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Individual and contextual determinants of inter-regional mobility in cancer patients

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This paper investigates inter-regional mobility in patients with a diagnosis of cancer. By virtue of the availability of geocoded information related to the patient's residence, the effect of socio-economic status and other individual characteristics linked to inter-regional mobility will be analysed by means of multilevel logit models. The results demonstrate the influence of age and comorbidity on mobility propensity, in addition to the treatment type, both of which play a role in patient mobility. As contextual determinants, patients residing in less deprived areas show greater mobility than those who reside in materially deprived areas. The extent of patients' mobility, and its dependence on their socio-economic status raises issues about equity, as well as regional policy considerations.

keywords: Patient mobility, Equity, Geocoding, Sicily.

1 Introduction

Due to its relevance from financial and equity points of views (Aggarwal et al., 2016; Brenna and Spadonaro, 2015), the topic of inter-regional mobility has attracted the interest of many researchers. The financial issue is related to resource reallocation policies

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among regions while the equity topic, particularly relevant to this study, considers a potential inequality in healthcare access, as determined by the costs associated with hospitals which can be located far from the patient. On a European level, all EU member states are required to implement the EU *Patient's Rights Directive*, concerning cross-border healthcare (Riedel, 2016) by October 2013. By virtue of this decision, EU residents now can access healthcare services in other member states if they already have healthcare granted in their home country. In order to monitor the status of application of the Directive, the recent 2018 European Commission report (European Commission, 2018) aims at covering the key provisions, trends and progress to date in the period 2015–2018. As a consequence, the topic of patient mobility poses challenges and raises issues of equity, where people who can afford travel expenses to other member states enjoy improved access to healthcare.

The National Health Service in Italy is a regionally decentralized system, in which patients may choose to receive healthcare services for free at the point of consumption, within a tax-funded system. However, each region should sustain the healthcare costs associated with all patients residing in that region, thus compensating the treatment costs of those patients whose healthcare services are provided by another region. In this context, various sources (e.g. Balia et al., 2018; Brenna and Spadonaro, 2015; Fattore et al., 2014) report the greatest pattern of patient mobility to be in southern Italy, thereby determining an imbalance in terms of payments due to other regions for healthcare services, which are delivered to other regions' residents (Balia et al., 2014).

Against this backdrop, the aim of this study is to analyse the effect of individual and contextual determinants on the mobility of patients diagnosed with cancer, residing in the region of Sicily (Italy). In line with the relevance of healthcare mobility from both a financial and an equity point of view, the results of this study may orient healthcare management policies in order to optimize the decentralized healthcare provisioning and to ensure equal access to healthcare services at a national level.

2 Background

Over the last decade, the topic of patient mobility has received growing attention (Levaggi and Montefiori, 2014), especially in the context of the patient's choice of health care provider (Victoor et al., 2012) and the evaluation of healthcare quality (Buntin et al., 2006). The international literature focusing on the relationship between healthcare providers, quality and competition reports evidence of its mixed effects on patient mobility. Empirical research, mainly conducted in the USA and the UK, has occasionally demonstrated a positive effect of competition on the quality of healthcare provision in both countries (Kessler and McClellan, 2000). However, other authors (Cooper et al., 2011; Gowrisankaran and Town, 2003) have reported negative or mixed results/effects on the quality of healthcare provision (Shen, 2003).

The topic of patient mobility has been investigated in terms of cross-border mobility (Glinos et al., 2010; Helena, 2016) and as inter-regional mobility. For the purposes of this study, the latter will be discussed although the motivation and determinants may be similar for cross-border and inter-regional patient mobility. When analysing inter-regional mobility in Spain, Cantarero (2006) demonstrated a positive association of patient mobility with the per-capita regional GDP of the destination region. Similar results were also obtained by Fabbri and Robone (2010) on the local health authority (LHA) level in Italy, which revealed a pattern of mobility from poorer LHAs to those richer, especially regarding the treatment of cancer. Moreover, their results demonstrate that the spatial gradient among LHAs is more pronounced with increasingly complex categories of treatment (Fabbri and Robone, 2010).

Balia et al. (2014) examined patient mobility across Italian regions using data regarding hospital discharge, occurring in 2008. Their findings indicated that hospital capacity, advanced technological competence, a high degree of management efficiency and accessibility to target regional health services are the most effective pull factors. Furthermore, Balia et al. (2018) highlighted the relevance of inter-regional mobility in the Italian context, accounting for 7.5% of total admissions in 2010; the south-north pattern accounted for 34.2% of total inter-regional flows (Balia et al., 2018). Regarding the individual determinants of patient mobility, Aggarwal et al. (2016) have observed that mobility related to secondary care services was negatively associated with age and socio-economic background; on the other hand, reduced waiting times, better quality indicators and access to advanced technology are structural factors, which are generally positively associated with mobility.

Whilst regional per-capita GPD has been used to explain patterns of inter-regional mobility across countries and regions, the influence of socioeconomic status on patient mobility has received less attention by scholars. By considering the observed pattern for treatment from poorer to richer regions, an analysis of the influence of patients' socioeconomic status on mobility may be seen as an additional, potential element of inequality at a sub-regional level, which consequently amplifies observed inequalities at the regional level.

Another aspect to consider in the analysis of patient mobility is the availability of healthcare services in terms of quantity and service type (Glinos et al., 2010). Indeed, it is reasonable to assume that patients prefer to be treated as close to home as possible, as supported by established evidence of the impact of physical proximity to healthcare facility use (Ambroggi et al., 2015; McGuirk and Porell, 1984; Stitzenberg et al., 2009). Thus, among the determinants of inter-regional mobility, geographical distance can be expected to play an adverse effect on inter-regional flows (Balia et al., 2018).

3 Materials and Methods

In order to analyse the mobility of patients, data regarding the hospitalization of cancer patients residing in the region of Sicily (Italy) were used to select the cohort being investigated. This cohort comprised patients initially diagnosed with cancer (ICD9-CM: 140-209) who had been hospitalized in and beyond Sicily between 1 January 2010 - 31 December 2012. A further selection criterion was that patients had not been hospitalized for cancer in the previous seven years.

At the regional level, information relating to the place of residence of people living in municipalities with more than 10,000 inhabitants is available by virtue of a geocoding procedure. Information regarding their socio-economic status (SES), measured through the deprivation index (Caranci et al., 2015), is also available. The deprivation index considered in this study is a composite indicator comprising five variables, namely: the share of the population with a minimal educational level (*cultural deprivation*); the percentage of the unemployed population and those looking for their first job (*power resource deprivation*); the number of persons per house per $100m^2$ (*material component deprivation*); the percentage of rented houses (*material component deprivation*); and the percentage of one-parent families with cohabiting children (*lack of social support*) (Caranci et al., 2015). All the selected variables were standardized and aggregated with equal scores for each dimension. Finally, five categories were created according to the natural-breaks criterion. Of the various comorbidity scores proposed in the literature (Corrao et al., 2017), the Charlson comorbidity index was used in the present study (Charlson et al., 1987); it has been widely utilized to measure the patients' case mix, obtained from information derived from administrative records (Quan et al., 2011) and it takes into account different comorbid conditions.

The cohort being investigated comprised 24,214 incident episodes of the hospitalization of cancer patients, including those residing in municipalities for which the deprivation index of the census tract of residence was available. These patients were then grouped into 8,071 census tracts. The phenomenon of inter-regional mobility concerned approximately 8% of the patients under investigation (1,934). The contingency tables for factors potentially associated with patient mobility for the individual and contextual levels are reported in Table 1.

These results reveal a rather higher prevalence of men (53.4%) who had been hospitalized for cancer treatment, compared to women (46.6%). More than the half the patients (53.3%) were between 61 and 80 years of age whereas only 7% were younger than 40 years of age. Regarding comorbidities, 50.3% of patients scored 2 on the Charlson comorbidity index whereas 16.8% scored 7 or more. Approximately 57.3% of patients underwent a surgical procedure in the hospitalization scenario under consideration and the remaining 42.7% did not have a surgical procedure.

With reference to contextual determinants, the patients in the study were rather uniformly distributed across the different levels of deprivation index categories, with a lower share (16.5%) for the highest deprivation category. And, in terms of distance from the place of residence to the nearest cancer center, 50.1% of patients under investigation resided approximately 30 to 50 minutes' travelling time from the cancer center. According to the factors under consideration, an analysis of the conditional distributions of inter-regional mobility revealed marked differences in age, treatment type and deprivation index, whereas the differences among inter-regional mobility shares for the other variables (gender, comorbidity and distance) were not immediately clear.

Over the last decades, there has been a growing interest in the field of public health in considering not only individual determinants of health outcomes, but also the individuals' social context. This has determined an increased interest in the use of multilevel analysis to investigate problems of public health (Diez-Roux, 2000). These models have been used in many fields, such as education (Rampichini et al., 2004), demography (Vignoli and De Santis, 2010), and sport (Carpita et al., 2019) since they allow for the simultaneous examination of individual-level and context-level variable on a given outcome. For the purposes of this present study, multilevel logit models were used (Rabe-Hesketh and Skrondal, 2012). This was also to take into account for the hierarchical structure of the data, in which patients are grouped according to their census tract of residence, and to explicitly consider the effect of socio-economic status of the census tract of residence on patient mobility.

In this statistical framework, the probability of being hospitalized outside the region π_{ij} for the i-th patient living in the j-th census tract, was modelled as a function of individual characteristics. These last include: gender (X_1), age (X_2), comorbidity, as measured by the Charlson comorbidity index (Charlson et al., 1987) (X_3), type of diagnosis-related group (DRG) (X_4), and contextual characteristics, such as the socio-economic status (X_5) of the j-census residence tract, and the distance between the place of residence and the nearest specialized cancer center (X_6). A random intercept at census tract level was also considered in order to take into account any unobserved, contextual heterogeneity. The complete model is as follows:

$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \beta_4 X_{4ij} + \beta_5 X_{5j} + \beta_6 X_{6j} + u_j \quad (1)$$

After estimating a model without any explanatory variable (null model) and a random intercept model with only individual-level variables (age, gender, comorbidity and DRG), a random intercept model with both individual level and census-tract level explanatory variables was estimated.

4 Results

In order to consider the effects of the individual-level and contextual-level factors on inter-regional mobility, as well as the potential residence heterogeneity, the results of multilevel logit models are reported in Table 2. After examining the census tract-level variance of patient mobility, without any explanatory variable (null model), the association between individual-level variables (age, gender and comorbidity) and patient mobility was evaluated by including a census tract-level random intercept (Model 1). Finally, the deprivation index was also included (where 1 indicated *better conditions* and 5 the *worse socio-economic conditions*), as a census tract-level variable, together with an indicator of distance from the nearest specialized cancer center (Model 2).

The likelihood ratio test statistics for testing the null hypothesis that $\sigma_u = 0$ for the null model, was equal to 32.39, with a corresponding $p-$value lower than 0.0001, thus demonstrating a convincing evidence that the between community variance is non-zero. Moreover, given the nested structure of the considered models, the LR-test statistics corresponding to Model 1 and Model 2 show an improvement in the fit of data for Model

Table 1: Distribution of factors potentially associated to patients' mobility in Sicily for in and out-region hospitalizations, 1/Jan/2010 - 31/Dec/2012. Row percentages

Variable	**Categories**	n	**In region**	**Out-of-region**
Gender	Male	12,937	92.32	7.68
	Female	11,277	91.66	8.34
Age	0-40	1,685	83.74	16.26
	41-60	5,887	88.84	11.16
	61-80	12,897	92.89	7.11
	more than 80	3,745	97.70	2.30
Charlson index category	0-1	2,364	97.76	2.24
	2	12,267	90.15	9.85
	3	2,826	93.77	6.23
	4-6	2,696	94.14	5.86
	≥7	4,061	91.65	8.35
Diagnosis-related group (DRG)	Non-surgical	10,345	94.49	5.51
	Surgical	13,869	90.17	9.83
Deprivation index	1	4,730	89.45	10.55
	2	4,830	91.37	8.63
	3	5,197	92.55	7.45
	4	5,452	93.53	6.47
	5	4,005	93.06	6.94
Distance from the nearest cancer center	within municipality	4,667	90.59	9.41
	less than 30 min	3,476	93.81	6.19
	30-50 min	12,131	92.39	7.61
	more than 50 min	3,940	90.94	9.06
Total		24,214	92.01	7.99

1 compared to the null model, and for Model 2 compared to Model 1 respectively, with $p-$values lower than 0.0001 in both cases.

By analysing the results in Table 2 relating to the effects of individual covariates (Model 1), an increase in the probability of being hospitalized outside the region can be observed as age decreases. Better health conditions (as measured by the Charlson comorbidity index) seem to be negatively correlated with inter-regional mobility, with the highest risks of being hospitalized out of the region for patients with worse health conditions, compared to the baseline (Charlson = 0-1). Indeed, Charlson index β estimates are high and very similar to each other with respect to the reference category, thus indicating that comorbidity (in general) is related to a higher inter-regional mobility. Finally, there appears to be weak but significant association between gender and inter-regional mobility in the cohort under investigation (p-value equal to 0.007 in Model 1). This result may be related to a higher propensity in mobility for certain specific types of cancers, which can be related to gender. A cancer-specific analysis of inter-regional mobility could also shed light on this aspect. Similarly, the presence of a surgical DRG is associated with a higher inter-regional mobility, meaning that surgical procedures represent one of the reasons for receiving treatment out of the region. By looking at Model 2, the above described results do not change substantially when census-tract level

Table 2: The results of multilevel logistic regression models for intra-regional mobility by individual level and census-tract level characteristics, Sicily, 1/Jan/2010-31/Dec/2012.

	Null model		**Model 1**		**Model 2**	
	exp(β)	(95% CI)	exp(β)	(95% CI)	exp(β)	(95% CI)
Fixed effects						
Intercept	0.075	(0.070 − 0.081)	0.003	(0.002 − 0.004)	0.003	(0.002 − 0.004)
Individual level						
Age (0-40)			7.27	(5.59 − 9.46)	7.39	(5.69 − 9.61)
Age (41-60)			4.67	(3.69 − 5.93)	4.74	(3.74 − 6.00)
Age (61-80)			2.99	(2.38 − 3.77)	3.01	(2.40 − 3.79)
Age (>80=ref.)						
Gender (Female=ref)			1.15	(1.04 − 1.27)	1.16	(1.05 − 1.28)
Charlson (0-1=ref.)						
Charlson (2)			5.23	(3.93 − 6.96)	5.34	(4.02 − 7.11)
Charlson (3)			4.31	(3.12 − 5.95)	4.43	(3.21 − 6.11)
Charlson (4-6)			4.63	(3.34 − 6.43)	4.80	(3.46 − 6.66)
Charlson ($\geq$ 7)			5.31	(3.91 − 7.19)	5.47	(4.04 − 7.42)
DRG (Non-surgical=ref)			1.96	(1.75 − 2.18)	1.97	(1.76 − 2.20)
Census-tract level						
Deprivation (5=ref.)						
index 1					1.65	(1.39 − 1.96)
2					1.29	(1.08 − 1.54)
3					1.08	(0.91 − 1.29)
4					0.93	(0.78 − 1.12)
Distance (>50 min=ref.)						
0					0.98	(0.83 − 1.16)
1-30 min					0.61	(0.50 − 0.74)
31-50 min					0.82	(0.71 − 0.95)
Random effects						
σ_u	0.60	(0.49 − 0.74)	0.67	(0.56 − 0.80)	0.60	(0.48 − 0.74)
Log likelihood	−6726.30		−6351.39		−6298.97	
LR test statistics	32.39		749.83		104.84	
AIC	13456.6		12724.8		12633.9	
BIC	13472.8		12813.8		12779.6	

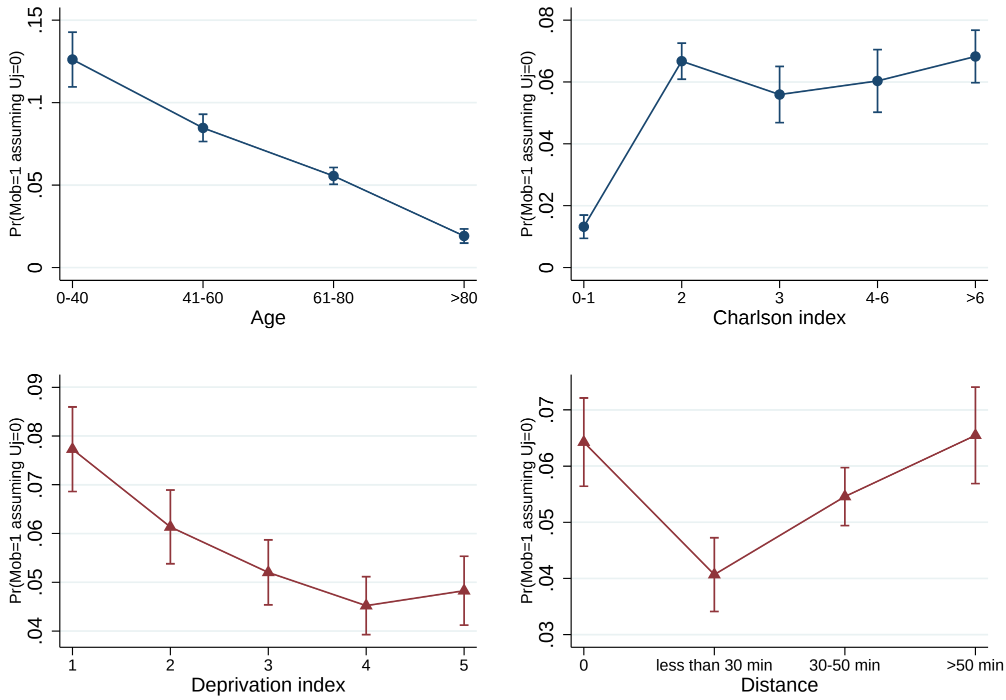

Figure 1: Cluster-specific predicted probabilities of out-of-region hospitalization according to age, Charlson index, deprivation index and distance from the nearest cancer center, at $u_j = 0$.

covariates are included.

By considering the effect of socio-economic conditions on inter-regional mobility (Model 2), a significant association emerges between the deprivation index and inter-regional mobility. Specifically, those residing in areas with a deprivation index values between 1 and 2 show the highest propensity for being hospitalized outside the region, compared to those living in areas with deprivation index equal to 5. No remarkable differences appear for those living in areas with a deprivation index equal to 3 and 4 when compared to the worst deprivation index category.

Finally, the effect of distance from the place of residence to the nearest cancer center shows a less than clear relationship, with the highest risks of inter-regional mobility for patients residing at the highest distance from the nearest cancer center and for those who reside in municipalities with a cancer center, compared to those who live at intermediate values of distance (up to 50 minutes). This non-linear relationship could well indicate a path for future research. Moreover, by looking at the σ_u coefficient, a certain degree of residual heterogeneity still exist at the census tract level, even after the inclusion of level 2 covariates.

In terms of the probabilities of inter-regional mobility, the graphs in Figure 1 report cluster-specific predicted probabilities at $u_j = 0$ for individual covariates (such as age and the Charlson index), as well as for level 2 covariates (namely *deprivation index* and *distance from the nearest cancer center*). An analysis of the graphs in Figure 1 would indicate that the probability of a patient under 40 years old being hospitalized out of the region is higher than 10%, compared to patients over 80+ years old, whose hospitalization probability is lower than 5%. Similarly, the deprivation index determines a decrease in out-of-region hospitalization as the deprivation level of the census residence tract increases. Less clear is the effect of distance from the nearest cancer center on patients' mobility, for which a non-linear relationship emerges with the probability of an out-of-region hospitalization. Nonetheless, an evaluation of distance, in terms of costs associated with mobility (inside and outside the region), may provide a clearer picture of the influence of this variable on inter-regional mobility.

5 Conclusion

Inter-regional mobility is an important issue from financial and equity points of view. Despite the Italian national health service fully covering healthcare costs independently of the treatment region, patient mobility raises several concerns relating to equity. The differences observed in this study in terms of individual characteristics (such as age and comorbidity) highlight a potential source of discrimination, with more severely ill patients being compelled to stay in their region of origin, compared to those who can travel out of their region. Indeed, whilst differences in terms of quality between centers located in a particular region and outside that region were not examined in this study, a different perception of quality may exist (Glinos et al., 2010).

Beyond the role of individual characteristics, the association between out of region healthcare-seeking and the one's own socio-economic status raises several concerns from an equity point of view; the latter includes equal access to healthcare services. The private cost of travelling to an alternative, higher quality healthcare provider may represent an economic constraint for lower socio-economic groups (Fattore et al., 2014). The empirical findings of this study may highlight a greater degree of polarization between richer and poorer people, even within the southern regions of Italy which, on a broader level, reinforce an already observed inequality between northern and southern regions in Italy (Costa et al., 2003).

From a methodological point of view, the use of geocoded information regarding patients' place of residence allows for a reduction in any potential bias deriving from the use of larger units, such as municipalities or provinces. This enhances the reliability of the contextual information relating to socio-economic status at the census tract level. Moreover, the use of multilevel models permits the inclusion of the effect of other sources of unobserved heterogeneity at the census-tract level related to inter-regional patients' mobility.

However, the empirical application proposed in this study has limitations and these are related to the lack of outcome measures of the medical treatments received. Including these data may orient future research towards the examination of potential differences between the perceived healthcare quality and cancer treatment outcomes among southern and northern regions. Moreover, a specific focus on inter-regional mobility relating to different types of cancers may highlight areas of intervention at a regional level. Finally, distance from the nearest cancer center has been measured only in terms of travel time, without including any information concerning the costs of mobility. If such information was available, it would be possible to improve the analysis of the effects of distance on inter-regional mobility. In conclusion, any consideration regarding the south-north pattern of patients' mobility and an improved knowledge of its determinants could orient healthcare policies related to the distribution of services and resources countrywide to improve equity of access to healthcare.

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References

Aggarwal, A., Lewis, D., Mason, M., Sullivan, R., and van der Meulen, J. (2016). Patient mobility for elective secondary healthcare services in response to patient choice policies: A systematic review. *Medical Care Research and Review*, on-line:1–25.

Ambroggi, M., Biasini, C., Del Giovane, C., Fornari, F., and Cavanna, L. (2015). Distance as a barrier to cancer diagnosis and treatment: review of the literature. *The Oncologist*, 20(12):1378–1385.

Balia, S., Brau, R., and Marrocu, E. (2014). What drives patient mobility across Italian regions? Evidence from hospital discharge data. In Levaggi, R. and Montefiori, M., editors, *Healthcare Provision and Patient Mobility. Health integration in the European Union*, chapter 12, pages 133–154. Springer-Verlag, Milan.

Balia, S., Brau, R., and Marrocu, E. (2018). Interregional patient mobility in a decentralized healthcare system. *Regional Studies*, 52(3):388–402.

Brenna, E. and Spadonaro, F. (2015). Regional incentives and patient cross-border mobility: evidence from the Italian experience. *International Journal of Health Policy and Management*, 4(6):363–372.

Buntin, M. B., Damberg, C., Haviland, A., Kapur, K., Lurie, N., McDevitt, R., and Marquis, M. S. (2006). Consumer-directed health care: early evidence about effects on cost and quality. *Health Affairs*, 25(6):w516–w530.

Cantarero, D. (2006). Health care and patients' migration across Spanish regions. *The European Journal of Health Economics*, 7(2):114–116.

Caranci, N., Biggeri, A., Grisotto, L., Pacelli, B., Spadea, T., and Costa, G. (2015). The Italian deprivation index at census block level: definition, description and association with general mortality. *International Journal of Health Policy and Management*, 4(6):363–372.

Carpita, M., Ciavolino, E., and Pasca, P. (2019). Exploring and modelling team performances of the kaggle european soccer database. *Statistical Modelling*, 19(1):74–101.

Charlson, M. E., Pompei, P., Ales, K. L., and MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal of Chronic Diseases*, 40(5):373–383.

Cooper, Z., Gibbons, S., Jones, S., and McGuire, A. (2011). Does hospital competition save lives? Evidence from the English NHS patient choice reforms. *The Economic Journal*, 121(554).

Corrao, G., Rea, F., Di Martino, M., De Palma, R., Scondotto, S., Fusco, D., Lallo, A., Belotti, L. M. B., Ferrante, M., Addario, S. P., Merlino, L., Mancia, G., and Carle, F. (2017). Developing and validating a novel multisource comorbidity score from administrative data: a large population-based cohort study from Italy. *BMJ Open*, 7(12):e019503.

Costa, G., Marinacci, C., Caiazzo, A., and Spadea, T. (2003). Individual and contextual determinants of inequalities in health: the Italian case. *International journal of health services*, 33(4):635–667.

Diez-Roux, A. V. (2000). Multilevel analysis in public health research. *Annual Review of Public Health*, 21(1):171–192.

European Commission (2018). Report from the Commission to the European Parliament and the Council on the operation of Directive 2011/24/eu on the application of patients' rights in cross - border healthcare. *Eur-Lex*, COM(2018)(651).

Fabbri, D. and Robone, S. (2010). The geography of hospital admission in a national health service with patient choice. *Health Economics*, 19(9):1029–1047.

Fattore, G., Petrarca, G., and Torbica, A. (2014). Traveling for care: Inter-regional mobility for aortic valve substitution in Italy. *Health Policy*, 117(1):90–97.

Glinos, I. A., Baeten, R., Helble, M., and Maarse, H. (2010). A typology of cross-border patient mobility. *Health & Place*, 16(6):1145–1155.

Gowrisankaran, G. and Town, R. J. (2003). Competition, payers, and hospital quality. *Health Services Research*, 38(6p1):1403–1422.

Helena, R. (2016). Cross-border healthcare directive: Assessing stakeholders' perspectives in Poland and Portugal. *Health Policy*, 120(4):369–376.

Kessler, D. P. and McClellan, M. B. (2000). Is hospital competition socially wasteful? *The Quarterly Journal of Economics*, 115(2):577–615.

Levaggi, R. and Montefiori, M., editors (2014). *Healthcare Provision and Patient Mobility. Health integration in the European Union*, volume 12 of *Developments in Health Economics and Public Policy*, Milan. Springer-Verlag.

McGuirk, M. A. and Porell, F. W. (1984). Spatial patterns of hospital utilization: the impact of distance and time. *Inquiry*, pages 84–95.

Quan, H., Li, B., Couris, C. M., Fushimi, K., Graham, P., Hider, P., Januel, J.-M., and Sundararajan, V. (2011). Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *American Journal of Epidemiology*, 173(6):676–682.

Rabe-Hesketh, S. and Skrondal, A. (2012). *Multilevel and longitudinal modeling using Stata. Volume II: Categorical Responses, Counts, and Survival.* STATA press.

Rampichini, C., Grilli, L., and Petrucci, A. (2004). Analysis of university course evaluations: from descriptive measures to multilevel models. *Statistical methods and Applications*, 13(3):357–373.

Riedel, R. (2016). European patient's cross-border mobility directive. *Public Health*, 139:222–223.

Shen, Y.-C. (2003). The effect of financial pressure on the quality of care in hospitals. *Journal of Health Economics*, 22(2):243–269.

Stitzenberg, K. B., Sigurdson, E. R., Egleston, B. L., Starkey, R. B., and Meropol, N. J. (2009). Centralization of cancer surgery: implications for patient access to optimal care. *Journal of Clinical Oncology*, 27(28):4671–4678.

Victoor, A., Delnoij, D. M., Friele, R. D., and Rademakers, J. J. (2012). Determinants of patient choice of healthcare providers: a scoping review. *BMC Health Services Research*, 12(1):272.

Vignoli, D. and De Santis, G. (2010). Individual and contextual correlates of economic difficulties in old age in Europe. *Population Research and Policy Review*, 29(4):481–501.