Spatial Inequality in Access to Health care: Evidence from an Italian Alpine Region

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Abstract

Potential access to healthcare facilities is one of the main determinants of health. This study investigates the extent of spatial inequalities in potential access to care, and the relationship between potential access and patients' behavior. Taking Piedmont, an Italian Alpine region, as a case study, our analysis emphasizes that potential access is not uniform within the region and lower potential access is associated with other important indicators of socioeconomic deprivation. Moreover, people living in places characterized by poor access tend to use health care services less than other citizens, and to be less mobile than the rest of the population.

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INTRODUCTION

The issue of physical access to healthcare services in remote areas has been addressed by research dating back to the original contribution by Joseph and Bantock (1982). While many papers focus on countries like Canada, the USA and Australia (e.g., Carriere et al., 2000; Hare and Barcus, 2007), few works consider the occurrence of spatial imbalances in Europe, where rural areas are still very common, although distances tend to be much smaller than in the Americas or Africa (e.g., WHO, 2010).

In particular, although access to care is one of the main determinants of health (e.g., Gold, 1998), little is known about the spatial divide in this dimension *within* a region in Europe. This paper aims to fill the gap by providing evidence on healthcare access in Piedmont, an Alpine region in Italy bordering on France and Switzerland. We focus on two distinct dimensions of access (Joseph and Phillips, 1984): *potential* access is defined as the minimum distance between place of residence and the nearest healthcare provider, a proxy for the availability of the service; *revealed access* is a measure of utilization of healthcare services (Khan, 1992). These are two related but different concepts: potential access does not guarantee utilization (e.g., Martin and Williams, 1992) and, in turn, utilization depends on more than potential access (like, for instance, patients' education and income; e.g., Field and Briggs, 2001). Our findings show that potential access is far from being uniform within the region, and poor access is associated with other important indicators of socioeconomic deprivation. Moreover, we find that people living in places with poor access tend to use fewer healthcare services and to be less mobile than other citizens.

These results are important for Italy, as for other similar European countries, where universal and comprehensive access to health care is constitutionally guaranteed, and half of the country's around 8,000 municipalities are classified as "rural areas" and subject to specific development projects managed by the Italian government, including access to basic public services. The recent economic crisis has tightened public budgets even more, requiring greater efficiency and possibly threatening equity of access (De Belvis et al., 2012). However, maintaining healthcare facilities in rural areas can be costly and inefficient, meaning that (small) local hospitals in remote areas are the most likely candidates for closure.

The paper is organized as follows. The next section provides background information on the organization of the Italian National Health Service (NHS), with a focus on Piedmont. Then, an analysis of potential access to health care is provided, followed by an analysis of the association between potential and revealed access. Conclusions and policy implications are discussed in the last section.

THE ITALIAN NHS AND ITS REGIONAL DIMENSION

The Italian National Health Service (NHS) is a good example of the difficulty of striking a balance between spending efficiency and equity in health care (e.g., Turati, 2014). It was created in 1978 by consolidating over 100 health insurance funds in financial difficulties. After the NHS's foundation, because of the original focus on equity, a remarkable increase in spending was recorded for all regions, with large annual deficits almost always bailed out by the central government. At the beginning of the 1990s, to solve the problem of financial irresponsibility, reforms were implemented at both the macro and the micro level.

The result of these reforms has been a multi-layered organization involving the central government, the regional governments and the Local Health Authorities (LHA), sub-regional public bodies acting as local insurers for citizens. In each region, citizens are enrolled with a given LHA according to their municipality of residence. However, they are entirely free to choose the provider from which to receive the medical treatment they need, either within their LHA or not, either within their region or not, either from a private (licensed) provider or from a public one. Hospital treatments are fully free of charge for the patient: the cost of service provision is paid by his/her LHA of residence according to a prospective payment system based on Diagnosis Related Groups (DRG). Hence, a system of intra- and inter-regional transfers remunerate providers for patients who decide to obtain treatment from a hospital outside their LHA of residence.

Despite the strong characterization in terms of equity of this multi-layered organization, a relatively large flow of patients, especially from southern to northern regions, has been observed since the NHS's inception. In 2009, more than 851,000 patients (about 7.9 per cent of total discharges) received healthcare services outside their region of residence. While interregional mobility has received attention in the literature, very little is known about the flows of intra-regional mobility and on the role played by potential access on patients' behavior. Here we concentrate on Piedmont, a region located in the north-western corner of Italy, bordered by mountains (the French Alps to the West, the Swiss Alps to the North, the Apennines to the South), and the Po Plain to the East. It is the second largest region in Italy, with a population of about 4.36 million residents. Analyzing spatial imbalances in the potential access to health care is particularly interesting in the case of Piedmont for three main reasons:

a. The territorial morphology is highly differentiated among mountain, upland and lowland areas. Hence, identification of potentially under-served areas is a significant issue for regional healthcare policies.

b. While the regional area accounts for nearly 8.4 per cent of the national territory, the number of municipalities (1,206) represents 15 per cent of the entire country. Therefore, the small average size of towns allows for accurate measurement of residents' potential access to care , avoiding biases from the definition of the spatial units (Hewko et al., 2002).

c. Finally, the Regional Health Service (RHS) is one of the best performers in the country in terms of the quality of services delivered. However, its financial performance is not as good, and the regional government is strictly monitored by the central government, which since 2007 has told the RHS to restructure the hospital network in order to cut inefficient spending and deficit.

POTENTIAL ACCESS TO HEALTH CARE

Spatial inequalities in potential access to health care

This section describes the spatial imbalances in the potential access to the nearest hospitals given the current hospital network. Several works have discussed the different methods with which to describe hospital service areas (Schuurman et al., 2006). Similarly to some previous studies (Amram et al., 2016), in this paper potential access is measured by the shortest distance between a municipality (geographic centroid) and the nearest hospital providing the service. Distance is expressed in terms of travel time by car. Data, collected from Google Maps[1], account for the different morphological characteristics of the region: for instance, the presence of mountain areas, which are likely to make journeys longer.

The indicator of potential access is calculated for the provision of a set of eight basic healthcare services.[2] We focus on basic care for two main reasons: first because potential

[1] In particular, distances are obtained using the STATA routine *traveltime3* developed by Bernhard (2013).

[2] The DRG included in the analysis are DRG 6 (carpal tunnel release), DRG 42 (intraocular procedures except retina, iris and lens), DRG 119 (vein ligation & stripping), DRG 229(hand and wrist proc, except major joint proc w/o CC), DRG 359 (uterine and adnexal procedures for non-malignancy without CC), DRG 371 (cesarean section w/o cc), DRG 381 (abortion with D and C, aspiration curettage or hysterotomy), DRG 410 (chemotherapy without acute leukemia as secondary diagnosis).

access to these particular services should be guaranteed to all citizens; second because for several basic treatments the empirical evidence on the Italian NHS suggests that patients tend to gravitate close to the place of residence (e.g., Fabbri and Robone, 2010).

Potential access is very similar across the eight services analyzed, and. ifor all of them, at least 10 per cent of municipalities have a minimum distance to the closest hospital of more than 31.8 minutes.[3]

Taking caesarean deliveries (DRG 371) as an example, Figure 1 shows the map of towns[4] in Piedmont characterized by the lowest potential access. [5]

These are peripheral areas, mainly in the western and northern part of the region, where the Alps make the natural border with France and Switzerland, and the resident population cannot easily access services beyond that border.

INSERT FIGURE 1 ABOUT HERE

Moreover, all these villages are located in mountain (71 out of 84) or upland (13) areas, with poor road and railway connections with other Italian regions. Only about 24,700 people are involved. Nevertheless, the evidence reported in the map highlights two important policy issues.

First, municipalities with the lowest potential access to health care define a spatial cluster clearly visible from Figure 1 and confirmed by the Moran's I spatial autocorrelation test reported in Table 1. The geographical association of remoteness is persistent and statistically significant, also considering alternative specification of the distance matrix. This finding warns that, at least above a certain threshold of travel time, the organization of the network of public providers is inefficient due to the morphological structure of the region,

[3] Descriptive statistics on the minimum distance to the closest hospital are provided in Table A1, Appendix A.
[4] Polygons represent the municipalities' boundaries.
[5] Empirical evidence on the remaining seven services is consistent with that referred to DRG 371 and available from the authors upon request.

which makes it difficult to serve part of the population. As suggested by Burkey (2012), solutions may involve the expansion of transport services such as shuttles and helicopters to facilitate the access of people living in remote areas.

INSERT FIGURE 2 ABOUT HERE

The second finding concerns the disparities among morphological areas. Figure 2 shows the potential access to the nearest hospital for four groups of municipalities with different morphological characteristics. The travel time for all the towns included in the metropolitan area of Torino – the regional capital – is less than 20 minutes, while 40 per cent of mountain villages have an indicator of potential access higher than 30 minutes. In general, rural areas are therefore characterized by a disadvantage in the access to services.

INSERT TABLE 1 ABOUT HERE

Inequalities in potential access to health care and some indicators of deprivation

The previous section pointed out the occurrence of spatial inequalities in the access to health care services. We now explore whether these spatial imbalances are associated with other socioeconomic disparities. Many studies provide evidence on the association between poor potential access and other indicators of deprivation. For instance, the areas most distant from providers are often those marked by the lowest average level of per capita income and educational attainment and by the highest rates of unemployment (e.g., Hare and Barcus, 2007). To investigate the issue, we collected a set of municipal-level indicators whose detailed descriptions are available in Table A2 in Appendix A. Table 2 shows the results of an analysis of variance (ANOVA) across groups of towns.[6] Municipalities with a potential access to the nearest hospital of more than 40 minutes were contrasted to those below this threshold.

INSERT TABLE 2 ABOUT HERE

The results highlight significant differences in the socioeconomic characteristics of the two groups of towns. Less accessible communities are rural villages with low population density. More than 38 per cent of the residents in these areas are over 60 years old, a proportion significantly higher than the average of the rest of the region (31 per cent). The share of population with tertiary education is lower than in the other municipalities. Finally, poor potential access is associated with an average level of income well below the regional per capita level. This evidence conveys an important message to policy makers: citizens experiencing the most difficult access to health care services are also those characterized by an above-average level of socioeconomic deprivation.

REVEALED ACCESS TO HEALTH CARE SERVICES

From service availability to utilization

After determining the occurrence of spatial inequalities in the potential access to health care, the issue addressed in this section concerns the link between peripheral locations and the actual utilization of services. We analyze in particular two distinct behaviors. The first is the frequency of utilization of healthcare services for communities characterized by different degrees of potential access. Previous literature has pointed out a "distance decay effect": hospitalization rates tend to decrease as the distance from the hospital increases, since patients incur a higher cost to access care; this evidence has been found for different types of

[6] As above, the evidence in Table 2 refers to the provision of caesarean deliveries (DRG 371). Evidence on the other seven DRG is fully consistent and available from the authors upon request.

diagnoses and socioeconomic groups of patients (Mayer, 1983; Brustrom and Hunter, 2001; Lin et al., 2002; Arcury et al., 2005). Based on these findings, the first hypothesis that we test is that, *ceteris paribus*, more peripheral areas are characterized by lower hospitalization rates.

The second issue in which we are interested is patients' mobility. As discussed above, in the Italian NHS patients are free to choose where to be hospitalized considering all hospitals within and outside the administrative boundaries of the LHA where the patient is resident. This choice can be assumed to rely on three distinct factors: (*1*) the minimization of travel costs from the place of residence to the hospital; (*2*) the maximization of the medical quality of the service; (*3*) the preference for a specific hospital, unrelated to the medical quality of services but based on factors like, for instance, the proximity to relatives or friends. Therefore, when patients decide where to be hospitalized, they have to collect information on the alternative providers of the service in order to understand whether the quality of non-nearest options compensates the extra travel costs that they will have to cover. Our assumption is that - whenever patients want to compare the quality of different hospitals - residents in peripheral areas face higher costs of information collection for two main reasons. The first is because an increase in the physical distance between the place of residence and the nearest hospital raises the travel costs for a *direct* access to this information.[7] The second is because peripheral areas are also those characterized by the lowest levels of population density (Table 2); as a consequence, residents are also less likely to have an *indirect* access to relevant information via other patients' experiences. These higher costs mean that patients living in remote areas are less likely to select a hospital facility more distant than the closest one. Based on this reasoning, the second hypothesis which we test is that, when they need to

[7] Information on the quality of alternative health care providers could also be collected on the Internet (Tsouri et al., 2016). Nevertheless, in 2008 only 53.7 percent of households in Piedmont were using the Internet, and the diffusion of this technology was considerably lower in rural areas. Moreover, in the same year, only 11.9 percent of the population chose Internet to contact a doctor (OICT, 2010).

be hospitalized, patients located in more peripheral areas are, *ceteris paribus*, more likely to choose the closest hospital.

Data on hospital discharges

In order to investigate the relationship between potential and revealed access it is necessary to collect data on hospital discharges. We considered data from the Piedmont Hospital Discharge Register (HDR) for the period 2006-2010. The register includes all the discharges of Piedmontese residents from Piedmontese hospitals, both public and private licensed.[8] Besides information on some individual characteristics of the patients (age, gender, level of education, family and occupational status, nationality) and on the hospitalization episode (type of treatment and relative DRG code, length of stay, number of diagnoses), the HDR includes information on the municipality of residence of each patient, so that it is possible to calculate the physical distance between this residence and the hospitals offering the specific treatment.

Revealed access to health care: municipal hospitalization rates

Model specification

We first focused on the relationship between potential access and the frequency of use of healthcare services. For all the 8 DRGs defined above and for each of the 1,206 municipalities in Piedmont, we computed a weighted municipal-specific hospitalization rate (*WMHR*), where the weights were the number of discharges for the relevant age cohorts (in the case of birth deliveries, for instance, we considered the resident population of women of childbearing age). The frequency-adjusted use of health care services was then regressed on a set of

[8] Data were kindly supplied by the Assessorato alla Sanità of the Regione Piemonte, the public body responsible for the provision of health care services within the region. Data are not publicly available but they can be obtained for research purposes upon request.

controls, including the potential access indicator, defined above as the travel time by car from the patients' municipality of residence to the nearest hospital providing the specific service (*potential access*). Our model took the following specification:

$$WMHR_m = \beta_0 + \beta_1\, potential\ access_m + \beta_2\, av.\ pc\ income_m + \qquad [1]$$

$$+\beta_3 pop.density_m + \beta_4\, metropolitan\ area_m + \beta_5\, distance\ to\ Milano_m + \varepsilon_m,$$

where the other controls defined at the municipality level *m* include:

(*i*) Average per capita income (*av. pc income*). The impact of this variable is not clear *a priori*. On the one hand, low-income communities are those with the lowest rates of overall service utilization (Cromley and Lafferty, 2002). On the other hand, in the case of some specific diseases, hospitalization rates are negatively associated with income, since wealthier patients access preventive care services, thus avoiding acute episodes (Dowler, 2001).

(*ii*) Population density (*pop. density*), to control for the clustering of hospital facilities in urban areas. In this regard, the literature has pointed out that knowledge spillovers resulting from the concentration and competition of hospitals may yield better health outcomes (Bates and Santerre, 2005). As a further check for the impact of these "agglomeration economies" on the frequency of use of hospital facilities, we included a dummy variable (*metropolitan area*) equal to one for the 53 municipalities belonging to the Torino metropolitan area.

(*iii*) Finally, we considered the distance between each town and Milano (*distance to Milano*) to account for the fact that discharges of residents from hospitals outside the regional borders were not included in our data. Since interregional mobility outflows are mainly directed towards Lombardy and the eastern part of the country, facilitated by the Po Plain and the availability of a good network of roads and transports, we expected (at least for some

DRGs) an underestimation of hospitalization rates measured in our analysis for municipalities close to Milano, which is both an attraction pole for all its hospitals (some highly specialized and of very good quality) and the hub for connection with other cities in the north-eastern part of the country.[9]

Results

Regression results are reported in Table 3. Two specifications were estimated for each DRG: in the first specification (model [a]), hospitalization rates were regressed only on *potential access*; all the other controls discussed above were then added in the second specification (model [b]). Spatial autocorrelation tests showed the occurrence of spatial dependency in OLS estimates (Table B1 in Appendix B). Based on this evidence, Spatial Error Models (SEM) were used for the empirical analysis .[10]

The empirical findings showed that potential access was associated in five cases out of eight with lower hospitalization rates, while coefficients were not statistically significant in the remaining cases. This evidence supports the “distance decay effect” usually found in the literature: residents in peripheral areas utilize healthcare services less than other citizens.

This evidence is also robust when controlling for the other factors at the municipal level. The distance to Milano is statistically significant and with a positive sign, implying that municipalities closer to Milano are characterized by lower hospitalization rates also because of the unobserved outflows of patients. The relationship between the frequency of usage, on

[9] According to the Italian Ministry of Health, more than 60 percent of Piedmontese patients receiving health care services outside their region of residence are directed towards hospital in the neighboring region Lombardy, whose capital is Milano. Given the peripheral location of Piedmont, in the North-western corner of Italy, the distance from each of its municipalities to Milano is positively correlated to the distance to other major cities in Lombardy and in other regions in the North-eastern part of the country. Therefore, the inclusion in our model of travel time distance to Milano represents the relationship between revealed and potential access to health care from the effects due to the proximity of the municipality to hospitals outside the regional borders.

[10] The spatial weights matrix employed in the analysis was an inverse distance matrix with distance band equal to the largest minimum one. The results were consistent under other specifications of the spatial weights. In the case of DRG 42, model [b] OLS estimates are reported, based on the results of the spatial autocorrelation analysis.

the one hand, and population density and per capita income on the other, varies across different medical treatments, but - when the related coefficients are significant - lower population density or poorer communities are always associated with lower hospitalization rates. The results reported for model [b] show that a peripheral location is, *per se*, often associated with lower hospitalization rates, and this effect is reinforced when remoteness is combined with other indicators of socioeconomic deprivation.

INSERT TABLE 3 ABOUT HERE

Revealed access to health care: individual patients' mobility

Defining patients' mobility

The second dimension of revealed access on which we focus is the mobility of patients to alternative hospital facilities with respect to the closest-to-home solution.

A conceptual issue in the analysis of patients' mobility is the definition of mobility itself. In most empirical works, mobility is simply based on administrative criteria. However, disregarding the spatial proximity between the patients' place of residence and all the providers of the service, this approach suffers from a major limitation. Consider for instance two neighboring LHAs, A and B, represented in Figure 3. Both LHAs are provided with a hospital, respectively H_A and H_B. Suppose that H_A is close to the south-western border of its administrative area, while H_B is close to the north-western border of LHA B. Consider now a patient living in town C, within the LHA A. If s/he goes to the hospital located in the LHA B (H_B), according to the mainstream approach s/he would be classified as a mobile patient and the motivations of this behavior would be sought among the characteristics of the healthcare services supplied (for instance, the quality-maximizing behavior discussed above). Nevertheless, if the distance between town C and H_B is lower than the distance to H_A, the choice may be based only on the minimization of travel costs. In other words, the patient may not necessarily prefer the hospital facility of the LHA B because of higher quality, but simply because it is the most accessible one.

INSERT FIGURE 3 ABOUT HERE

Neglecting this issue would lead to biased results, especially when mobility within a small area is analyzed. In the Italian case, in fact, empirical analyses on patients' migrations have mainly explained long-distance mobility from southern to northern LHAs characterized by a broadly recognized divide in the quality of the services provided (Levaggi and Zanola, 2004; Fabbri and Robone, 2010). To avoid the bias, in what follows we define mobility by considering physical distance instead of administrative borders. Hence, a resident in C is mobile if s/he decides to consume health care services offered by H_A, avoiding the closest solution H_B. Following discussion from the previous sections, we expected the residents in more peripheral areas to be more likely than the others to choose the nearest provider. Our empirical investigation of this hypothesis is described in what follows.

Model specification

This section presents the model investigating the decision to choose a hospital more distant than the closest one. It is important to note that, while the analysis reported in the previous section considered the relationship between potential access and the *average* hospitalization rate of each municipality, the effect of potential access on patients' mobility was now studied at the *individual* level.

In particular, an indicator of individual mobility was regressed on a set of covariates which included the travel time by car to the nearest hospital (our indicator of *potential access* defined above and log transformed).[11] The model took the following general form:

$$Mobility_i = \theta log(potential\ access_m) + \alpha X_i + \beta Q_h + \gamma S_m + u_h + \tau_t + \varepsilon_i \qquad [2]$$

where *i* stands for the patient, *h* for the hospital, *m* for the municipality of residence, and *t* for the year. The dependent variable *Mobility* was defined as the ratio between the actual extra-distance (in terms of travel time) covered by the patient with respect to the nearest facility and the minimum distance s/he could have traveled if s/he had chosen the closest hospital (*Mobility = Δ distance with respect to minimum / minimum distance*).[12] Since this indicator captures a relative dimension of mobility, to control the robustness of our results we also tested two alternative definitions of *Mobility*, where the previous relative indicator was replaced by binary variables equal to 1 if the difference between the distance traveled by the patient and the closest facility was respectively higher than 30 and 45 minutes, and equal to 0 otherwise (*Mobility = 1 if Δ distance with respect to minimum > 30/45 minutes*). When *Mobility* took the form of a binary variable, Linear Probability Models (LPM) replaced multiple linear regressions.[13]

[11] The information about the place of residence is available only at the municipal level. Therefore, we do not know whether, within the same municipality, the patient chose the closest hospital or not. This concern arises in the case of Torino, which is endowed with several hospitals. Hence, we decided to classify as non-mobile all those patients who live in Torino and received the health care service in the same city. This choice is, in our opinion, appropriate since the commuting time from one part of the city to another one is extremely low. As discussed below, in this paper we are particularly interested in studying the mobility of patients when the difference in the distance to alternative hospitals reaches a minimum threshold of time and thus implies a relevant additional cost for the patient.

[12] Descriptive statistics in Table A3, Appendix A show that the maximum extra-time covered by patients in our sample is 34.69 times the distance to the closest solution.

[13] The same findings are obtained under alternative specifications of the model, such as binomial probit or logit. Results are available from the authors upon request.

Controls were classified into three main categories (see Table A4 in Appendix A). The first group comprised *individual characteristics* (X_i) such as gender, age and education. These factors were expected to play a role in the decision on where to receive the medical treatment. The family network, for instance, is likely to be linked to the propensity to move away from the nearest hospital. Italian citizens are expected, compared with foreigners, to have better information about the quality of the service provided. Higher education may have contrasting effects on patients' mobility. On the one hand, high-educated patients may be better able than low-educated ones to assess hospitals' quality, which would lead to higher mobility rates. On the other hand, they may also be more likely to be personally connected with people employed in hospitals. They may therefore have easier access (such as shorter waiting times) to the closest facility, which would imply lower mobility rates. Two other variables at the individual level are the occurrence of multiple diagnoses and the length of stay (LOS): the most problematic patients should also be those considering alternative providers of the service more carefully.

The second group of explanatory variables was a set of controls defined at the *hospital level* (Q_h). As regards the supply characteristics of hospital facilities, our controls included the yearly number of discharges (which reflects the overall size of the provider), the yearly number of discharges for the DRG under consideration (a proxy for the hospital specialization), and a dummy equal to 1 if the hospital was privately-owned and equal to 0 otherwise. The quality of healthcare services was proxied by three indicators, all defined with reference to the specific DRG analyzed: the LOS, the occurrence of Day Hospital (DH) discharges over the total treatments, and the relative number of cases of repeated hospitalization within the same year.

The third group of controls included *socioeconomic and spatial characteristics* at the *municipal level* (S_m), considering both the place of residence and the destination facility of patients. We once again considered population density and average per capita income, based on the assumption that they may have an influence on individuals' behavior. Again, the distance to Milano was included to account for unobserved interregional mobility flows.[14] A dummy variable equal to 1 if the hospital providing the medical treatment was located in Torino accounted for urbanization economies typical of large urban areas. Given city size and the multifunctional activities located in Torino, the assumption was that patients may prefer to be hospitalized in the chief town simply because it is characterized by additional services or linkages not available elsewhere (e.g., the patient may work in that city or have social connections there).

Finally, to account for unobserved characteristics of health care providers and for time fixed effects, we included in all specifications two sets of dummies, respectively at the hospital (u_h) and year level (τ_t). Standard errors were cluster-robust at the municipal level, based on the place of residence of the respondent.

Results

For each of the eight DRGs analyzed we estimated three models. The first one (model [a]) included the measure of *potential access* and the individual characteristics of the patients (X_i). The second specification (model [b]) controlled also for factors defined at the hospital-level (Q_h) and for potential (unobserved) outflows of patients to Milano. Finally, model [c] extended the previous ones to account for socioeconomic and spatial features of the

[14] We expect that, *ceteris paribus*, the higher the distance to Milano, the higher the probability that the patient will choose a hospital more distant than the closest one. This assumption is based on the fact that people living close to the regional border have a broader choice of hospitals (those outside the region) we are not able to control for.

municipalities (S_m). For the sake of brevity, Table 4 reports only the coefficients for our measure of potential access for all the three alternative definitions of *Mobility*. The results, reported in Table 4, are strongly consistent across mobility definitions and model specifications.

INSERT TABLE 4 ABOUT HERE

Potential access always has a strong and negative effect on our mobility measures: for all the DRGs considered, people living in less accessible municipalities are less likely to move away from the nearest hospital, consistently with the presence of a "distance decay effect". Take for instance DRG 6 and *y = 1 if Δ distance with respect to minimum > 30 minutes*: considering estimates in model [c], a 100 percent increase in potential access (e.g., from 10 to 20 minutes of travel time needed to reach the closest hospital) implies a reduction of about 0.13 in the probability of choosing a hospital more distant (by at least 30 minutes) than the closest one. As regards the other covariates included in the model[15], the dummy for the hospitals located in Torino has mostly a significant and positive coefficient, reflecting the differentiated supply of health providers and the role of "urbanization economies". Additionally, the travel time distance to Milano is positively correlated with the probability of selecting a hospital that is not the nearest one, most likely because we were unable to directly control for the behavior of those patients that were closer to Milano and often chose a hospital outside the Piedmont RHS.

The relationship between individual characteristics (X_i) and mobility varies across the different types of treatments. The only factor whose impact is consistent across the eight

[15] Complete tables are not included for brevity. Full results for the first specification of the dependent variable (y = Δdist. /min. dist.) are available in Table B2, Appendix B. The other results are available upon request from the authors.

DRGs analyzed is the nationality of the patient: as expected, foreigners are less likely than Italians to move away from the nearest hospital. Lower levels of cultural proximity therefore appear to obstruct comparison among alternative healthcare providers. As regards the role of the family network, married people are in general less likely to travel more than the minimum distance. The same applies – even if coefficients are not always significant and stable across DRGs –to high-educated patients, suggesting an easier access to the healthcare provider close to their place of residence. Finally, both the individual LOS and the number of diagnoses do not show a clear correlation pattern with the mobility indicator.

Mixed results also characterize the set of variables defined at the hospital level (Q_h). In light of previous studies on patients' choices this evidence is not surprising. For instance, Moscone et al. (2012) pointed out that patients' hospital choices are mainly driven by social interactions that may lead, due to information asymmetries, to the selection of sub-optimal hospitals in terms of the quality of the service provided. This assumption is consistent with results reported in Table B2, Appendix B, where objective indicators for the characteristics and the quality of healthcare providers are poorly statistically significant.

As regards socioeconomic and spatial features of municipalities (S_m), both population density and average per capita income are associated with lower departures from the minimum travel time to the nearest hospital. These two variables capture the benefit of living in urban and peri-urban municipalities in the Po Valley, characterized by the highest levels of wealth and population density and, also, by a marked spatial proximity to different hospitals.

CONCLUDING REMARKS

Our analysis provided new evidence on the strong association between potential access and the utilization of healthcare services within a region in Europe. Three main findings emerged from the study. First, potential access is far from being uniform within the region. Peripheral, mountain areas are those associated with the lowest degree of access to health care. Moreover, the distance to the nearest hospital is also strictly related to other indicators of socioeconomic deprivation. This situation is likely to worsen in the future, assuming the potential occurrence of a vicious cycle: the lack of easy access to basic services may induce further depopulation of these alpine communities, with the migration of young people to urban areas, which in turn will make it even more difficult to justify – from an efficiency point of view – policies aimed at improving access for the few who decide to remain.

Second, people living in places marked by poor potential access tend to use healthcare services less than other citizens. This effect is reinforced when peripheral location is associated with low levels of average income and population density. The cost of commuting from the place of residence to the hospital reduces the probability of receiving the treatment, which implies – assuming homogeneous healthcare needs within the region – that part of the demand is not met by the supply. Put differently, the right to health care is not guaranteed equally to all citizens.

Third, people living in places marked by poor potential access are also less mobile than other citizens. This means that citizens residing in these areas tend to use healthcare facilities less than those living elsewhere and, when they do, are more likely to choose the nearest hospital. As before, this mechanism is reinforced when poor potential access combines with socioeconomic deprivation.

The policy implications of this analysis are important, especially in countries like Italy where the right to health care for all citizens is supposed to be constitutionally guaranteed, and remote areas represent a large part of the country. The analysis could be extended to other European health care systems characterized by similar (or even stronger) divides between core urban centers and a periphery of small towns. An interesting case study would be, for instance, that of Catalonia in Spain, another country where healthcare policies are devolved to regions within a set of constitutionally defined rules. Our results call for innovative ways to provide services in order to achieve two potentially contrasting goals: efficiency and equity. The current policy debate rarely deals with these issues, but our findings show that they should be included on the political agenda.

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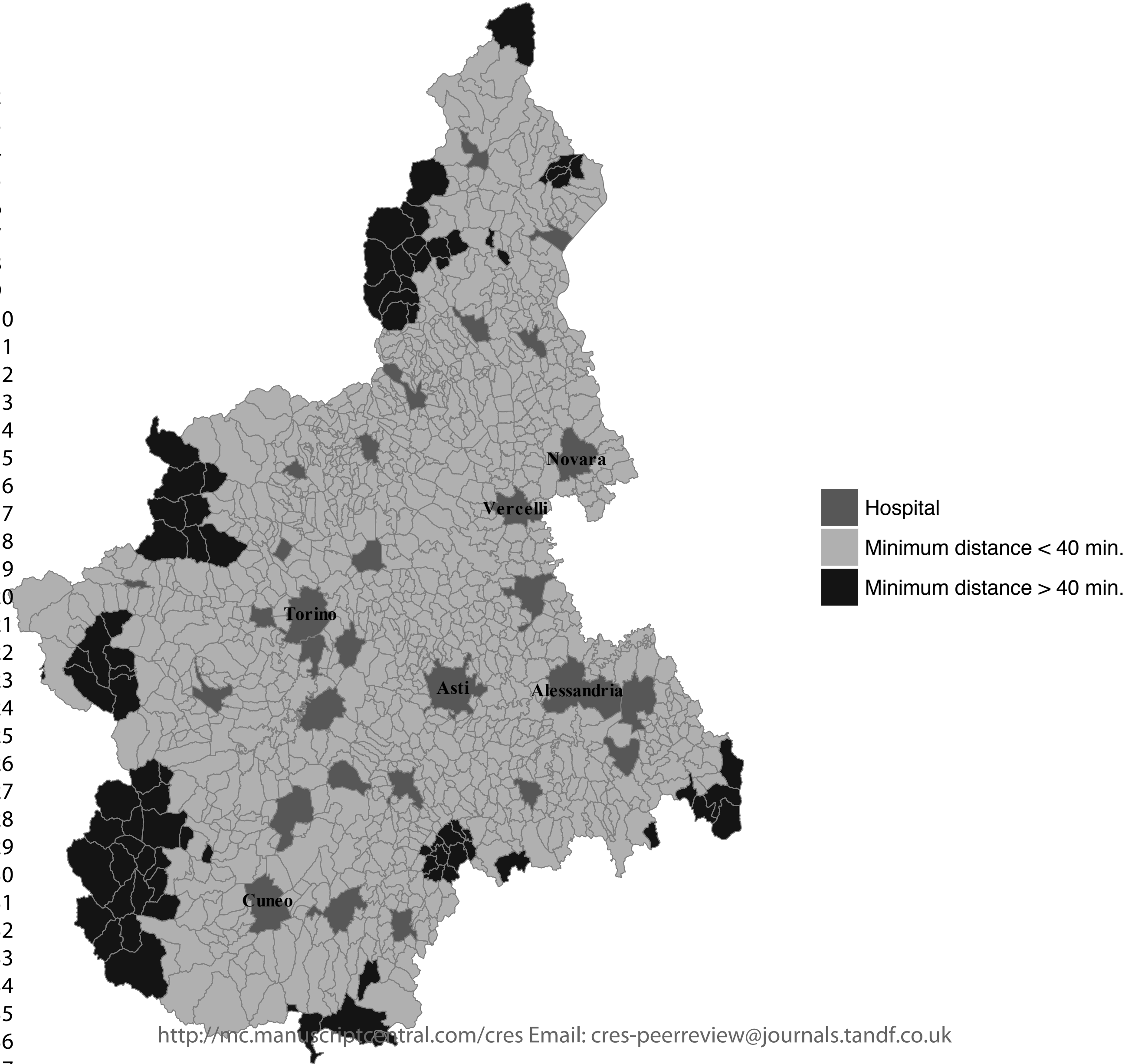
Novara
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Minimum distance > 40 min.

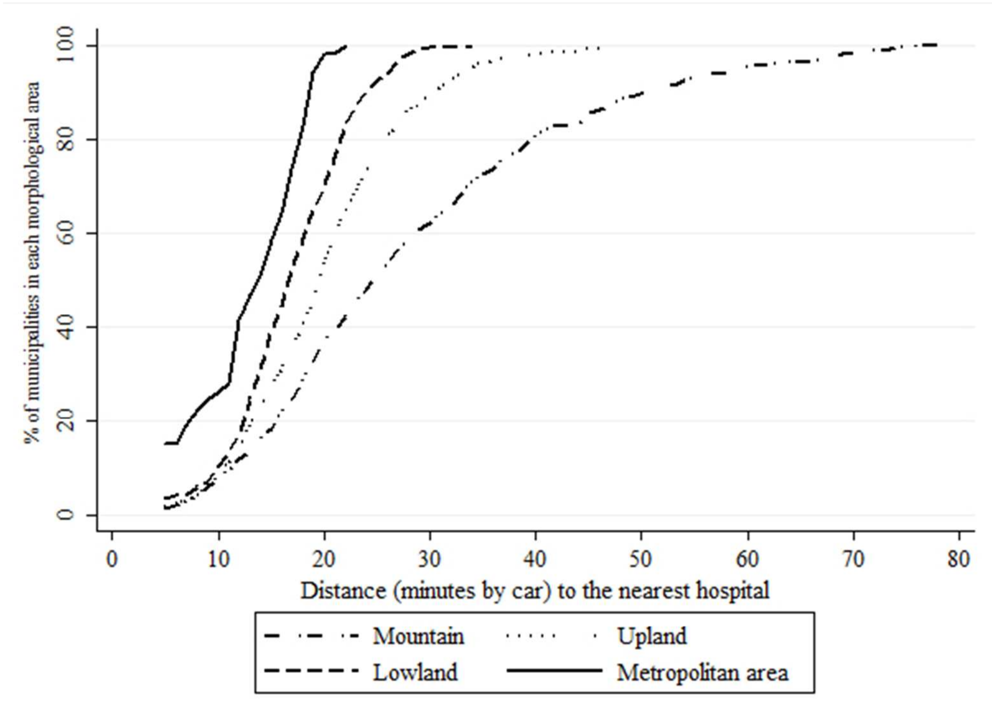

Figure 2. Potential access of Piedmontese municipalities with different morphological characteristics to the closest hospital providing caesarean deliveries (DRG 371).

213x155mm (72 x 72 DPI)

Figure 3. Definition of mobility: LHA A and LHA B

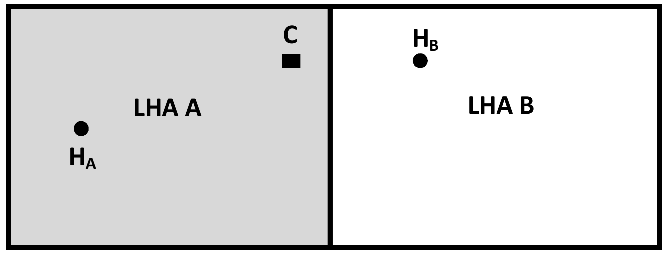

Table 1. Measures of global spatial autocorrelation (Moran's I)

Variable	Distance band: 25 km		Distance band: 50 km	
	Inverse distance matrix	Binary matrix	Inverse distance matrix	Binary matrix
Min. distance to the nearest hospital	0.243***	0.320***	0.141***	0.044***
Average distance to the 3 nearest hospitals	0.144***	0.261***	0.213***	0.123***

Table 2. Potential access (distance to the nearest hospital) and some socioeconomic indicators: ANOVA results (DRG 371).

Variable	Distance < 40 min. (n=1,122)	Distance > 40 min. (n=84)	F-value
Population density	168.13	11.07	20.44 ***
% of pop. over 60	0.31	0.38	109.39 ***
% of graduated residents	0.07	0.06	13.45 ***
Average income	18,675.14	14,878.21	140.70 ***

Source: authors' own elaborations.

Table 3. Estimates of equation [1]: hospitalization rates in Piedmont's municipalities as a function of potential access and other controls.

	DRG 6		**DRG 42**		**DRG 119**		**DRG 229**	
VARIABLE	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**
Potential access	-0.006***	-0.010***	-0.007***	-0.009***	0.002	-0.002	0.003	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Av. pc income		0.016***		0.016		0.021***		0.011***
		(0.006)		(0.010)		(0.005)		(0.004)
Pop. density		-0.018		0.030		0.066		0.027
		(0.031)		(0.038)		(0.043)		(0.027)
Metropolitan area		-0.071		-0.088		0.060		-0.031
		(0.052)		(0.064)		(0.046)		(0.031)
Distance to Milano		0.007***		0.004***		0.005***		0.003***
		(0.001)		(0.001)		(0.001)		(0.001)
Constant	1.045***	0.086	1.019***	0.403*	0.793***	0.020	0.338***	0.029
	(0.081)	(0.066)	(0.110)	(0.237)	(0.085)	(0.030)	(0.052)	(0.018)
Observations	1,206	1,206	1,206	1,206	1,206	1,206	1,206	1,206
	DRG 359		**DRG 371**		**DRG 381**		**DRG 410**	
VARIABLE	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**	**Model [a]**	**Model [b]**
Potential access	-0.001	-0.008*	-0.010***	-0.011***	-0.029***	-0.035***	-0.006	-0.004
	(0.005)	(0.005)	(0.002)	(0.002)	(0.011)	(0.013)	(0.004)	(0.004)
Av. pc income		0.044***		0.056		0.020		0.060***
		(0.010)		(0.044)		(0.035)		(0.009)
Pop. density		0.066		-0.055		0.344***		-0.073
		(0.077)		(0.157)		(0.133)		(0.081)
Metropolitan area		0.018		0.509**		-0.016		-0.293***
		(0.123)		(0.257)		(0.228)		(0.096)
Distance to Milano		0.008***		0.010**		0.011***		0.004**
		(0.002)		(0.004)		(0.004)		(0.002)
Constant	1.223***	0.065	5.814***	3.743***	5.265***	3.721***	1.394***	0.068
	(0.144)	(0.057)	(0.313)	(1.038)	(0.327)	(0.905)	(0.146)	(0.054)
Observations	1,206	1,206	-0.010***	-0.011***	1,206	1,206	1,206	1,206

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimates of equation [2]: propensity to move away from the nearest hospital under different definitions of the dependent variable (y).

		y = Δdist./min. dist.			***y = 1 if Δdist. > 30 minutes***			***y = 1 if Δdist. > 45 minutes***		
		Model [a]	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**
DRG 6	*Potential access (log)*	-0.974***	-1.104***	-1.410***	-0.071***	-0.096***	-0.132***	-0.021***	-0.032***	-0.041***
		(0.137)	(0.139)	(0.128)	(0.023)	(0.024)	(0.024)	(0.008)	(0.009)	(0.009)
	Observations	25,057	25,048	25,048	25,057	25,048	25,048	25,057	25,048	25,048
	R-squared	0.194	0.217	0.227	0.116	0.146	0.160	0.067	0.087	0.092
DRG 42	*Potential access (log)*	-1.979***	-1.999***	-2.483***	-0.142***	-0.153***	-0.244***	-0.089***	-0.085***	-0.112***
		(0.322)	(0.318)	(0.310)	(0.040)	(0.042)	(0.039)	(0.024)	(0.022)	(0.026)
	Observations	18,782	18,782	18,782	18,782	18,782	18,782	18,782	18,782	18,782
	R-squared	0.223	0.230	0.259	0.125	0.137	0.208	0.095	0.104	0.116
DRG 119	*Potential access (log)*	-1.300***	-1.494***	-1.890***	-0.091***	-0.136***	-0.199***	-0.037**	-0.054***	-0.068***
		(0.162)	(0.165)	(0.155)	(0.030)	(0.030)	(0.030)	(0.015)	(0.016)	(0.017)
	Observations	32,512	32,512	32,512	32,512	32,512	32,512	32,512	32,512	32,512
	R-squared	0.250	0.294	0.308	0.144	0.230	0.253	0.102	0.138	0.141
DRG 229	*Potential access (log)*	-0.911***	-1.116***	-1.407***	-0.063***	-0.097***	-0.123***	-0.022**	-0.039***	-0.036***
		(0.163)	(0.160)	(0.154)	(0.021)	(0.021)	(0.023)	(0.009)	(0.011)	(0.009)
	Observations	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356
	R-squared	0.202	0.241	0.248	0.134	0.184	0.191	0.078	0.111	0.113
DRG 359	*Potential access (log)*	-1.329***	-1.399***	-1.783***	-0.097***	-0.111***	-0.166***	-0.049***	-0.051***	-0.076***
		(0.147)	(0.152)	(0.143)	(0.022)	(0.023)	(0.022)	(0.014)	(0.013)	(0.015)
	Observations	36,377	36,377	36,377	36,377	36,377	36,377	36,377	36,377	36,377
	R-squared	0.264	0.299	0.311	0.154	0.201	0.220	0.103	0.151	0.160
DRG 371	*Potential access (log)*	-0.503***	-0.532***	-0.843***	-0.076***	-0.085***	-0.131***	-0.032***	-0.030***	-0.053***
		(0.123)	(0.124)	(0.139)	(0.019)	(0.020)	(0.020)	(0.009)	(0.009)	(0.011)
	Observations	31,741	31,741	31,741	31,741	31,741	31,741	31,741	31,741	31,741
	R-squared	0.208	0.213	0.238	0.139	0.150	0.181	0.098	0.100	0.124
DRG 381	*Potential access (log)*	-0.784***	-0.856***	-1.212***	-0.085***	-0.102***	-0.158***	-0.030***	-0.032***	-0.053***
		(0.119)	(0.122)	(0.121)	(0.020)	(0.021)	(0.020)	(0.009)	(0.009)	(0.012)
	Observations	40,692	40,692	40,692	40,692	40,692	40,692	40,692	40,692	40,692
	R-squared	0.210	0.223	0.243	0.106	0.135	0.170	0.050	0.053	0.069
DRG 410	*Potential access (log)*	-0.862***	-1.014***	-1.614***	-0.053**	-0.081***	-0.159***	-0.027**	-0.036***	-0.075***
		(0.197)	(0.179)	(0.159)	(0.026)	(0.024)	(0.026)	(0.012)	(0.014)	(0.016)
	Observations	70,256	70,256	70,256	70,256	70,256	70,256	70,256	70,256	70,256
	R-squared	0.217	0.258	0.319	0.104	0.179	0.242	0.068	0.082	0.122

Standard errors (cluster-robust at the municipal level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Equation [A] includes only the individual controls, equation [B] adds the hospital-level variables and the full specification (equation [C]) includes also the socioeconomic controls for the municipality of residence.

APPENDIX A – Data

Table A1. Minimum distance (in minutes by car) to the closest hospital providing the treatment: descriptive statistics on Piedmontese municipalities.

DRG	10th percentile	25th percentile	Median	75th percentile	90th percentile
DRG 6	9.1	12.5	17.2	22.9	31.8
DRG 42	11.0	14.8	20.7	28.0	37.8
DRG 119	9.0	12.4	17.0	23.0	31.8
DRG 229	8.9	12.3	17.1	22.9	31.8
DRG 359	9.5	12.9	18.1	24.5	33.4
DRG 371	11.0	14.3	19.3	25.2	33.5
DRG 381	9.9	13.2	18.4	24.2	33.2
DRG 410	9.5	12.9	18.2	24.4	33.4

Table A2. Socioeconomic indicators at the municipal level: source and description of the data

Indicator	Description	Source	Mean	Min.	Max.
Population density	Density of resident population per square kilometer	ISTAT	157.19	0.92	6,709.94
% of pop. over 60	% of resident population over 60 years	ISTAT	0.31	0.17	0.66
% of graduated residents	% of resident population with tertiary education (ISCED level 5 and 6)	ISTAT, Census data (2011)	0.07	0.00	0.26
Average income	Average income of the resident population	Ministry of Economy and Finance (2011)	18,413.25	6,879.00	35,530.00

Appendix A3. Descriptive statistics for patients' mobility (y = Δdist./min. dist.) and potential access.

	Patients' mobility			***Potential access***		
	Mean	Min.	Max.	Mean	Min.	Max.
DRG 6	1.87	0.00	32.37	10.52	5.00	69.15
DRG 42	2.28	0.00	34.69	12.42	5.00	79.13
DRG 119	2.24	0.00	28.91	10.10	5.00	74.93
DRG 229	1.97	0.00	22.97	10.61	5.00	74.33
DRG 359	2.23	0.00	22.97	10.41	5.00	72.55
DRG 371	1.35	0.00	25.82	11.97	5.00	72.33
DRG 381	1.47	0.00	22.97	10.51	5.00	72.33
DRG 410	1.85	0.00	25.58	10.29	5.00	73.72

Table A4. Description of the explicative variables for patients' mobility.

Variable	Description
potential access	Minimum travel time by car from the municipality of residence of the respondent to the nearest hospital facility.
INDIVIDUAL CHARACTERISTICS (X_i)	
female	Dummy equal to1 if the patient is a woman and 0 otherwise.
age	Age of the respondent (a quadratic term is added to check for non-linear effects).
nationality	Dummy equal to 1 if the patient is Italian and 0 otherwise.
family status	Set of dummies for the family status of the patient. Single person is the reference category; the other groups are: married, separate/divorced, widow.
education	Dummy equal to 1 if the patient is graduated and 0 otherwise.
secondary diagnosis	Dummy equal to 1 for those patients with more than one diagnosis and 0 otherwise.
LOS (patient)	Length of stay of the patient.
HOSPITAL CHARACTERISTICS (Q_h)	
yearly nr. of cases (DRG-specific)	Yearly number of cases (for the DRG analyzed) treated by the hospital of recovery.
yearly nr. of cases (all DRGs)	Yearly number of cases (for all DRGs) treated by the hospital of recovery.
private hospital	Dummy equal to 1 if the hospital is privately-owned and 0 otherwise.
frequency of DH (DRG-specific)	Share of Day Hospital treatments (for the DRG analyzed) over the total treatments in the hospital of recovery.
LOS (DRG-specific)	Average length of stay (for the DRG analyzed) in the hospital of recovery.
repeated hospitalization (DRG-specific)	Share of repeated hospitalization cases (for the DRG analyzed) in the hospital of recovery.
SOCIOECONOMIC AND SPATIAL CHARACTERISTICS OF MUNICIPALITIES OF RESIDENCE (S_m)	
population density	Population density in the municipality of residence of the patient.
average per capita income	Average per capita income in the municipality of residence of the patient.
hospital in Torino	Dummy equal to 1 if the chosen hospital facility is in Torino.
distance to Milano	Travel time by car from the municipality of residence of the respondent to Milano.
OTHER CONTROLS	
hospital dummies (u_h)	Set of dummies for the unobserved characteristics at the hospital-level.
year dummies (τ_t)	Set of dummies for the unobserved characteristics at the year-level.

Appendix B. Results

Table B1. Diagnostic tests for spatial dependence in OLS regression (equation [1]).

	DRG 6		DRG 42	
	Model [a]	**Model [b]**	**Model [a]**	**Model [b]**
Spatial error				
Moran's I	1.960**	1.941**	0.539	0.677
Lagrange Multiplier	469.703***	401.762***	9.436***	1.137
Robust Lagrange Multiplier	427.468***	360.331***	10.789***	0.775
Spatial Lag				
Lagrange Multiplier	51.666***	54.047***	0.007	0.415
Robust Lagrange Multiplier	9,531***	12.617***	1.360	0.053
	DRG 119		**DRG 229**	
	Model [a]	**Model [b]**	**Model [a]**	**Model [b]**
Spatial error				
Moran's I	1.733*	1.653***	2.436**	2.198**
Lagrange Multiplier	347.834***	177.813***	779.955***	402.929***
Robust Lagrange Multiplier	333.627***	157.774***	690.735***	346.874***
Spatial Lag				
Lagrange Multiplier	14.399***	22.855***	97.816***	63.437***
Robust Lagrange Multiplier	0.192	2.816*	8.596***	7.382***
	DRG 359		**DRG 371**	
	Model [a]	**Model [b]**	**Model [a]**	**Model [b]**
Spatial error				
Moran's I	2.982***	3.088***	0.877	1.061
Lagrange Multiplier	1227.221***	964.874***	63.367***	41.605***
Robust Lagrange Multiplier	1078.277***	801.634***	47.915***	26.976***
Spatial Lag				
Lagrange Multiplier	201.751***	253.636***	39.701***	45.145***
Robust Lagrange Multiplier	52.807***	90.396***	24.249***	30.516***
	DRG 381		**DRG 410**	
	Model [a]	**Model [b]**	**Model [a]**	**Model [b]**
Spatial error				
Moran's I	0.916	1.182	2.105**	2.061**
Lagrange Multiplier	63.843***	55.303***	558.579***	339.426***
Robust Lagrange Multiplier	48.487***	38.037***	496.822***	310.293***
Spatial Lag				
Lagrange Multiplier	37.197***	47.491***	69.833***	30.036***
Robust Lagrange Multiplier	21.841***	30.674***	8.076	0.903

Table B2. Estimates of equation [2]: propensity to move away from the nearest hospital facility as a function of potential access and other controls (dependent variable y = Δdist. /min. dist.).

	DRG 6			DRG 42			DRG 119		
VARIABLE	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**
potential access (log)	-0.974***	-1.104***	-1.410***	-1.979***	-1.999***	-2.483***	-1.300***	-1.494***	-1.890***
	(0.137)	(0.139)	(0.128)	(0.322)	(0.318)	(0.310)	(0.162)	(0.165)	(0.155)
female	-0.074*	-0.054	-0.042	0.021	0.026	0.029	0.082***	0.079***	0.066**
	(0.040)	(0.039)	(0.038)	(0.061)	(0.061)	(0.060)	(0.030)	(0.029)	(0.029)
age	0.026***	0.029***	0.029***	-0.004	-0.003	0.003	0.015*	0.015*	0.015*
	(0.008)	(0.008)	(0.008)	(0.012)	(0.012)	(0.012)	(0.009)	(0.009)	(0.008)
age²	-0.000***	-0.000***	-0.000***	-0.000	-0.000	-0.000	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
nationality	0.274***	0.275***	0.281***	0.544**	0.527**	0.479**	0.501***	0.470***	0.440***
	(0.066)	(0.066)	(0.065)	(0.220)	(0.218)	(0.210)	(0.085)	(0.083)	(0.081)
married	-0.085**	-0.081**	-0.082**	-0.422***	-0.414***	-0.360***	-0.127**	-0.100*	-0.089*
	(0.035)	(0.036)	(0.037)	(0.091)	(0.088)	(0.083)	(0.054)	(0.052)	(0.053)
sep./div.	-0.005	0.006	0.015	-0.859***	-0.863***	-0.805***	0.021	0.040	0.058
	(0.087)	(0.085)	(0.085)	(0.205)	(0.199)	(0.181)	(0.083)	(0.080)	(0.081)
widow	0.016	0.021	0.016	-0.449***	-0.432***	-0.380***	-0.073	-0.058	-0.058
	(0.067)	(0.065)	(0.065)	(0.134)	(0.129)	(0.123)	(0.079)	(0.078)	(0.079)
education	0.039	0.048	0.029	0.124	0.117	0.016	-0.054	-0.048	-0.095*
	(0.056)	(0.053)	(0.052)	(0.130)	(0.129)	(0.120)	(0.046)	(0.050)	(0.052)
secondary diagnosis	0.052	0.040	0.040	-0.042	-0.001	-0.004	-0.105	-0.120	-0.121
	(0.065)	(0.065)	(0.065)	(0.061)	(0.062)	(0.061)	(0.073)	(0.078)	(0.082)
LOS (patient)	0.030*	0.033**	0.029*	0.042***	0.046***	0.040***	0.004	0.018	0.010
	(0.016)	(0.017)	(0.016)	(0.015)	(0.015)	(0.014)	(0.017)	(0.022)	(0.021)
yearly nr. of cases (DRG-specific)		-0.000	-0.000		0.000	0.000		0.000	0.000
		(0.001)	(0.001)		(0.000)	(0.000)		(0.000)	(0.000)
yearly nr. of cases (all DRGs)		0.000	0.000		-0.000	-0.000		-0.000	-0.000*
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
private hospital		2.707***	4.739***		-1.213	1.599		-0.014	0.419
		(0.923)	(1.816)		(0.811)	(1.812)		(0.679)	(1.529)
frequency of DH (DRG-specific)		-0.831	-0.489		-2.003***	-1.955***		0.151	0.230*
		(1.565)	(1.575)		(0.569)	(0.574)		(0.136)	(0.129)
LOS (DRG-specific)		0.982**	1.114**		1.112***	1.042***		0.217	0.155
		(0.468)	(0.458)		(0.377)	(0.375)		(0.160)	(0.154)
repeated hospitalization (DRG-specific)		-2.332	-2.228		1.598***	1.575***		-0.415	-0.215
		(1.636)	(1.634)		(0.594)	(0.594)		(1.012)	(0.994)
distance to Milano		0.027***	0.023***		-0.001	-0.010		0.038***	0.032***
		(0.007)	(0.007)		(0.007)	(0.008)		(0.007)	(0.008)
population density			-0.506***			-0.730***			-0.406***
			(0.098)			(0.122)			(0.115)
average per capita income			-0.081***			-0.216***			-0.156***
			(0.022)			(0.048)			(0.028)
hospital in Torino			2.244*			2.824**			0.446
			(1.177)			(1.372)			(1.157)
hospital and year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
constant	4.368***	0.321	1.398	8.951***	9.759***	13.992***	5.141***	2.493**	7.281***
	(0.438)	(1.403)	(2.058)	(0.984)	(1.437)	(2.403)	(0.500)	(0.999)	(2.008)
observations	25,057	25,048	25,048	18,782	18,782	18,782	32,512	32,512	32,512
R-squared	0.206	0.225	0.240	0.262	0.269	0.309	0.272	0.307	0.326

Standard errors (cluster-robust at the municipal level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B2.. Estimates of equation [2]: propensity to move away from the nearest hospital facility as a function of potential access and other controls – continued 1

	DRG 229			DRG 359			DRG 371		
VARIABLE	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**
potential access (log)	-0.911***	-1.116***	-1.407***	-1.329***	-1.399***	-1.783***	-0.503***	-0.532***	-0.843***
	(0.163)	(0.160)	(0.154)	(0.147)	(0.152)	(0.143)	(0.123)	(0.124)	(0.139)
female	-0.046	-0.038	-0.035	-	-	-	-	-	-
	(0.035)	(0.033)	(0.033)						
age	-0.025***	-0.022***	-0.024***	-0.014***	-0.014***	-0.012***	-0.013	-0.014	-0.010
	(0.007)	(0.007)	(0.007)	(0.005)	(0.004)	(0.004)	(0.023)	(0.023)	(0.023)
age^2	0.000**	0.000**	0.000**	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
nationality	0.212***	0.200**	0.204***	0.334***	0.372***	0.380***	0.284***	0.281***	0.280***
	(0.082)	(0.079)	(0.078)	(0.075)	(0.071)	(0.071)	(0.048)	(0.047)	(0.046)
married	0.094*	0.111**	0.122**	-0.071	-0.052	-0.069*	0.002	0.002	-0.009
	(0.050)	(0.048)	(0.048)	(0.046)	(0.042)	(0.041)	(0.030)	(0.029)	(0.029)
sep./div.	0.189*	0.213**	0.238**	0.025	0.044	0.041	0.078	0.076	0.070
	(0.102)	(0.100)	(0.100)	(0.086)	(0.084)	(0.086)	(0.069)	(0.070)	(0.068)
widow	0.167**	0.200***	0.212***	-0.137**	-0.129**	-0.155**	-0.048	-0.036	-0.095
	(0.073)	(0.074)	(0.074)	(0.065)	(0.061)	(0.062)	(0.235)	(0.236)	(0.227)
education	-0.087*	-0.086*	-0.099**	-0.074**	-0.068**	-0.098***	0.075	0.082	0.085
	(0.050)	(0.048)	(0.048)	(0.036)	(0.035)	(0.034)	(0.074)	(0.075)	(0.077)
secondary diagnosis	0.127***	0.089*	0.081*	0.043	0.037	0.038	-	-	-
	(0.046)	(0.046)	(0.046)	(0.033)	(0.032)	(0.032)			
LOS (patient)	0.038***	0.049***	0.044***	0.008	0.010*	0.005	0.027***	0.026***	0.025***
	(0.015)	(0.017)	(0.016)	(0.005)	(0.006)	(0.005)	(0.009)	(0.009)	(0.008)
yearly nr. of cases (DRG-specific)		0.002***	0.002***		0.000	0.000		-0.000	-0.000
		(0.001)	(0.001)		(0.000)	(0.000)		(0.000)	(0.000)
yearly nr. of cases (all DRGs)		0.000	0.000		-0.000	-0.000		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
private hospital		0.691	2.259		-2.119***	-0.882		2.709**	2.349**
		(1.247)	(1.738)		(0.720)	(0.709)		(1.129)	(1.094)
frequency of DH (DRG-specific)		-0.071	-0.023		-1.739***	-1.411***		-	-
		(0.450)	(0.448)		(0.481)	(0.462)			
LOS (DRG-specific)		0.972***	0.998***		2.453***	1.972***		1.352*	1.664**
		(0.247)	(0.238)		(0.514)	(0.490)		(0.720)	(0.714)
repeated hospitalization (DRG-specific)		-0.318	-0.159		0.201	0.777		7.670	8.970
		(1.687)	(1.705)		(1.284)	(1.277)		(21.951)	(22.082)
distance to Milano		0.034***	0.031***		0.009	0.006		0.008	0.001
		(0.008)	(0.009)		(0.008)	(0.008)		(0.007)	(0.007)
population density			-0.523***			-0.558***			-0.580***
			(0.144)			(0.114)			(0.087)
average per capita income			-0.070***			-0.120***			-0.101***
			(0.026)			(0.028)			(0.018)
hospital in Torino			1.936*			0.814***			2.134**
			(1.169)			(0.235)			(0.839)
hospital and year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
constant	5.917***	0.914	1.959	6.893***	4.098***	7.934***	3.371***	0.998	2.832**
	(0.506)	(1.064)	(1.625)	(0.439)	(0.811)	(1.173)	(0.410)	(0.972)	(1.131)
observations	24,356	24,356	24,356	36,377	36,377	36,377	31,741	31,741	31,741
R-squared	0.211	0.247	0.256	0.284	0.316	0.333	0.211	0.216	0.244

Standard errors (cluster-robust at the municipal level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B2.. Estimates of equation [2]: propensity to move away from the nearest hospital facility as a function of potential access and other controls – continued 2

	DRG 381			DRG 410		
VARIABLE	**Model [a]**	**Model [b]**	**Model [c]**	**Model [a]**	**Model [b]**	**Model [c]**
potential access (log)	-0.784***	-0.856***	-1.212***	-0.862***	-1.014***	-1.614***
	(0.119)	(0.122)	(0.121)	(0.197)	(0.179)	(0.159)
female	-	-	-	-0.051	-0.042	-0.012
				(0.038)	(0.037)	(0.033)
age	-0.026**	-0.027**	-0.023*	-0.018*	-0.014	-0.009
	(0.012)	(0.012)	(0.012)	(0.010)	(0.009)	(0.009)
age^2	0.000**	0.000**	0.000**	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
nationality	0.379***	0.376***	0.377***	0.314**	0.269**	0.270**
	(0.035)	(0.034)	(0.034)	(0.130)	(0.123)	(0.114)
married	-0.222***	-0.214***	-0.215***	-0.160***	-0.145***	-0.133***
	(0.044)	(0.045)	(0.045)	(0.045)	(0.043)	(0.042)
sep./div.	-0.048	-0.047	-0.046	-0.235***	-0.252***	-0.240***
	(0.062)	(0.062)	(0.062)	(0.082)	(0.079)	(0.074)
widow	-0.126	-0.127	-0.132	-0.173**	-0.158**	-0.162**
	(0.112)	(0.110)	(0.113)	(0.069)	(0.065)	(0.063)
education	-0.046	-0.041	-0.078	-0.007	-0.012	-0.100***
	(0.063)	(0.063)	(0.060)	(0.045)	(0.041)	(0.039)
secondary diagnosis	-	-	-	-	-	-
LOS (patient)	0.020	0.032**	0.028*	-0.006***	-0.007***	-0.006***
	(0.015)	(0.016)	(0.015)	(0.001)	(0.001)	(0.001)
yearly nr. of cases (DRG-specific)		0.000	0.000		-0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)
yearly nr. of cases (all DRGs)		0.000	0.000		0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)
private hospital		0.910	0.692		-10.368***	-9.424***
		(0.641)	(0.603)		(2.588)	(2.342)
frequency of DH (DRG-specific)		-0.477	-0.412		-0.339	-0.175
		(0.399)	(0.383)		(0.580)	(0.553)
LOS (DRG-specific)		0.664	0.544		1.572***	1.323***
		(0.423)	(0.394)		(0.345)	(0.320)
repeated hospitalization (DRG-specific)		-0.841	-1.064		-2.925***	-2.620***
		(1.464)	(1.453)		(0.987)	(0.942)
distance to Milano		0.020***	0.014*		0.019**	0.009
		(0.008)	(0.008)		(0.008)	(0.007)
population density			-0.568***			-1.040***
			(0.091)			(0.163)
average per capita income			-0.114***			-0.189***
			(0.020)			(0.031)
hospital in Torino			2.939***			0.531***
			(0.944)			(0.191)
hospital and year dummies	yes	yes	yes	yes	yes	yes
constant	5.415***	2.965***	4.535***	5.343***	3.242***	10.223***
	(0.422)	(1.002)	(1.131)	(0.525)	(0.746)	(1.329)
observations	40,692	40,692	40,692	70,256	70,256	70,256
R-squared	0.220	0.231	0.255	0.226	0.267	0.336

Standard errors (cluster-robust at the municipal level) in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$