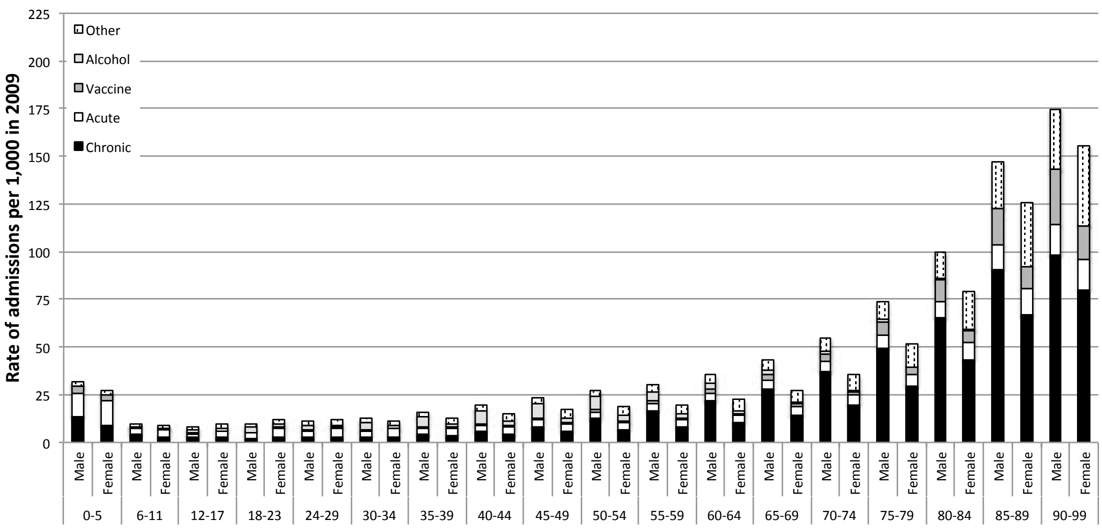
Figure 1a. For 2009 and 2010, by age category examined, number of admissions for chronic, acute, vaccine-preventable, alcohol-related, and other ACSCs in mainland France.

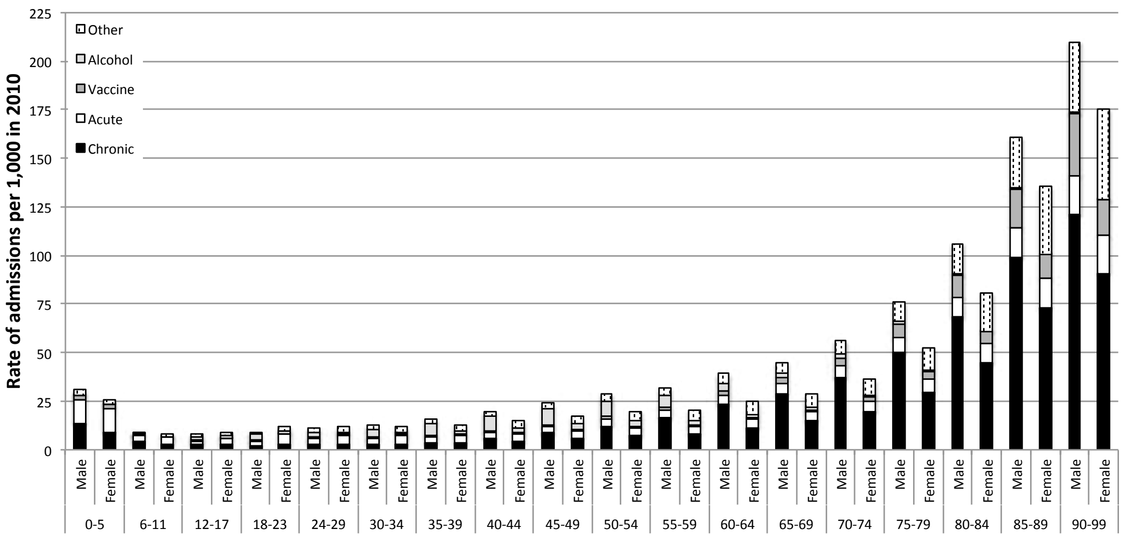




A U-shaped distribution across the lifespan, with higher numbers of admissions occurring in the very young and very old, is evident; further, with the exception of the 12-29 and the 80-99 age groups, counts for males were higher than those for females. Categories of ACSCs had their own patterns: for instance numbers of admissions for chronic ACSCs tended to increase with age while those for acute tended to decrease; admissions for vaccine-preventable ACSCs peaked at the extremes of life, while those for alcohol related ACSCs peaked in midlife and were more common among men. Per-capita rates of admission for ACSCs generally increased with increasing age (after the age 0-5 category); males had higher rates of admission for ACSCs except in the 6-29 year old age groups (**Figure 1b, below and on the top of the following page**).

Figure 1b. For 2009 and 2010, by age category examined, rate of admissions per 1,000 for chronic, acute, vaccine-preventable, alcohol-related, and other ACSCs in mainland France.





Admission rates for chronic and vaccine preventable ACSCs accounted for the large majority of all admissions for ACSCs beginning at about age 50. Across years, counts and rates of admissions for ACSCs were fairly stable in the younger age groups, but increased in the older age groups.

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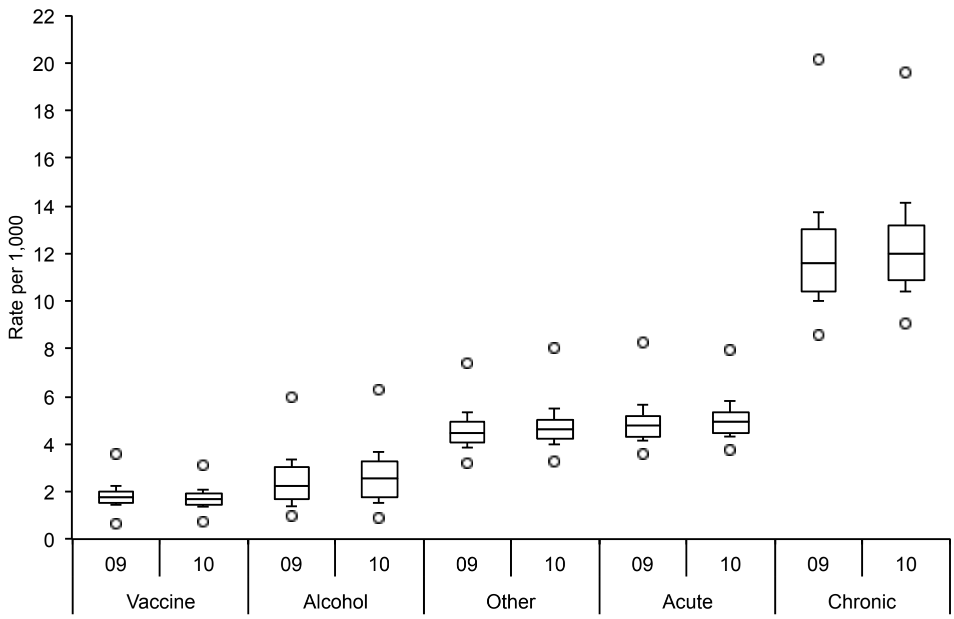
Figure 2 (on the following page) shows geographic variation in age- and sex-adjusted rates of admission for the five categories of ACSCs that we examined. With the exception of vaccine-preventable ACSCs, age- and sex-adjusted per-capita rates of all categories of ACSCs increased from 2009 to 2010. Over the two-year period, rates of admission for alcohol related ACSCs increased by 8.9%; other, by 3.1%; acute, by 3.7%, and chronic, by 3.1%. Interquartile ratios and coefficients of variation remained stable across years. Except for alcohol related ACSC admissions, the systematic component of variation was considered low (<5.0); it decreased for all types of ACSCs between 2009 and 2010.

Figure 2. Geographic variation in age-sex adjusted rates per 1,000 population of different categories of ACSCs for 94 departments in mainland France in 2009 and 2010.

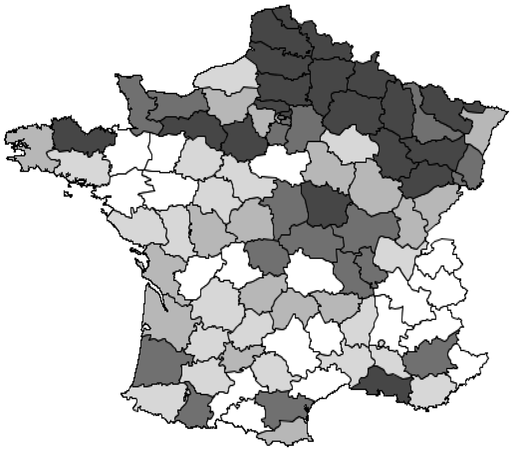


	Vaccine 09	Vaccine 10	Alcohol 09	Alcohol 10	Other 09	Other 10	Acute 09	Acute 10	Chronic 09	Chronic 10
National age-sex adjusted mean rate per 1,000	1.80	1.71	2.36	2.57	4.59	4.73	4.88	5.06	11.87	12.24
Lowest department rate per 1,000	0.61	0.74	0.99	0.92	3.17	3.29	3.59	3.71	8.60	9.04
Highest department rate per 1,000	3.56	3.11	5.99	6.28	7.41	8.00	8.22	7.93	20.18	19.57
Extreme ratio	5.82	4.20	6.07	6.81	2.34	2.43	2.29	2.14	2.35	2.16
Interquartile ratio	1.29	1.29	1.80	1.82	1.21	1.20	1.21	1.20	1.25	1.21
Coefficient of variation	0.22	0.21	0.40	0.41	0.16	0.16	0.16	0.15	0.16	0.15
Systematic component of variation (x10)	4.88	4.55	16.26	16.68	2.35	2.31	2.24	1.99	2.28	2.15

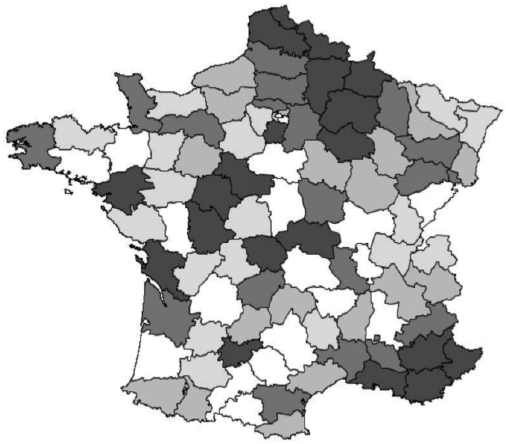
In **Figure 2**, the open circles show the rates of highest and lowest departments, the whiskers show plus and minus one standard deviation, ant the horizontal lines in the boxplot show 75th, 50th, and 25th percentiles. Below, for each category and year, the national age-sex adjusted average rate per 1,000 population, the standard deviation, the coefficient of variation, the rates for the departments with the lowest and highest rates, and systematic component of variation x 10 are provided.

On the following page, **Figure 3** shows maps that indicate higher rates of total ACSCs in the north of France. However, each ACSC category has a unique geographic pattern: for instance, northeast France had relatively higher rates of admission for chronic ACSCs, southeast France had relatively higher rates of admission for acute and other ACSCs, and northwest France had relatively higher rates of admission for alcohol related ACSCs.

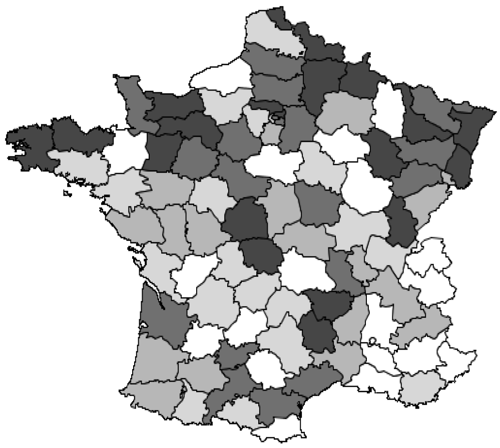
Figure 3. cates
lowest quintile of per capita rates; darkest indicates highest quintile of per capita rates.



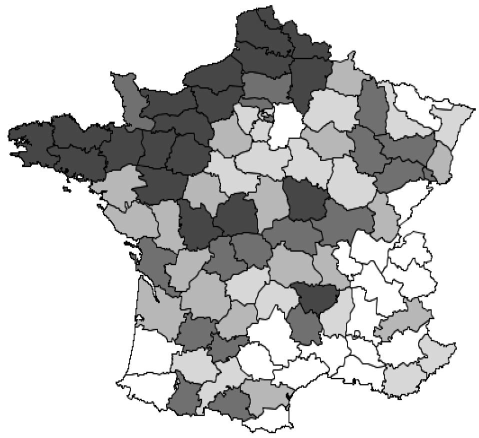
Chronic ACSCs



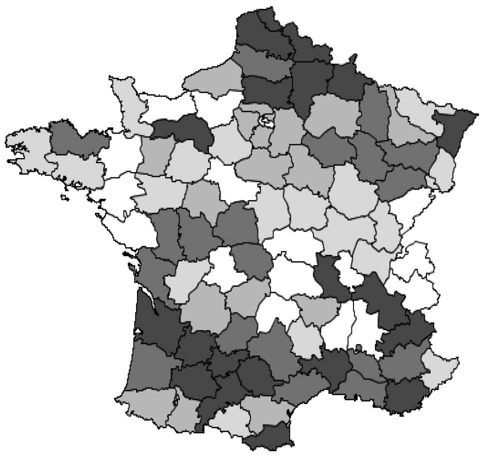
Acute ACSCs



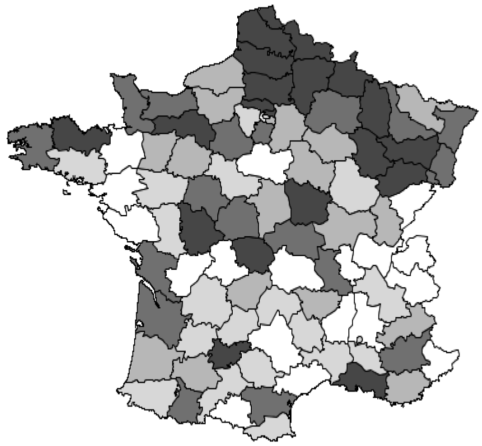
Vaccine preventable ACSCs



Alcohol related ACSCs



Other ACSCs

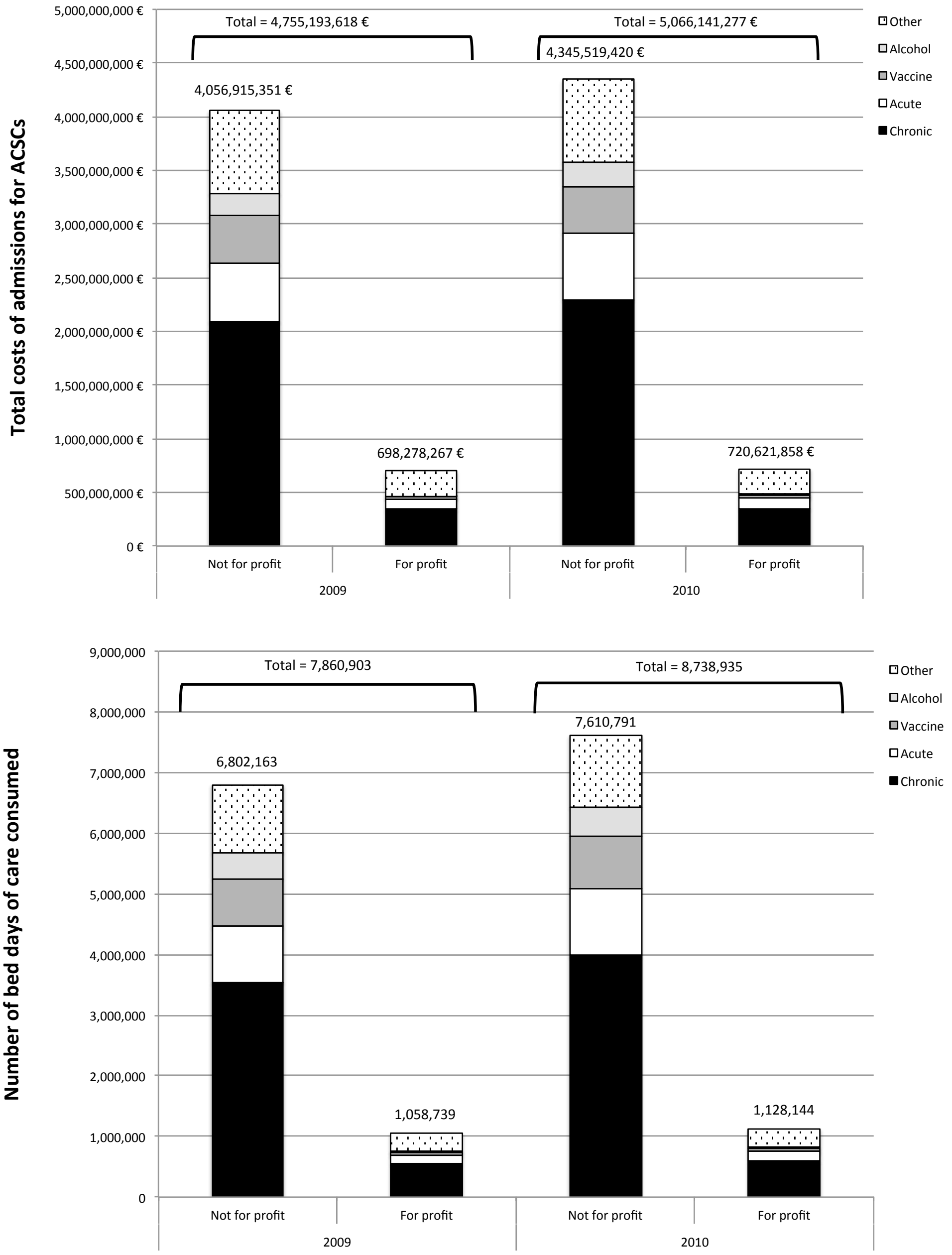


Total ACSCs

Costs and resource consumption

Admissions for the ACSCs that we examined cost 4.755 billion euros in 2009 and 5.066 billion euros in 2010 (**Figure 4**).

Figure 4. s of care consumed by (bottom) admissions to not-for-profit and for-profit hospitals in mainland France for chronic, acute, vaccine-preventable, alcohol-related, and other ACSCs.



The vast majority of those costs were due to admissions that occurred in not-for-profit hospitals; admissions to for-profit hospitals accounted for less than 15% of total costs each year. Regardless of the type of hospital examined, admissions for chronic ACSCs accounted for about 50% of total costs of all ACSC admissions; those for acute ACSCs accounted for about 14% of total costs of all ACSC admissions. When compared to for-profit hospitals' total costs, a higher proportion of not-for-profit hospitals' total costs for ACSCs were spent on alcohol related ACSCs (about 5% each year vs. 0.3% in 2009 and 1.4% in 2010), but a lower proportion was expended on admissions for the 'other' ACSCs that we examined (less than 20% vs. about 33% of total costs in both years). ACSC admissions consumed 7.86 million bed days of care in 2009 and 8.74 million bed days of care in 2010. Admissions for chronic ACSCs consumed about 50% of the total bed days of care consumed for all ACSCs admissions that we examined, regardless of the type of hospital examined. Patterns of consumption of bed days of care tracked those of costs, with the exception that admissions for alcohol-related ACSCs consumed relatively more bed days of care (6.4% and 6.3% of not-for-profit hospitals' total bed days of care and 1.7% and 2.0% of for profit hospitals' bed days of care in 2009 and 2010, respectively) than they did costs.

From year to year, costs for all examined ACSCs increased by 6.5% and overall bed days of care increased by 11.1%. Annual increases were highest for acute and alcohol-related ACSCs where costs increased by 14.3% and 14.0% and bed days of care increased by 18.0% and 11.3%, respectively.

Comparison of rates across independent variables and regression analyses

The Likelihood Ratio test indicated that spatial regression techniques should be used for analysis of chronic, alcohol related, other, and total ACSCs in 2009 and 2010 and for analysis of acute ACSCs in 2009; ordinary least squared regression techniques were used to analyze vaccine preventable ACSCs in 2009 and 2010 and acute ACSCs in 2010 (**Table 3**).

Table 3. Results of spatial regression analysis where the Likelihood Ratio Statistic of spatia dependence was statistically significant at p<0.05 and ordinary least squared regression analysis when it was not for 94 departments in mainland France. Bold text indicates p<0.001; otherwise p values are given in parentheses.

Year		Chronic	Acute	Vaccine preventable	Alcohol related	Other	Total
2009	Population density x 100,000	-25.066 (0.032)	**-18.960**	-0.596 (0.857)	-4.298 (0.497)	-6.376 (0.245)	-53.166 (0.009)
	Median income x 10,000	**-3.857**	-1.207 (0.020)	-0.568 (0.068)	-1.033 (0.084)	-1.031 (0.042)	**-7.930**
	Inter-decile income ratio	0.597 (0.006)	**0.460**	-0.014 (0.822)	-0.144 (0.218)	0.211 (0.039)	1.071 (0.006)
	Among those 65 and older, enrolled in ASPA	-0.429 (0.002)	-0.181 (0.005)	-0.050 (0.196)	0.043 (0.552)	-0.073 (0.243)	-0.702 (0.004)
	Reallocated medical beds per capita	**1.959**	0.360 (0.053)	0.306 (0.007)	0.632 (0.003)	-0.017 (0.926)	**3.221**
	Reallocated general practitioners per capita	-0.063 (0.930)	0.496 (0.153)	-0.071 (0.731)	-1.026 (0.011)	0.539 (0.115)	-0.143 (0.911)
	Spatial lag term	**0.371**	0.230 (0.052)	0.223 (0.075)	**0.517**	**0.400**	**0.353**
	Likelihood ratio statistic of spatial dependence	**12.325**	3.931 (0.047)	2.828 (0.093)	**21.462**	10.711 (0.001)	10.526 (0.001)
	Model adjusted r-square	0.471	0.273	0.101	0.411	0.238	0.454
2010	Population density x 100,000	-23.502 (0.044)	-19.712 (0.001)	-1.192 (0.695)	-2.560 (0.698)	-7.338 (0.205)	**-47.862**
	Median income x 10,000	**-3.872**	-1.215 (0.025)	-0.378 (0.184)	-1.429 (0.022)	-1.078 (0.044)	**-7.856**
	Inter-decile income ratio	0.702 (0.002)	**0.554**	-0.008 (0.891)	-0.119 (0.326)	0.226 (0.036)	1.138 (0.004)
	Among those 65 and older, enrolled in ASPA	**-0.492**	**-0.242**	-0.036 (0.311)	0.002 (0.979)	-0.093 (0.160)	-0.795 (0.001)
	Reallocated medical beds per capita	**1.734**	0.206 (0.286)	0.342 (0.001)	0.619 (0.005)	0.013 (0.944)	**2.851**
	Reallocated general practitioners per capita	0.423 (0.556)	0.696 (0.055)	-0.125 (0.512)	-0.895 (0.032)	0.698 (0.052)	0.741 (0.569)
	Spatial lag term	**0.350**	0.182 (0.135)	0.106 (0.420)	**0.557**	0.360 (0.001)	**0.393**
	Likelihood ratio statistic of spatial dependence	10.406 (0.001)	2.439 (0.118)	0.532 (0.466)	**26.289**	8.181 (0.004)	**12.802**
	Model adjusted r-square	0.456	0.251	0.119	0.458	0.209	0.451

Higher total per capita rates of admissions for the ACSCs we examined were associated with lower population density, lower department-level median incomes, higher inter-decile income ratios, lower proportions of older residents enrolled in ASPA, and higher numbers of medical beds per capita. For individual ACSC categories, lower incomes were associated with higher rates of chronic, acute, and 'other' ACSCs in both years, as well as with rates of alcohol related ACSC in 2010. Higher measures of income disparities were most strongly related to higher rates of chronic, acute, and 'other' ACSCs. A greater degree of enrollment of older citizens in ASPA was associated with lower rates of chronic and acute ACSCs. Higher numbers of medical beds per capita were associated higher rates of chronic, vaccine preventable, and alcohol related ACSCs in both years. However, higher numbers of general practitioners per capita were statistically associated only with lower rates of alcohol related ACSCs. Results were consistent across years.

International comparisons

While exact comparisons of rates were impossible in some cases (when, for instance, age- or sex-adjustment was not used or additional ACSCs beyond those that we examined were also included), France demonstrated higher rates of admission for ACSCs than all countries save the United States, Brazil, and Australia (but, in the case of Brazil, a number of relatively common admission types, including stroke and acute myocardial infarction, were included in the Brazilian definition of ACSCs; with Australia, comparisons were made to results from a decade previous) (**Table 2, above**). However, as can be seen when comparing French to UK rates, the composition of the ACSCs might differ across countries: in 2009-2010, France had lower rates of admission for acute ACSCs, but substantially higher rates of admission for chronic ACSCs and similar rates of admission for vaccine preventable ACSCs. Depending on the year and the country, France's rates of admission for comparably defined ACSCs in 2009 ranged from 12% (when compared to Ireland in 2005-2008) to 152% (when compared to Singapore in 1991-1998) higher than that seen in other countries. The table also demonstrates the effect of using different inclusion criteria and age groups for determination of per capita rates of admission for ACSCs: in France, in 2010, rates calculated using different definitions and age groups varied from 4.46 per 1,000 when using the Australian definition of ACSCs across the entire age spectrum to 49.40 per 1,000 when using the US definition of ACSC in the 65 year old and older age group.

Discussion

We examined five categories of admissions for ACSCs in mainland France in 2009 and 2010 and found that numbers of such admissions tend to peak at the extremes of life and per-capita rates of such admissions peak near the end of life. We found relatively low levels of systematic geographic variation (as measured by the SCV) at the departmental level in rates of admission overall and for all categories of admission for ACSCs except for those for alcohol related ACSCs; nonetheless, we did find that numbers and rates of specific categories of ACSCs are age-, gender-, and region-specific. For instance, admissions for alcohol related ACSCs peaked in midlife, were primarily seen in males, and were most prevalent in the northwest region of France; admissions for chronic ACSCs peaked at the end of life and were more prevalent in the northeast region of France.

The larger regional patterns that we saw in per-capita admissions for chronic, acute, and alcohol related ACSCs warrants some comment. While our regression models suggest that some of the explanation of the regional variation we saw in admission for chronic and acute ACSCs might be explained by low population density or higher per-capita bed supply, it is possible that regional cultural differences are in play, as well. Indeed, the Likelihood Ratio test for all categories of ACSCs that we examined except vaccine related ACSC suggests larger regional influences in practice patterns. In the US, researchers have demonstrated regional variation in physicians' propensity to diagnose,[19,125] test,[13,14] and intervene[13,15] that has been, in part, attributed to regional differences in the way physicians practice medicine. Further, as has been shown in the US, lack of consensus about best treatment options[11,23] might contribute to the regional variation that we saw. In France, future work exploring geographic variation in per-capita admission rates might specifically examine physicians' discretionary decision-making and test whether practice protocol implementation might reduce regional practice variation.

In 2010, the 1.635 million admissions for ACSCs cost French taxpayers about 5 billion euros a year, more than ½ of the French healthcare system deficit that year;[126] these admissions consumed about 8.74 million bed days of care – equivalent to one 255 bed hospital operating at full capacity in each of the 94 departments that we examined. As has been found elsewhere,[36,39,43,44,67,68] we found that lower income levels were related to higher rates of admission for ACSCs. Interestingly, we found that higher numbers of medical beds per capita were associated with higher admission rates for ACSCs, suggesting a form of supplier-induced demand phenomenon.[11] Finally, in contrast to an earlier study of several metropolitan areas in France[48] and a number of international studies,[45,47,67,68] we did not find a relationship between higher rates of admission for ACSCs and a lower per-capita supply of primary care physicians. Comparisons of rates of ACSCs in France to those in other countries suggests that France experiences higher rates than most other countries we examined; however, comparability in definitions of ACSCs and availability of data from the same time period tended to preclude exact comparisons.

Our findings suggest that substantial healthcare resources might be unleashed should France successfully reduce admissions for ACSCs. The magnitude of the potential cost and resource savings – representing 2.9% of the 175 billion euros that France spent on all healthcare and 6.3% of the 81.2 billion euros that France spent on hospital care in 2010[127] – suggests that policymakers should make efforts to reduce admissions for ACSCs in France and monitor progress in these efforts. But our results suggest that targeted efforts – attentive screening of admissions for alcohol related ACSCs in the northwest, for chronic ACSCs in the northeast, and for acute ACSCs in the southeast – may be wise. That we did not find a relationship between greater availability of general practitioners and lower rates of admission for ACSCs suggests that arbitrarily increasing the supply of general practitioners may not help reduce ACSC admission rates; rather, low incomes and a high availability of medical beds seem to be driving higher admission rates for most ACSCs.

Our study has several limitations. First, we did not have access to clinical data that could determine whether the admissions that we examined were warranted. Our inability to differentiate admissions that were and were not appropriate suggest that not all costs incurred associated with admissions for ACSCs could be saved; future work in this area might try to divine which ACSC admissions were truly preventable. Without intervention, it seems logical that, as populations grey and accumulate chronic diseases in developed countries, admissions for chronic and vaccine preventable ACSCs (which are concentrated at the extremes of life) are likely to increase. Second, we could not examine outcomes; it is unclear whether admission for ACSCs results in better health outcomes. However, it seems to be consensus that such admissions constitute a 'failure' of outpatient care that, in general, unnecessarily consumes expensive resources. Our findings suggest that such resource consumption is, indeed, quite expensive. Third, had we used a different geographic scale, we might have uncovered more variation or different relationships. For instance, an analysis of variation in diabetes treatment the Provence-Alpes-Côte d'Azur region that was performed at the 'canton' level showed higher extreme ratios[128] than we found for ACSCs at the department level. Further, the study of ACSC in three metropolitan areas in France[48] found a different relationship between primary care physician and ACSC rates than we found; this might be due, in part, to the different level of geographic analysis in the two studies. Finally, we were not able to correct for health status, or to use additional sources of data (like medication utilization) to identify other comorbid conditions, factors that might explained the admission rates that we found.[69]

Despite these limitations, policymakers should consider methods to reduce variation in – and overall admissions for – ACSCs. Seemingly, such efforts would have a high payoff. France's centralized planning and resource allocation process might help with the execution of strategies designed to reduce rates of ACSCs, such as development of consensus around best treatment patterns, identification of early ambulatory care interventions, and implementation of care pathways. In addition, international collaboration may identify new methods for reducing ACSCs in France and might facilitate equivalent cross-country comparisons, learning, and improvement.

Chapter 4 appendix: An example of bed reassignment

In 2009 and 2010, hospitals in the Ain department (department 01) used 581 medical beds to provide 14,399 hospitalizations for ACSCs. Although 12,968 admissions were for patients who lived in Ain, the balance of patients lived in 66 different French departments; for example, 437 admissions were fro patients from the neighboring Jura department (department 39). Those 437 bed days represented 3.1% of all 14,092 admissions for ACSCs that were provided by hospitals in Jura, a department with 549 medical beds. Therefore, we reallocated 17.02 medical beds from Ain to Jura for the purposes of determining bed supply for Jura patients. However, 12,140 admissions for patients who lived in Ain occurred in hospitals located outside of Ain, 6,683 of which were obtained in Rhône (department 69). Using its 3,759 medical beds, Rhône hospitals provided 90,073 hospitalizations for ACSCs in 2009-2010. Therefore, we reallocated 7.4% of these beds, or 278.9 surgical beds from Rhône to Ain. After allocation from and to other French departments, we calculated that Ain had an adjusted supply of 1,033 medical beds, while Jura had an adjusted supply of 614 medical beds, and Rhone had an adjusted supply of 3,053 surgical beds.

Conclusions and areas for future work

We examined geographic variation in rates of admission for preference-sensitive surgical procedures and ACSCs in France in 2008-2010. We found substantial geographic variation in both areas, although (with the exception of admissions for alcohol related conditions) measures of geographic variation were generally lower for ACSCs than for the preference-sensitive surgical procedures we examined. In comparison to other countries, with the exception of the US, France had somewhat higher rates of admissions for ACSCs; France had lower rates of admission than the US for most preference-sensitive surgical procedures, but similar measures of geographic variation to results from the US and in the UK. We found that ACSCs consume substantial resources in France, that most ACSCs occur in not-for-profit hospitals while most preference-sensitive surgical procedures occur in for-profit hospitals, that there is evidence of supplier induced demand in for-profit hospitals in France (but that the for-profit and the not-for-profit sectors seemingly complement one another in providing these surgical procedures), that for-profit hospitals appear to be more efficient in the provision of these surgical procedures (being less costly and consuming fewer bed days of care), but that there may be evidence of up-coding (to maximize revenues) and down-coding (which may represent overuse of services, in that potentially lower treatment thresholds for admission are used) in the for-profit hospital sector.

Our findings regarding ACSC admissions suggest that scarce resources might be better used if, in departments where ACSC admission rates are high, additional support of primary care and outpatient services were provided. Our findings regarding admissions for preference-sensitive surgical care suggests that for-profit hospitals may be providing unnecessary care: the provision of such care might offset any cost-savings generated through lower per-admission reimbursement rates seen in for-profit hospitals. Because of the recent changes in French policy that are designed to promote competition between for-profit and not-for profit, rates of admission for preference-sensitive care should be monitored over time.

While France's centralized planning for hospital capacity might help explain the lower per-capita rates of admission for preference-sensitive surgical care that we found, the recent incentives to promote competition may change how both for-profit and not-for-profit hospitals provide care. Monitoring rates of care provision in these two sectors may uncover sudden increases (or decreases) in rates of admission that might warrant interventions to reduce unnecessary care (or make care more available). Further, ongoing monitoring of admissions for ACSCs or preference-sensitive surgical care might identify departments that have inadequate access to primary care or treatment for particular disorders (such as alcohol problems in Normandy) or overuse of care for which providers are uncertain about the effectiveness of care (such as radical prostatectomy). Such monitoring might allow policymakers to intervene when abnormalities are uncovered.

Finally, particularly as more investigators in the EU examine geographic variation, ongoing international collaboration might help policymakers identify areas for improvement. Methods of care delivery that result in more effective use of outpatient care that minimizes admissions for ACSCs, for instance, might be found in a collaborating nation and imported to France to reduce costs of care associated with admissions for ACSC; similarly, where France is found to excel, comparatively, in care management, those care management techniques could be exported to collaborating countries.

Our work did not examine other areas where revelation of variation in provision of healthcare services might inform policymakers, such as the treatment of mental health conditions, the management of ambulatory care services, and even diagnostic patterns. Such work may uncover unwarranted variation and lead to informed interventions that will lead to more efficient use of healthcare resources in France.

Further, while our work included an analysis of ecological variables, we did not have individual or departmental level clinical or health status data that might have helped us determine whether admissions were warranted (for either ACSCs or preference sensitive surgical procedures) or whether the healthcare needs of different population groups might differ, after incorporating variables like low income and high participation in social programs, that we were able to include in our models.

Since Arrow identified opportunities for healthcare regulation in 1963,[1] healthcare has become more complex. As suggested by initial results of researchers who are geographic variation, ongoing of small-area analysis may help inform regulators and policymakers in their quest to most efficiently use scarce resources in the national provision of healthcare services.

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ABSTRACT:

For all of this work, we applied 'small-area variation' techniques to the study of geographic variations in hospitalization rates in France. We conducted four studies:

Study 1: Geographic variation in rates of common surgical procedures in France in 2008-2010 and comparison to the US and Britain. Here, we wanted to determine the degree to which rates of hospitalization for elective surgeries show geographic variation, how rates vary with ecological factors (including measures of income, income disparity, and healthcare resource availability), and how rates and measures of geographic variation compare to those in other countries. This study provided us a sense of the magnitude of the problem.

Study 2: Geographic variation in admissions for knee replacement, hip replacement, and hip fracture in France: evidence of supplier-induced demand in for-profit and not-for profit hospitals. Here, we wanted to explore whether there is evidence for supplier-induced demand associated with higher rates of admission for hip and knee replacement surgery (a subset of elective surgeries), overall, and within the for-profit and not-for-profit hospital sectors. This study constituted a special case, wherein we examined the roles of the for-profit and not-for-profit hospital sectors in France, explicitly searching for evidence of supplier induced demand in either sector.

Study 3: Characteristics and patterns of elective admissions to for-profit and not-for-profit hospitals in France in 2009 and 2010**.** Here, we wanted to determine whether there might be discrepancies in coding practices for elective surgeries between for-profit and not-for-profit hospitals, with the possibility that one sector or the other 'upcodes' to maximize revenues. Again, this work was examining the roles of the for-profit and not-for-profit hospital sectors, and was exploring the possibility of supplier induced demand in one sector or the other.

Study 4: Rates of admission for ambulatory care sensitive conditions in France in 2009-2010: trends, geographic variation, costs, and an international comparison. Here, we wanted to determine the degree to which hospitalization for ambulatory care sensitive conditions (where higher rates are generally associated with failure of outpatient care or reduced access to primary care physicians) show geographic variation, determine whether rates vary with ecological factors (including measures of income disparity, and healthcare resource availability), determine how rates compare to those in other countries, and calculate how much money admissions for ACSCs costs French taxpayers.

Comprendre les variations géographiques de taux d'hospitalisation: analyse économique des déterminants et implications en termes de politique publique

RESUME : Dans l'ensemble de la thèse, nous avons appliqué des techniques de 'mesure des variations spatiales' pour l'étude des variations géographiques de taux d'hospitalisation en France. La thèse est composée de 4 études :

Étude 1 : « Variation géographique des recours aux procédures chirurgicales en France en 2008-2010 et comparaison avec les États-Unis et la Grande-Bretagne ». Ici, nous voulions déterminer la mesure dans laquelle les taux d'hospitalisation pour les chirurgies électives sont susceptibles de varier d'une unité géographique à l'autre (le niveau retenu étant le département), comment ils varient en fonction de facteurs écologiques (les revenus des départements, la disparité des revenus et des ressources hospitalières offertes) et dans le cadre de comparaisons internationales. Ces premiers résultats nous permettent de souligner l'ampleur du phénomène.

Étude 2 : « Variation géographique des admissions pour les prothèses du genou, de la hanche et la fracture de la hanche en France : existence d'une demande induite dans le secteur des hôpitaux à but lucratif et dans les hôpitaux public et privés à but non-lucratif ». Ici, nous voulions explorer les preuves d'une demande induite par l'offre (au niveau global puis en fonction du secteur tarifaire) qui serait à l'origine de taux plus élevés d'admission pour la chirurgie de remplacement de la hanche et du genou (un sous-ensemble de chirurgies dites « électives »). Nous observons les effets sur la « demande induite » de l'articulation public/privé -très spécifique à la France.

Étude 3 : « Caractéristiques et tendances des admissions non urgentes des hôpitaux à but lucratif et sans but lucratif en France en 2009 et 2010 ». Ici, nous voulions déterminer s'il pourrait y avoir des divergences systématiques dans les pratiques relatives aux chirurgies électives entre les hôpitaux à but lucratif et les hôpitaux sans but lucratif (publics et privés à but non-lucratif), avec la possibilité que l'un ou l'autre secteur « surcode » les actes effectués pour exagérer la lourdeur médico-économique des séjours et, partant, maximiser les revenus. Ce travail donne un éclairage supplémentaire sur les rôles joués par les différents secteurs tarifaires et aide au diagnostic d'anomalies du fonctionnement d'un secteur ou d'un autre.

Étude 4 : « Taux d'admission pour des 'hospitalisations évitables par le système ambulatoire' (ACSC) en France en 2009-2010 : tendances, variation géographique, coûts et comparaison internationale ». Ici, nous voulions déterminer la mesure dans laquelle les « ACSC » existent en France (une liste d'actes hospitaliers pour lesquels des taux plus élevés sont généralement révélateurs d'une prise en charge insuffisante par la médecine de ville, du fait de problèmes d'accès ou de dimensionnement de l'offre de soins ambulatoires) ; en montrer la variation géographique et déterminer s'ils varient en fonction de facteurs écologiques (y.c., des mesures de la disparité des revenus et des ressources hospitalières offertes). Les mesures obtenues sont comparées aux relevés disponibles pour d'autres pays. L'impact financier pour l'Assurance-Maladie de ces recours évitables fait aussi l'objet d'une évaluation.