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The sorting effect in healthcare access: Those left behind

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Abstract

Many governments have sought to enhance patient choice in hospital by intensifying competitive pressure on hospital administrations that results in an improvement in efficiency, quality, and innovation. However, there is mixed evidence on whether patients travel past their local hospitals to seek better quality care and whether higher-income patients are those most sensitive to respond to competitive pressures. Using detailed data from 17 million inpatient stays admitted in France during 2019, this paper explores the attributes of hospital ownership as determinants of patients' choice for healthcare. We found that, in general, patients travel for their care, with just one-quarter of them going to the nearest hospital. In fact, the most vulnerable patients (i.e., those socio-economically deprived, and very aged) are mostly treated in local public hospitals with the lowest quality service level, and with large variability in quality as well, while those with less socio-economic deprivation seek care at higher-quality for-profit hospitals. Our counterfactual simulations show that admission to university hospitals attenuates existing inequalities. However, whether it delays the healthcare access sought by this population remains an open question.

Key words: Deprivation, Ageing, Inequality, Patient choice, Demand for healthcare, Rural areas, Quality, Distance, Empirical referral hospital

JEL: I11, I18, L1, L44, D12

1. Introduction

The determinant of patient choice of hospital is a topic that has been widely discussed in the access to care literature (Haynes, 2003 ; Chandra, 2016 ; Gutacker, 2016 ; Aggarwal, 2017). However, the patient choice may be more about a type of hospital than a particular facility. When patients choose a university hospital, their expectations in terms of quality or distance to travel are likely to differ from when they choose a local or private facility. It has been observed that clinically comparable patients do not always choose to go to the same healthcare facilities, which can lead to (health) care inequalities. Little is known about the factors regarding the patient's freedom of choice. This paper explores how hospital choice is related to hospital ownership, which depends on socioeconomic factors.

Often, state-owned hospitals are not enough to serve a population pool. This leads to for-profit and not-for-profit hospitals serving the private healthcare sector and providing government-funded healthcare services (European Commission, 2015). In the USA, since 2008, government-funded healthcare services have been outsourced to the for-profit sector in ambulatory surgical centers (ASCs). In the UK, a series of policy reforms in the 2000s allowed for-profit providers to treat patients funded by the National Health Service (NHS; Anell, 2015). Therefore, the patient may not choose the hospital but rather the hospital's ownership. Indeed, the hospital's ownership determines part of the patient expectation and experience (Perotin et al., 2013). Hospital ownership studies have found differences in service use and outcomes (Moscelli, 2018), and variations in the quality and types of care patients receive according to the characteristics of hospital ownership (Milcent, 2005). In the main publicly-funded health systems context, local public hospitals offer proximity but with a low quality and quantity of equipment. By contrast, university hospitals are highly equipped and have well-trained staff but remain concentrated in urban areas with a high population density. When it comes to for-profit hospitals, they are specialized providers on the market that do not often have intensive care facilities. They provide more individualized patient management. In France, non-profit hospitals are “in-between” state-owned hospitals and for-profit hospitals (Milcent, 2021). Therefore, the different types of hospital ownership imply different benefits for the patient. When it is assumed hospital

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ownership matters much more than the hospital itself, a different scientific perspective may emerge. This paper focuses on the drivers for the hospital ownership chosen in a publicly funded healthcare context. Then, using counterfactual simulations, we investigate the role of the deprivation gradient on the patient's choice for hospital ownership.

First, based on preliminary descriptive results, we show that nearby hospitals, (defined at the postcode level), treat only one-quarter of patients. By geographical area, we define a set of choices such that for each ownership, we select the closest hospital. The paper highlights that 82% of patients choose their admission hospital from this set of hospitals. Therefore, distance is related to hospital ownership. This paper then shows that healthcare quality is worse in local public hospitals. This first-order finding is nuanced by the second-order finding with a huge standard deviation compared to other hospital categories.

Second, the paper studies the determinants of patient hospital ownership choice. Healthcare quality and distance to the hospital are typical factors, but family, friends, relatives, and more generally, social networks may magnify any effect of distance. The empirical referral hospital is calculated from the most frequently accessed hospital. Belonging to a consortium is also considered part of the patient's choice of the healthcare facility. Therefore, we use the distance, the quality of care, the empirical referral hospital, and being part of the consortium as hospital attributes that influence the patient's choice of hospital ownership. Preliminary statistics show that patients at the top of the socio-economic deprivation gradient do not have access to the same hospital ownership as those in the bottom fourth (fifth) quintile. This bottom fourth is primarily admitted to a local public hospital (over 40%). Socio-economic deprivation and aging are used as individual attribute drivers contributing to patient sorting between hospital ownership.

Finally, the paper explores how differences in the patient choice of hospital ownership in healthcare, develop. Counterfactual simulations show that being treated in university public hospitals is not sensitive to the level of patient socio-economic deprivation. Increasing the distance or reducing the quality level drives patients to be treated in university hospitals, and in some ways, existing inequalities are attenuated.

The paper is structured as follows: Section 2 presents the literature and context; Section 3 describes the identification of the consumer choice model strategy; Section 4 describes the data and provides some preliminary statistics; And Section 5 has the results. Section 6 presents the sensitivity analysis, and Section 7 presents the conclusions.

2. Literature and context

2.1 The Literature

The empirical literature clearly shows the interplay between distance and quality (Aggarwal et al., 2017; Gutacker et al., 2016; Victoor et al., 2014). The patient's choice depends on the hospital's location, which itself depends on the market; the market being an indicator of the level of competition and consolidation. A pro-competition policy between healthcare facilities improves the quality of care and requires a certain number of healthcare institutions; a consolidation that allows economy of scale enhances the quality of learning-by-doing, and affects the distance to healthcare.

In healthcare, policymakers in several OECD countries have been increasingly keen to introduce or encourage competition among hospitals in an attempt to improve the quality of care to patients. The rationale is that if hospitals are paid a regulated price for each patient treated, competition will then be based solely on quality to attract patients, and, therefore will lead to greater efficiency of the healthcare system. Given all this, the quality of healthcare should be taken into consideration (Brekke et al., 2014 for review). Some authors have found that US hospitals with poorer-than-expected health outcomes attracted significantly fewer admissions (Luft et al., 1990; Hodgkin, 1996; Tay 2003).

Nevertheless, patient responsiveness to changes in quality is not well established. Patient demand could have a delayed response, and in fact may not always be sensitive to the hospital's quality. Additionally, providers' quality of output may differ from the perception of quality expected by the patient; quality may also be observed with other unknown factors that affect the anticipated demand of care, such as word of mouth, reputation among patients, or variants in patient-to-patient expectations.

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Other drivers may also impact this demand-responsiveness to hospital quality. Distance to a healthcare provider is one of the most important predictors of provider choice (Capps et al., 2003; Ho, 2006; Raval et al., 2017). Gowrisankaran et al. (2015) found that a five-minute increase in travel time to a hospital reduces demand by between 17 and 41 percent. Different factors may explain this relationship; the most typical is to interpret distance effects as due to transport costs.

Another explanation for distance effects is that distance is correlated with unobserved consumer preferences. Recent papers examine the impact of physician referral on the distance effect. For example, Beckert and Collyer (2017) found that distance elasticity decreased by over 50% after accounting for physician referrals in a population of UK patients choosing hospitals for elective surgeries. Raval and Rosenbaum (2021) focus on separating unobserved consumer preferences, which they called "home bias," from transport costs. According to them, patients' preferences depend on their friends, and their friends are more likely to live near them and choose nearby hospitals. This work adds to this literature by defining a proxy for the empirical referral hospital as the most frequently accessed hospital. This empirical referral hospital can be interpreted as the social proximity of hospital.

This push for quality through competition has often been simultaneous with a wave of consolidations in the healthcare market. This wave usually concerns both the insurer(s) and delivery sides of the market. The typical arguments supporting hospital consolidation are growth in efficiency and lower costs resulting from harnessing economies of scale and scope. Small hospitals often do not have the patient base to support specialist services such as oncology, cardiology, and orthopedic surgery. There are also arguments against hospital mergers, mainly around reducing competition that can lead to higher prices (Gaynor et al. 2013). According to Beaulieu et al. (2020), hospitals acquired by bigger groups are associated with a decline, albeit modest, in patient experience. Hanson et al. (2019) identified that changes in patient satisfaction are positively related to increases in insurance concentration and negatively associated with increases in hospital concentration. Hospital consolidation thus impacts the distance to care. Another fact is that for technical procedures, learning by doing is a preeminent quality factor. Small hospitals fail to reach the threshold for a commonly accepted level of quality, and the consequences of poor quality in healthcare can be dire.

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Therefore, distance to the hospital can be for the patient's good and the hospital's efficiency. This paper explores the deprivation gradient in accessing hospitals distinguishing small hospitals from university hospitals.

There is a concern that healthcare access is harder for the most vulnerable part of the population. While market mechanisms are being harnessed ever more broadly, limits to a more extensive use by the most vulnerable part of the population have become apparent, particularly in the potential trade-off between greater efficiency and equity objectives (Gaynor et al., 2016 ; Blöchliger, 2008). It has led to price increases for US consumers and mixed effects on quality across populations (Gowrisankaran et al., 2015). According to the Healthcare Cost Institute (HCCI), in 2019, almost 75% of US hospital markets are now designated as "highly concentrated." Elsewhere, the UK government undertook a wave of consolidation in English hospitals between 1997 and 2005. Angeli and Maarse (2012) have also studied the consolidation effect from the example in the Netherlands. In France, the public hospital consolidation law with the introduction of the regional hospital consortia – GHT¹, was implemented in 2016. In this paper, being part of a network of hospitals is assessed.

This paper contributes to the literature on patient choice but focuses on hospital ownership. It includes literature on for-profit providers in publicly funded health systems (Bardsley and Dixon, 2011; Chard et al., 2011; Milcent and Zbiri, 2021). The main determinants of patient choice for hospital ownership considered are quality and distance factors and two new drivers that are a proxy for being part of a network of hospitals and the empirical referral hospital. Then, the paper investigates what mechanisms cause heterogeneity in preference of healthcare facility ownership, and explores inequality in patient health care access.

2.2 The French institutional framework

For more than seven decades, the French publicly funded healthcare system has included public, non-profit, and for-profit hospitals. Among state-owned hospitals, those administered by universities typically have high-tech equipment, as well as highly-trained and qualified physicians making them attractive facilities for patients. It has at

¹ In French, Groupements Hospitaliers de Territoires _ GHT

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least one university hospital in each French health administrative state². The other state-owned local hospitals have fewer beds, lower admissions, and a lower usage of high-tech equipment. Hospital consortia (GHTs) are introduced in the public sector in 2016. Within a given hospital consortium, patients are directed to the relevant public hospitals.

All public or private hospitals in France are publicly funded through a DRG-based³ prospective payment system that became broadly implemented in 2008.⁴ Though the DRG payment system, individuals can choose the facility where they receive care, although they tend to be treated in their area of residence. Patients do not need a GP's referral for receiving elective inpatient care in a specific hospital, and this rules out any problem in interpreting the nature of the choice (Balía et al., 2020). The doctor might write a referral letter to a specific colleague, but the patients have to schedule their own hospital visit. A public website managed by the French health authority agency provides information on hospitals.⁵ However, the information it provides is difficult for patients to interpret the level of hospital quality. However, patients often rely on word of mouth from relatives and social networks that give an informal valuation of a hospital's reputation.

The Public National Health Insurance (NHI) is a single-payer in the French hospital healthcare system. This NHI is compulsory in France and covers all of the resident population, and it is financed primarily by employee and employer contributions as well as by taxes. The reimbursements from the public health insurance cover nearly all medical services provided by the hospital.

The nuances of how this system is structured are actually complex. Admission to a private hospital consequently implies extra costs. Two significant exceptions involve an additional fixed hospital fee per day and fees earned directly by private-sector medical practitioners. Private supplementary health insurance reimburses potentially high additional fees according to the insurance premium. Private supplementary health

² There is 13 French States. A state is administratively defined, and each decides on a healthcare organization with the national health department.

³ French healthcare administration sets up a specific DRG classification. For simplicity's sake, the term "DRG" is used as a generic term for the French classification.

⁴ Payments for hospitals are based on national tariffs for French DRGs.

⁵ <http://www.scopesante.fr/>

insurance covers 95% of the population: the richer, the best covered. A complementary public insurance exists for the most economically vulnerable part of the population.

Hence, the main benefit of local hospitals is probably the proximity. The main benefit of the university hospital is the extensive range of specialized healthcare as well as the high level of equipment and medical staff training. The factors that may impact the choice to be treated in a private hospital are patient intake, catering, and individualized care (admission to a private hospital implies a more focused relationship between the patient and the specialist). Private hospitals are also best equipped to perform surgical activities. Whereas private hospitals typically rely on a specific specialist, medical teams in the public sector manage patient.

3. Identification of consumer choice model

In the hospital choice literature, the random utility function of the patient is the theoretical model used to describe the patient's discrete hospital choice problem (Gaynor et al., 2016; Gutacker et al., 2016; Moscelli et al., 2016; Beckert and Kelly, 2021).

3.1 The baseline model

Patient i becomes sick at time t . She chooses a hospital based on the hospital's ownership in a set of hospitals ownership j ($j = 1, \dots, 4$). Over the year 2019, patients may have returned several times to hospital that add a panel structure to the database.

Let U_{ij} denote the indirect conditional utility of the patient i admitted in hospital of ownership j at time t (in day),

$$U_{ijt} = V_{it}' \alpha_j + X_{ijt}' \beta + \varepsilon_{ijt} \quad (1)$$

where X_{ijt} is a K -vector of hospital attributes that may vary across patients. V_i is a vector of observable time-invariant patient level characteristics. The term ε_{ijt} , assumed to be i.i.d, captures unobserved taste variation across hospitals ownership that is not quantified by the hospital's ownership attributes X_{ijt} .

The hospital ownership attributes are the distance between the centroid of the postcode and the hospital's location, the quality indicators, the empirical referral hospital, and the dummy for being part of a hospital's network.

The patient characteristics are patient age, gender, quintile of local area deprivation index, dummy indicators for moderate and severe comorbidities, chronic disease, rural/suburb area of location and critical economic situation.

3.2 The strategy identification

Recent papers (Beckert and Kelly, 2021; Gaynor et al., 2016) use a mixed multinomial logit (MMNL) model to capture patient-level heterogeneity. For very computationally burdensome reasons – a database of over 17 million observations crossed by the number of alternatives – we impose a correlation structure across choice alternatives. This identification approach is used in previous research estimating patient demand for healthcare providers (Gowrisankaran et al., 2015; Raval et al., 2017; Ho and Lee, 2015; Ho and Pakes, 2014).

This restriction rules out the possibility of individual preference for hospital ownership that varies with unobservable characteristics of patients. For instance, individuals may have an unobserved preference for a given hospital. These persistent taste preferences could result from family, friends, relatives, and social networks that might magnify a facility above others for objective and subjective reasons. In this paper, we propose an approach to control for these preferences. The most frequently accessed hospital represents the empirical referral hospital effect that captures the social proximity to hospital. This proxy is computed at the postcode level. We assume that this proxy represents the aggregation of the common perception of the best choice for people in a given area. Moreover, observable heterogeneity between individuals is captured by allowing empirical pattern hospital, the consolidation process, the distance and the quality parameters to vary with socioeconomic characteristics.

4. Data sources

This study uses the French administrative data on hospitals (Programme de médicalisation des systèmes d'information – PMSI). The PMSI collects the discharge

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abstracts (DA) from all hospitals in France and is exhaustive for acute care in hospitals.

All hospital stays recorded in the database between 1 January 2019 and 31 December 2019 were included, except for those associated with unclassifiable and session stays. Stays for non-residents in France are also not included. We consider three different databases in function of healthcare activity: the whole dataset of care activity (17'952'639 stays), the elective dataset of care activity (12'762'062 stays), and the elective surgery dataset of care activity (6'637'718 stays).

A single patient may have different hospital stays within the study period; then, the information is linked over the 2019 year. Patients are anonymized.

At the in-patient level

The information selected includes age, gender, chronic disease, postcode of the location of residence, elective versus emergency care, the pathology coded with the International Classification of Disease (ICD-10), and the procedures performed during hospitalization coded according to the Common French Classification of Medical Acts. The Charlson Index was calculated using the comorbid factors stated in the acute care database and adapted to the study: Pathologies relating to this index were taken into account according to published algorithms (Sundararajan et al., 2004 ; Quan et al., 2005), with the corresponding weightings.⁶

At the in-hospital stay level

This paper uses information regarding hospitals' identifiers, hospitals' categories, and belonging to a hospital consortium (GHT).

The French Ministry of Health collected annual statistics from hospitals surveys (Statistiques Annuelles des Etablissements de santé, SAE). This administrative database

⁶ It is calculated using the comorbidities recorded at the point of the hip replacement admission. The Charlson Index predicts ten-year mortality using 22 comorbidity conditions. Each condition is scored a 1, 2, 3, or 6, depending on the severity of the condition, and is calculated based on all diagnoses recorded in hip replacement admission. We group patients into five categories: a score of zero for no comorbidities; a score of 1 for "very moderate comorbidities"; a score of 2 for "moderate comorbidities"; a score of 3 for "severe comorbidities"; and a score of 4 for "very severe comorbidities."

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provides information on all hospitals. The PMSI data information at the hospital level was matched to the SAE to get status and ownership information.

The HOSPIDIAG database developed by the French Health Authorities (HAS) provides information on the hospital's performance indicators. The PMSI data information was matched with this data at the hospital level. The nosocomial score and the all-adjusted quality score were used as quality indicators. A crossed quality score – nosocomial score crossed all-adjusted quality score – was used in the results presented.

At the residence postcode level

The PMSI data information at the patient residence-post code level was matched with databases on the type of geographical location (rural or urban) produced by the French National Statistical Institute (INSEE). The French deprivation index defined at the postcode level as developed by the Public Health Research Institute (INSERM) was also included.

In US, the Institute of Medicine suggested using “neighborhood and community composition” as a proxy for individual-level indicators that cannot be directly collected from patients (IOM, 2014 and Cook, 2021). We, here, follow the same line.

Hospital locations correspond with areas of residence. The geographical codes used in the INSEE geographic database are related to one of the 5571 "Geo PMSI" geographical codes. A Geo PMSI code has at least 1000 residents. Distance is calculated as the road distance between the centroid of the geographical information systems (GIS) coordinate postcodes of patients' locations and the GIS coordinate of hospitals' locations. The travel distance is defined as in kilometers.

We defined the empirical referral hospital per postcode, calculated as the most frequently chosen hospital per patients living in a given postcode. This variable was computed per main item of ICD (25 items).

In the following section, we present the result of the whole sample.

5. Results

The average age is 53 years old, and half of the distribution is female patients. Patients come for exploratory procedures (8.6%), low severity including day surgery (42.2%), and from moderate to very severe levels of severity (49.2%).

5.1 Empirical evidence: Distance and quality

Before proceeding to the structural analysis, it will be useful to analyse patterns in the data to provide some simple empirical evidence on patients' choice determinants.

Table 1 displays the figures. The nearest hospital treated 26.2% of patients, that means that only a quarter of patients go to nearby hospitals, that's shockingly low. The average distance to this nearest hospital is 9.55km. As additional results, the average distance between the nearest hospital and the chosen one is 18km.

The distance to the empirical referral hospital is around 20km, and they admit half of the patients (44.6%). Local hospitals (10 km) and for-profit hospitals (15 km) are closer to patients' locations than university hospitals (60 km).⁷

For each hospital category, we now identify the nearest hospital. These hospitals admit 81.7% of patients. By excluding the largest French cities from the database (Paris, Lyon, Marseille), this percentage increases to 89.1%.

As additional statistics, the local public hospital delivers the lowest quality scores measured by the three indicators used in this paper: the nosocomial score, the all-adjusted quality score, and the crossed quality score. In addition, the standard deviation is much higher for local hospitals than other hospitals suggesting a higher level of heterogeneity in healthcare facilities for local ones compared to other hospital's categories. For instance, for all-adjusted quality scores, the standard deviation is 38.59 for local hospitals, whereas this standard deviation is 21.71 for private ones.

Table 2 presents statistics on inpatients' characteristics by hospital category. Non-profit hospitals admit a marginal share of patients compared to other hospital categories. Over one-third of the patient is admitted to a local hospital or a FP hospital.

⁷ The small number of non-profit hospitals and the uneven distribution over the French territory explain the considerable average distance to patients' locations.

Rural resident patients are mainly treated in local hospitals (45.1%) of compared to just 17.1% in university hospitals and 34.4% in FP hospitals. The share of urban resident patients treated in local hospitals is much lower (30.3%), whereas 25.3% are admitted to university hospitals and 37.2% to FP hospitals.

Table 2 also provides information on the deprivation index according to patients and their characteristics. For the top one, richest quintiles, the share of patients treated by local hospitals is less than one quarter (22.5%); it exceeds 27.8% in university hospitals and goes up to 39.8% in FP hospitals. In the fifth quintile of deprivation distribution – the most deprived – patients in FP hospitals fall to 31.3%. Patients in the fourth quintile and the fifth quintile of the deprivation distribution go up to over 40% as treated in the local hospital (42.0% and 45.0%, respectively) and less than 20% as being admitted in university hospitals (19.6% and 17.5%, respectively). This table shows that, according to the raw data, the most deprived patients are more likely to choose local hospitals. And the less deprived patients are, on average, treated into FP hospitals patients and university hospitals patients.

Therefore, the distribution of admission by hospital category varies according to the deprivation index. For the population of patients admitted for elective care, this statement aligns with what is observed in the data for all hospital admissions, but in a muted way. When the patient population comes for elective surgical care, outsourcing care to the FP hospital is prominent (Appendix, Table A1).⁸

Figure 1 illustrates the variation in distance distribution by patient characteristics. Graph A presents the distance distribution by urbanization. The share of urban patients admitted near their residence is much higher than that of rural patients. Graph B shows the distance distribution between patients aged 60 to 74 years and those aged 75 years and older. Nearly 27% of patients aged 75 and older are treated close to home, compared with only 23% of patients aged 60 to 74. Graph C presents distance distribution when the population is divided according to the emergency (resp. elective) for their health care needs. As expected, patients are admitted to closer healthcare facilities for emergency care. Graph D presents the distance distribution for patients

⁸ See Appendix, Table 1A for details on presents the results of population of patients admitted for elective care and population of patients admitted for elective surgical care.

living in rich versus poor areas. We observe massive heterogeneity between these two patient populations.

5.2 Patient's choice and deprivation⁹

Table 3 displays mixed logit results on hospital attributes.

Patients show a preference for shorter travel distances. However, other factors in hospital attributes contribute to their decisions. Patients prefer higher health care quality and are more likely to choose the empirical referral hospital. The presence of a hospital network (consolidation process) also matters. The results are equivalent to those on the population of elective-stay patients (like those admitted for an elective surgical procedure).

Table 4 presents results on individual characteristics. A local public hospital is the base alternative. Therefore, negative coefficients tell us that as the deprivation index increases, people are more likely to choose a local hospital over other hospital categories; older patients and patients living in rural areas are more likely to be treated in a local public hospital.

The results indicate that the aging population is less likely to be admitted to the university and for-profit hospitals than local hospitals. Elderly patients of extreme age (over 85 years old) are more likely to go to a local public hospital.

Another significant point is that patients with a higher deprivation index are more likely to be treated in a local public hospital over a private hospital (non-profit or for-profit) or a public university hospital.

5.3 Counterfactual simulations

Table A2 displays results on average predicted probability. For simplicity of reading, this section focuses on Figure 2 resulting from Table A2's values.

⁹ Space restrictions do not permit us to present all estimates in the paper. The remaining parameter estimates are available on request.

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An examination of Figure 2 shows that as the deprivation index increases, patients are less likely to be treated in for-profit (resp. non-profit) but more likely to be cured in local public hospitals. The association between university hospitals and deprivation index categories is less clear: the probability is quite similar regardless of the deprivation index level.

The results in Figure 2 raise the question of equity in healthcare access for deprived patients. The data reveals that patients admitted to private hospitals are the less deprived. Furthermore, 47% of patients in the wealthiest quintile have a private sector hospital as the closest provider. These results align with previous works (as documented by Beckert and Kelly (2021) and elsewhere), demonstrating that private hospitals outperform small public providers.

In France specifically, Milcent (2005) showed that private hospitals outperform public hospitals, yet the variability in performance is higher than in the public sector. Expensive high-tech equipment is only available for university public healthcare facilities. Therefore, less deprived patients receive access to healthcare facilities relatively close to their residence and with a high level of quality.

What does the above model say would happen if the values of distance or healthcare quality change? What would the expected probability of going to a for-profit hospital (resp. local public hospital) if the distance is 10km longer? What if the distance is 20km? Table 5 displays results for distance and quality covariates change.

Table 5 exhibits that having a distance to a local hospital of 10km away increases the expected probability of selecting a university hospital for the most deprived patients. Equally, incremented by 10km, the distance to for-profit hospitals for less deprived patients increases the expected probability of selecting university hospitals. Increasing the distance by 20km instead of 10km amplifies the results. In some way, patients going more massively to university hospitals attenuate existing inequalities. However, whether it will delay healthcare access to this population is an open question.

We now turn on the results of quality change (Table 5). Since the healthcare quality level in for-profit hospitals increases by 10%, the expected probability of going to these

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hospitals is over 40% for the less deprived patient. Comparably, when the quality level in local public hospitals increases by 10%, the upsurge of being treated in these healthcare facilities is 7%. Symmetrically, Table 5 exhibits the results when the quality is reduced by 10%. Lessening the healthcare quality in local hospitals lowers the probability of going into by 4% for the most deprived patients. This percent is less than the percent obtained with a quality increase.

For the less deprived patient, we also show that for a quality reduction of 10% for the for-profit hospital, the probability of choosing them is reduced by 32%. This percent is lower than the percent obtained with an increase in healthcare quality (+43%).

6. Sensitivity analysis

In the most prominent French cities (Paris, Lyon, Marseille), the density of universities and research hospitals is much higher than in other parts of the French territory. In order to control for this potential bias, we run models excluding patients admitted in these three cities. We also run models on patients, excluding patients admitted to Paris city. The results are unaffected.

In addition, patients may have multiple choices for a given distance and a given hospital's ownership in the largest French cities. As a sensibility analysis, we run models on a database where patients have only one choice for a given distance and a given hospital's ownership. The results obtained are comparable.

Some patients live in areas with a large set of healthcare facilities choice. Some others have a poor set of hospitals. We then restrained the database to patients with only one choice for each hospital's category and ICD. In doing so, we distorted the deprivation distribution and the age distribution. However, the results are consistent: short distance, high quality, being the empirical referral hospital, and belonging to a network of hospitals significantly affect patient choice. In addition, vulnerable patients – with high deprivation index and very senior – are more likely to be admitted to a local public hospital. Patients living in areas with low deprivation index are more likely to be admitted to a for-profit hospital.

Over the year 2019, some patients were admitted several times, whereas others were admitted once. We restrained the database on the first hospital stay of patients. The results are unchanged.

We also run the model with age as a continuous variable. Results on age are less straightforward to interpret. The results on deprivation and hospital's attributes are unchanged.

7. Conclusion

This paper explores the drivers of patient choice for hospital ownership and the relationship to the socio-economic deprivation gradient.

The database is detailed and exhaustive data of inpatients admitted over the year 2019 in France, with over 17 million stays. We observe from preliminary statistics that patients do not go to the closest hospital (26%) de facto; they go to the closest hospital for given ownership (82%). Therefore, patients go beyond the nearest hospital. Moreover, the facility category does not imply the same level of healthcare quality: local public hospital provides the lowest healthcare quality measured by three quality scores. Moreover, in France as in Italy, patients do not have a referral hospital. We computed the empirical referral hospital as the most frequently chosen hospital. It supposes to capture the common perception of the best healthcare facility for people in a given area i.e., a proxy of the social proximity. This is an original variable for this study.

The set of hospital attributes that explains a patient's choice of hospital ownership are the distance, the level of quality provided, the empirical referral hospital, and the consolidation process (belonging to a network). Focusing on these drivers, we set the patient's choice on four hospital categories (public – local or university –, private non-profit, and private for-profit) that have co-existed for decades and provide health services. Each of these categories means differences in health care provided and location. Patients are free to be admitted to any of these hospital categories. A single

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public health insurance organization reimburses all hospitals under a DRG-based payment scheme, with prices administered by the government. We find that distance, quality, the empirical referral hospital, and the consolidation process affect patient choice.

The individual characteristics considered in the model are the seniority of the patient (over 85 years old), whether it is located in a rural area and the socio-economic deprivation level index of where the patient lives. This paper shows that the most vulnerable patients – the socio-economically deprived and very aged – are primarily treated in small public hospitals with poor amenities and the lowest level of healthcare quality. Our counterfactual simulations show that being treated in university public hospitals does not depend on the level of socio-economic deprivation. Increasing the distance and reducing the quality level drive patients to seek treatment in university hospitals.

Equality concerns are particularly acute in a publicly funded healthcare system that aims to provide equal access for equal needs. In some ways, admission to university hospitals attenuates existing inequalities. However, whether it delays the healthcare access sought by this population remains an open question.

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Appendix

Pathology type Dummies according to the ICD-10

The stay is associated to one of 25 organ system groups listed above:

- 1-Diseases and Disorders of the Nervous System,
- 2-Diseases and Disorders of the Eye,
- 3-Diseases and Disorders of the Ear, Nose, Mouth And Throat,
- 4-Diseases and Disorders of the Respiratory System,
- 5-Diseases and Disorders of the Circulatory System,
- 6-Diseases and Disorders of the Digestive System,
- 7-Diseases and Disorders of the Hepatobiliary System And Pancreas,
- 8-Diseases and Disorders of the Musculoskeletal System And Connective Tissue,
- 9-Diseases and Disorders of the Skin, Subcutaneous Tissue And Breast,
- 10-Diseases and Disorders of the Endocrine, Nutritional And Metabolic System,
- 11-Diseases and Disorders of the Kidney And Urinary Tract,
- 12-Diseases and Disorders of the Male Reproductive System,
- 13-Diseases and Disorders of the Female Reproductive System,
- 14- Pregnancy, Childbirth And Puerperium,
- 15-Newborn And Other Neonates (Perinatal Period),
- 16-Diseases and Disorders of the Blood and Blood Forming Organs and Immunological Disorders,
- 17-Myeloproliferative DDs (Poorly Differentiated Neoplasms),
- 18-Infectious and Parasitic DDs (Systemic or unspecified sites),
- 19-Mental Diseases and Disorders,
- 20-Alcohol/Drug Use or Induced Mental Disorders,
- 21-Injuries, Poison And Toxic Effect of Drugs,
- 22-Burns,
- 23-Human Immunodeficiency Virus Infection.
- 24-Multiple Significant Trauma,
- 25-Organ transplants

Table 1: Distance and Hospital's choice

Patients considered	Population %	Mean (Std dev.)			Hospital's type			
		In kilometers						
		Distance to chosen hospital	Distance to closest hospital	Distance to popular hospital	Distance to local hospital	Distance to university hospital in	Distance to NFP hospital	Distance to FP hospital
All activity	26.22%	26.80 (31.32)	9.55 (8.44)	19.61 (19.65)	11.15 (10.18)	58.90 (40.14)	42.70 (45.88)	14.79 (15.47)
Elective care	23.68%	28.21 (32.22)	9.95 (8.38)	19.81 (19.80)	11.26 (10.20)	58.03 (40.07)	41.80 (45.58)	14.51 (15.26)
Surgery elective care	22.67%	28.61 (32.60)	10.27 (9.49)	19.83 (19.14)	11.56 (10.24)	59.45 (40.61)	43.94 (46.39)	15.09 (15.38)

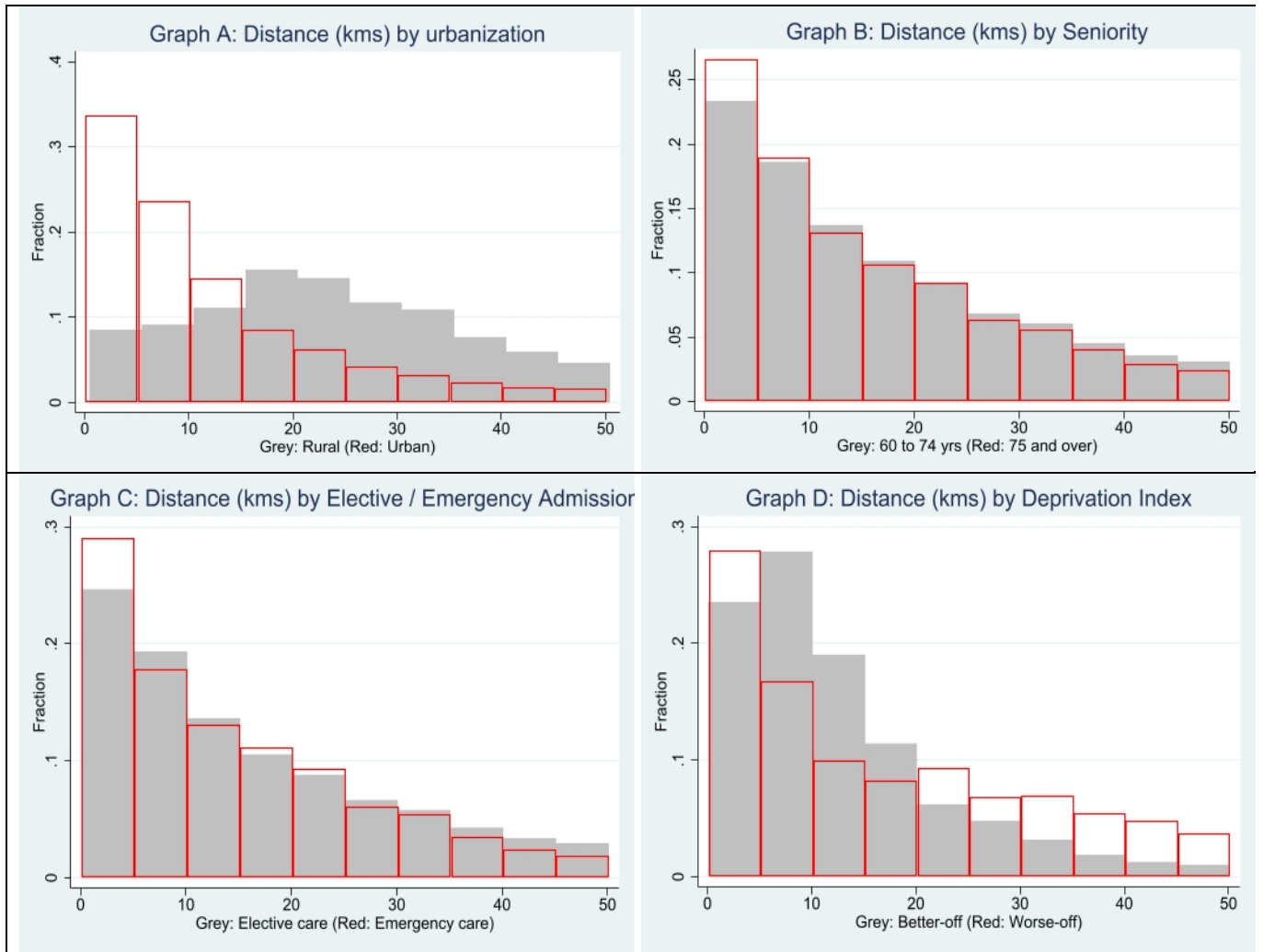
Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Table 2: Hospital's ownership: All, by age group, by rural areas, by level of deprivation

All activity	% Local hospitals	% University hospitals	% NFP hospitals	% FP hospitals
<i>All</i>	34.75	22.84	6.09	36.32
<i>Age</i>				
65 or less	33.29	24.84	5.79	36.07
66-75	30.29	20.17	6.33	43.21
76-85	37.94	19.04	6.62	36.40
Over 85	51.99	19.04	7.03	21.94
<i>Geographic area of residence</i>				
Rural areas	45.07	17.11	3.43	34.40
Urban areas	30.28	25.32	7.24	37.16
<i>Deprivation distribution by quintile</i>				
Q1 - Top	22.47	27.78	9.90	39.85
Q2	31.82	23.55	6.02	38.62
Q3	35.41	22.72	5.32	36.55
Q4	41.95	19.64	3.89	34.52
Q5 - Bottom	44.98	17.53	6.14	31.35

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Figure 1: Distance and socioeconomic factors



Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019

Table 3: Mixed logit results on hospital attributes

	Patients admitted in hospital over 2019		
	Coef.	Std. Err.	P>z
Quality	1.079	0.013	0.000
Distance	-0.008	0.000	0.000
Referral pattern hospital	1.285	0.001	0.000
Belonging to a network	1.965	0.001	0.000
	Patients admitted for elective procedure over 2019		
	Coef.	Std. Err.	P>z
Quality	1.070	0.013	0.000
Distance	-0.008	0.000	0.000
Referral pattern hospital	1.066	0.001	0.000
Belonging to a network	1.728	0.002	0.000
	Patients admitted for elective surgical procedure over 2019		
	Coef.	Std. Err.	P>z
Quality	0.838	0.013	0.000
Distance	-0.007	0.000	0.000
Referral pattern hospital	1.031	0.001	0.000
Belonging to a network	1.810	0.002	0.000

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Note: The model also includes the pathology type dummies (as described Appendix), dummies for moderate (Charlson index equal to unity) and severe (Charlson Index exceeding unity) comorbidities, gender dummy, chronic disease dummy as individual attributes.

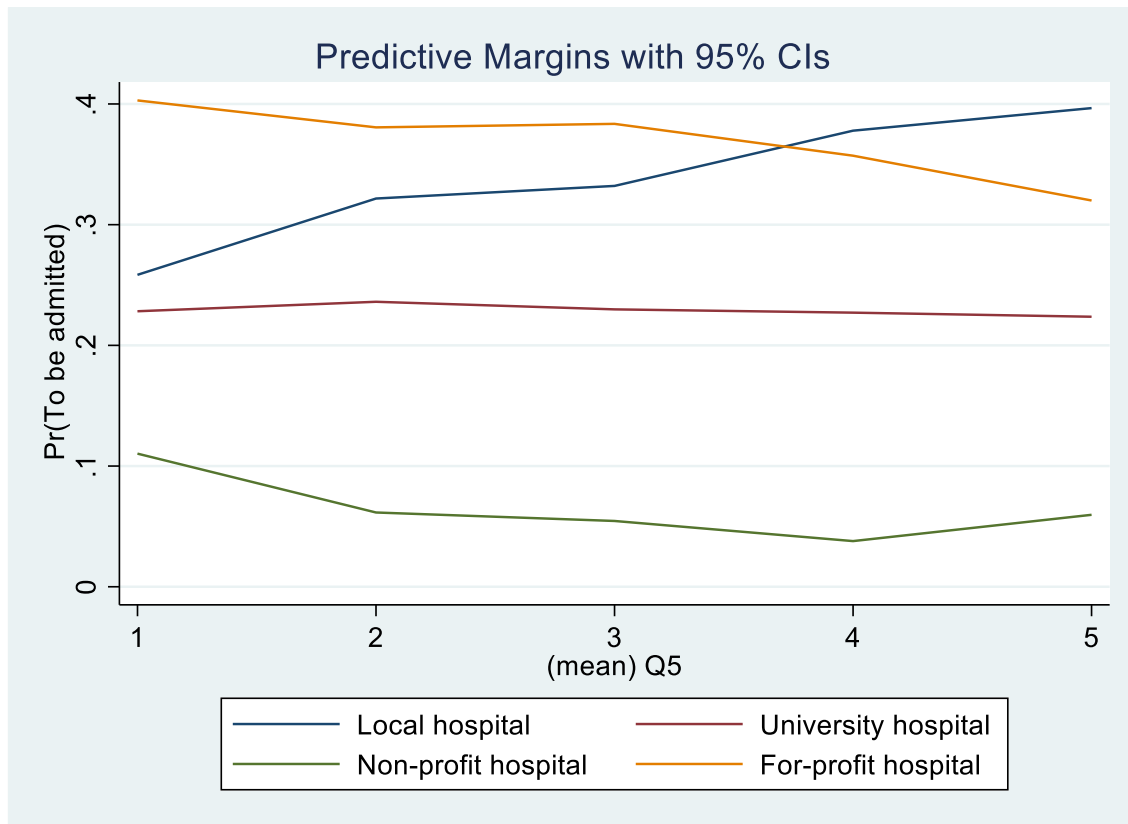
Table 4: Mixed logit results on individual's variables

	Patients admitted in hospital over 2019			Patients admitted for elective over 2019			Patients admitted for elective surgery over 2019		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Local public hospital	(base alternative)			(base alternative)			(base alternative)		
University hospital									
Location (Urban areas as reference)									
Rural	-0.576	0.002	0.000	-0.55	0.002	0.000	-0.548	0.003	0.000
Age (65 years or less as reference)									
66-75	-0.093	0.002	0.000	-0.071	0.002	0.000	-0.124	0.003	0.000
76-85	-0.416	0.002	0.000	-0.31	0.003	0.000	-0.383	0.004	0.000
Over 85	-0.776	0.003	0.000	-0.618	0.004	0.000	-0.799	0.005	0.000
Deprivation quintile (Less deprived as reference)									
2	-0.357	0.002	0.000	-0.342	0.003	0.000	-0.39	0.004	0.000
3	-0.472	0.002	0.000	-0.47	0.003	0.000	-0.569	0.004	0.000
4	-0.601	0.003	0.000	-0.58	0.003	0.000	-0.676	0.004	0.000
5 (most deprived)	-0.519	0.003	0.000	-0.523	0.003	0.000	-0.594	0.004	0.000
Non-profit hospital									
Location (Urban areas as reference)									
Rural	-1.059	0.003	0.000	-1.013	0.003	0.000	-0.994	0.004	0.000
Age (65 years or less as reference)									
66-75	0.272	0.003	0.000	0.273	0.003	0.000	0.252	0.004	0.000
76-85	0.065	0.003	0.000	0.195	0.004	0.000	0.194	0.005	0.000
Over 85	-0.266	0.004	0.000	0.064	0.005	0.000	0.096	0.006	0.000
Deprivation quintile (Less deprived as reference)									
2	-0.413	0.003	0.000	-0.42	0.004	0.000	-0.448	0.005	0.000
3	-0.514	0.003	0.000	-0.513	0.004	0.000	-0.48	0.005	0.000
4	-1.063	0.004	0.000	-1.038	0.004	0.000	-1.041	0.006	0.000
5 (most deprived)	-0.775	0.004	0.000	-0.831	0.004	0.000	-0.867	0.006	0.000
For-Profit									
Location (Urban areas as reference)									
Rural	-0.385	0.001	0.000	-0.414	0.002	0.000	-0.441	0.002	0.000
Age (65 years or less as reference)									
66-75	0.350	0.002	0.000	0.314	0.002	0.000	0.305	0.003	0.000
76-85	-0.054	0.002	0.000	0.094	0.002	0.000	-0.116	0.003	0.000
Over 85	-0.932	0.003	0.000	-0.506	0.004	0.000	-0.759	0.005	0.000
Deprivation quintile (Less deprived as reference)									
2	0.082	0.002	0.000	0.046	0.003	0.000	0.045	0.004	0.000
3	0.131	0.002	0.000	0.093	0.003	0.000	0.105	0.004	0.000
4	-0.149	0.002	0.000	-0.174	0.003	0.000	-0.222	0.004	0.000
5 (most deprived)	-0.43	0.002	0.000	-0.45	0.003	0.000	-0.478	0.004	0.000

Note: The model also includes the pathology type dummies (as described Appendix), dummies for moderate (Charlson index equal to unity) and severe (Charlson Index exceeding unity) comorbidities, gender dummy, chronic disease dummy as individual attributes.

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Figure 2: Deprivation index effect on patient's choice



Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Table 5: Distance and quality covariates change

DEPRIVATION	Hospital's categories	Patients admitted in hospital over 2019			
		Distance		Quality	
		Plus 10 km	Plus 20 km	Plus 10%	Minus 10%
	Changed in for-profit hospital localisation / quality				
Less deprived	Local hospital	0.34%	0.38%	-14.80%	10.94%
	University hospital	0.47%	0.95%	-20.58%	14.73%
	Non-profit hospital	0.18%	0.36%	-7.50%	6.05%
	For-profit hospital	-0.99%	-1.69%	42.88%	-31.72%
	Changed in local hospital localisation / quality				
Most deprived	Local hospital	-0.74%	-1.89%	7.13%	-4.97%
	University hospital	0.44%	1.09%	-2.16%	2.09%
	Non-profit hospital	0.18%	0.57%	-0.86%	0.85%
	For-profit hospital	0.12%	0.23%	-4.11%	2.03%

Note: Delta-Method standard error. These differences are statistically significant at significance 0.1% level.

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.

Appendix

Table A1: Hospital's ownership: All, by rural areas, by level of deprivation

All activity	% Local hospitals	% University hospitals	% NFP hospitals	% FP hospitals
All	34.75	22.84	6.09	36.32
<i>Age</i>				
65 or less	33.29	24.84	5.79	36.07
66-75	30.29	20.17	6.33	43.21
76-85	37.94	19.04	6.62	36.40
Over 85	51.99	19.04	7.03	21.94
<i>Geographic area of residence</i>				
Rural areas	45.07	17.11	3.43	34.40
Urban areas	30.28	25.32	7.24	37.16
<i>Deprivation distribution by quintile</i>				
Q1 - Top	22.47	27.78	9.90	39.85
Q2	31.82	23.55	6.02	38.62
Q3	35.41	22.72	5.32	36.55
Q4	41.95	19.64	3.89	34.52
Q5 - Bottom	44.98	17.53	6.14	31.35
Elective care	% local hospitals	% university hospitals	% NFP hospitals	% FP hospitals
All	25.60	22.47	6.61	45.32
<i>Age</i>				
65 or less	25.68	24.13	6.19	44.00
66-75	22.73	19.94	6.77	50.56
76-85	26.31	18.84	7.45	47.40
Over 85	34.12	19.53	9.42	36.92
<i>Geographic area of residence</i>				
Rural areas	33.67	18.49	4.13	43.72
Urban areas	22.16	24.17	7.66	46.00
<i>Deprivation level</i>				
Q1 - Top	16.28	26.19	10.07	47.45
Q2	23.27	23.08	6.57	47.08
Q3	25.94	22.10	6.00	45.96
Q4	31.10	20.33	4.58	43.99
Q5 - Bottom	33.89	18.98	6.56	40.56
Surgery elective care	% local hospitals	% university hospitals	% NFP hospitals	% FP hospitals
All	18.09	14.90	5.92	61.09
<i>Age</i>				
65 or less	28.47	30.74	6.47	34.32
66-75	26.72	25.46	7.17	40.65
76-85	32.26	25.32	8.61	33.80
Over 85	40.06	23.66	11.27	25.01
<i>Geographic area of residence</i>				
Rural areas	23.56	13.19	3.98	59.26
Urban areas	15.59	15.68	6.81	61.93
<i>Deprivation level</i>				
Q1	11.62	16.04	8.28	64.07
Q2	16.71	14.68	5.86	62.75
Q3	18.34	14.97	5.46	61.23
Q4	21.66	13.91	4.41	59.86
Q5	24.04	13.46	6.56	55.93

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019

Table A2: Deprivation index effect on patient's choice

Hospital categories <i>crossed</i> Deprivation level	Margin	z	P>z	[95% Conf.	Interval]
Local hospital#1	25.847%	0.000	0.000	0.258	0.259
Local hospital #2	32.168%	0.000	0.000	0.321	0.322
Local hospital #3	33.212%	0.000	0.000	0.332	0.332
Local hospital #4	37.788%	0.000	0.000	0.378	0.378
Local hospital #5	39.659%	0.000	0.000	0.396	0.397
University hosp.#1	22.826%	0.000	0.000	0.228	0.228
University hosp.#2	23.614%	0.000	0.000	0.236	0.236
University hosp.#3	22.984%	0.000	0.000	0.230	0.230
University hosp.#4	22.713%	0.000	0.000	0.227	0.227
University hosp.#5	22.373%	0.000	0.000	0.224	0.224
Non-profit#1	11.031%	0.000	0.000	0.110	0.111
Non-profit #2	6.155%	0.000	0.000	0.061	0.062
Non-profit #3	5.453%	0.000	0.000	0.054	0.055
Non-profit #4	3.783%	0.000	0.000	0.038	0.038
Non-profit #5	5.965%	0.000	0.000	0.060	0.060
For-profit#1	40.296%	0.000	0.000	0.403	0.403
For-profit #2	38.063%	0.000	0.000	0.380	0.381
For-profit #3	38.351%	0.000	0.000	0.383	0.384
For-profit #4	35.715%	0.000	0.000	0.357	0.357
For-profit #5	32.003%	0.000	0.000	0.320	0.320

Note: delta-method

Rows are labeled first by the hospital category, the chosen alternative, and second by the value of the deprivation index's quintile (from 1 to 5). The first column in the body of the table gives predicted probabilities of the hospital category. These are the expected probabilities based on our model. The 0.258 next to local hospital#1 is the expected probability of a patient with deprivation index = 1 treated in a local hospital. Said differently, we expect 25.8% of patients to go to a local hospital if they are in the first deprivation index quintile and have the same distribution of age, gender, location, distance, hospital quality, pattern referral hospital and hospital within a network of hospital that we observe in the data.

Source: Data from the PMSI (Ministry of Health). Acute stays for surgery, medical or obstetrical needs in mainland France. 2019.