HEALTH MOBILITY AMONG THE OLDER ADULTS IN ITALY: A REGIONAL INEQUALITY PERSPECTIVE

Giuseppe Venere

Abstract. As Italy faces rapid demographic aging, understanding the healthcare mobility of older adults (over 65) has become a crucial challenge for regional planning and ensuring equitable access to care. This study examines interregional health migration among individuals aged 65 and over, shedding light on the patterns of elderly patients moving across Italian regions in search of hospital services.
The main objective of this research aims to explore the determinants of health-related mobility for older adults and assess the territorial inequalities that drive these flows. Specifically, it investigates whether demographic factors, economic capacity, healthcare quality, and geographic proximity affect the direction and intensity of elderly patient mobility between regions.
The analysis is based on integrated data from Istat, the Italian Ministry of Health, and AGENAS (National Agency for Regional Health Services). The methodological approach employs count gravity models (Poisson and Negative Binomial), with interaction effects between healthcare quality – measured through LEA (Essential Level of Care) scores – and economic development (GDP per capita) of the receiving regions. These models help to assess how both the performance of regional healthcare systems and the economic capacity of regions influence the decisions of elderly patients to move in search of medical care.
Preliminary findings reveal significant disparities across regions. Older adults are more likely to move from Southern to Northern and Central regions, driven by better healthcare performance and infrastructure. The interaction between higher LEA scores and regional wealth strengthens a region's attractiveness.

1. Introduction

Aging of the population is one of the most pressing issues for healthcare and welfare systems in highly industrialized countries, like Italy. The increasing share of individuals aged over 65 years has generated increased pressure on the demand for healthcare services, particularly concerning chronic illnesses, multimorbidity, and continuity of care (Savaş ., 2023; King, 2024). In this respect, the mobility of the elderly among healthcare beneficiaries is a central element, not only as proof of inefficiencies and geographic holes in the delivery of healthcare but also as a survival and adaptation choice followed by the most disadvantaged groups (Williams *et al.*, 2000; Warnes, 2009; Ciobanu *et al*., 2017).

In Italy, access to healthcare is controlled by a decentralised universalistic system, where regional administrations are granted broad organisational and managerial autonomy. While this organization has been more responsive to regional needs, it has also generated important inequities regarding service quality, waiting lists, and services provided (Berta *et al*., 2021; Carnazza *et al*., 2025). These inequities are clearly evident in the interregional hospital mobility flows and constitute a multifaceted phenomenon that makes the most attractive areas trap a high percentage of patients from poorly performing areas (Levaggi *et al*., 2004; Frischhut *et al*., 2025). These interregional movements are not solely the result of inefficiencies, but also reflect a growing willingness among patients to wait and travel in order to access care perceived as higher in quality (Bruni *et al*., 2021). Moreover, it has been shown that the main factors influencing hospital mobility include hospital capacity, service organization, quality of care provided, and the availability of advanced medical technologies (Balia *et al*., 2018), all of which contribute to making certain regions systematically more attractive than others.

In recent years, the issue of Essential Levels of Care (Livelli Essenziali di Assistenza - LEA) has turned out to be one of the most effective tools for ascertaining the adequacy of healthcare services delivered at the regional level. The LEA scores, provided by the Ministry of Health, summarize regional performance in ensuring the minimum bundle of services required by national standards taking into account several dimensions such as prevention, community care, and hospital support. The scores act as a monitoring mechanism to ensure that fundamental care is assured universally across the country (Alfiero *et al*., 2021; Spano *et al*., 2022; Betti *et al*., 2023).

At the same time, other structural determinants - like per capita Gross Domestic Product (GDP) and geographic distance between regions - may be significant determinants of regional attractiveness and repellence (Levaggi and Zanola, 2004). GDP can be a measure of the region's economic capacity to provide for and finance healthcare services, and therefore its ability to meet healthcare demand (Gan and Frederick, 2011). Distance, however, contributes to the expense burden for older individuals to travel to access care in another region, with the potential to limit access for less well-off individuals (Glinos *et al*., 2010).

The overall purpose of this study is to track and examine interregional hospital-related healthcare mobility patterns amongst the population aged 65 and above, with a goal to observe the drivers that compel older adults to be treated outside their home region. Specifically, the analysis will investigate whether structural variables such as the LEA score and regional GDP can be considered principal drivers of healthcare mobility, using gravity models. To this end, the analysis revolves around two general research questions:

RQ.1 To what extent do structural characteristics of regional healthcare systems, as measured by LEA compliance and regional GDP, influence the direction and intensity of interregional hospital mobility among the elderly population?

RQ.2 What is the most appropriate gravity model specification for capturing the determinants and patterns of interregional hospital mobility among the elderly?

Drawing on administrative data and synthetic indicators, this work takes a data-driven, demography-oriented perspective to provide a comparative and detailed interpretation of the phenomenon, feeding into ongoing scientific and policy discussions on territorial equity in healthcare. The findings also aim to be of practical use for the planning and improvement of the balance between healthcare supply and demand, with specific reference to ageing populations.

2. Rethinking Elderly Mobility in Healthcare: A Literature-Based Perspective on Italy's North-South Divide

Italy is also characterized by a clear territorial diversification of the supply of healthcare services, historically expressed in the form of a persistent North–South divide in terms of infrastructures, economic resources, and performance indicators (Alfiero *et al*., 2021; Betti *et al*., 2023). Though all regions are required to guarantee the Essential Levels of Care (LEA), effective compliance is rather dissimilar: while Centre-North regions are consistently at the top of national performance rankings, Southern regions fall below minimum standards (Spano *et al*., 2022). This means a potentially more disadvantaged population that is less able to effectively access the right care pathways. At the same time, the increasing use of outgoing healthcare mobility testifies to a widespread feeling of distrust towards local healthcare systems.

Migration flows of older individuals, for too long confined to the role of marginal epiphenomenon, are now included in active ageing and life course optimisation processes. The notion of inactive old age is challenged by data showing an increasing tendency to migrate in old age, both within one's own country and outwards to other countries (Savaş *et al*., 2023; King, 2024). The reasons for this are several: from the search for more favourable climates (Bolzman *et al*., 2021) to the migration away from healthcare systems perceived as inefficient (Warnes, 2009; Gao *et al*., 2021).

The elderly migrant is not an inert individual, but a conscious person who makes informed decisions regarding quality of life, access to care, and the economic sustainability of his or her own ageing path (Ciobanu *et al*., 2017). This capacity for self-determination emerges clearly in the growing literature on the mobility of older people, which interprets such moves not only as responses to immediate needs but as conscious strategies of adaptation to vulnerability, aimed at living well and in good health.

Mobility in healthcare is not only an expression of escape from disadvantaged environments but is also linked to attraction to places with greater availability and quality of services. The literature shows that regions with higher performing healthcare can

attract patients not only due to the presence of clinical excellence, but also for organizational efficiency, shorter waiting lists, and greater transparency (Levaggi and Zanola, 2004; Berta *et al*., 2021).

In particular, LEA score is a suitable measure for summarizing the quality of healthcare delivery at the territorial level, while per capita GDP is employed as a proxy for the structural endowment of the system (Alfiero *et al*., 2021; Frischhut and Levaggi, 2024). As a matter of fact, hospitals in Northern Italy exert a strongly attractive function, generating a competitive care market in which health benefits represent an important discriminator that has important returns in economic terms (Carnazza *et al*., 2025). However, this polarisation reinforces existing inequalities, with some areas being strengthened by the additional income generated by interregional hospital admissions, while others are increasingly disadvantaged, with a decrease in the efficiency and reliability of their local healthcare systems (Spano *et al*., 2022; Betti *et al*., 2023).

Healthcare mobility therefore has a double meaning: on the one hand it represents an opportunity, on the other hand it entails a number of challenges. For elderly patients, moving to receive care often results in a complex emotional, economic and logistical undertaking. Studies on medical tourism (Glinos *et al*., 2010; Hanefeld *et al*., 2015) show that the choice of destination is influenced by social networks, perceived quality of care, affordability and relational support.

At the same time, mobility can enhance health inclusion when the place of origin fails to provide adequate care. In the context of cross-border healthcare, for instance, European policies uphold the right to seek medical treatment abroad (Wismar *et al*., 2011). National healthcare systems are therefore expected to facilitate these flows, ensuring that freedom of choice in accessing care is both meaningful and practicable (Jacobsen *et al*., 2023).

To conclude, the literature suggests that, if well managed, this phenomenon can produce economic and human capital returns for host communities (Mainil *et al*., 2017; Suess *et al*., 2018).

3. Data sources and methodological approach

The study is based on the integration of multiple official data sources, with the aim of ensuring analytical consistency and the robustness of results. The data come primarily from the Italian National Institute of Statistics (Istat) and refer to three specific domains: the “Health for All” database, which provides structured indicators on regional healthcare systems; resident population tables, which help contextualize healthcare demand; and hospital mobility data, which allow for the tracking of interregional patient flows. Some information was obtained through customized tables to refine the demographic and territorial analysis. These data are supplemented by indicators provided by the Ministry of Health, in particular with regard to the evaluation of the Essential Levels of Care (Livelli Essenziali di Assistenza - LEA), and by information

from the National Agency for Regional Health Services (Agenas), in particular the occupancy of hospital beds and the observed interregional health mobility in the year 2022 with a focus on the over-65 age group.

The dataset used for the analysis refers to the year 2022 and consists of 441 directional observations, representing all possible origin–destination combinations among the 21 Italian regions, including intra-regional flows, i.e., cases where hospital admissions occurred within the same region of residence.

The unit of analysis is the number of hospital admissions of individuals aged 65 and over who received care either within their own region or in a different one, depending on the recorded flow. The data refer exclusively to hospital mobility recorded in 2022.

These is a summary table of the variables included in the model, referring to both the region of origin and the region of destination, and used for the estimation of the gravity models.

Table 1 *Overview of the Variables Included in the Models.*

Variable	Type	Role	Meaning
origine	String	Descriptive	Region of origin
destinazione	String	Descriptive	Region of destination
flusso	Numeric	Dependent	Number of flows in 2022
log_pop_origine	Continuous (log)	Independent	Log of the population in the region of origin
log_pop_destinazione	Continuous (log)	Independent	Log of the population in the region of destination
log_pil_origine	Continuous (log)	Independent	Log of GDP in the region of origin
log_pil_destinazione	Continuous (log)	Independent	Log of GDP in the region of destination
LEA_origine	Continuous	Independent	LEA score of the region of origin
LEA_destinazione	Continuous	Independent	LEA score of the region of destination
log_distanza	Continuous (log)	Independent	Log of the distance between regions
stessaregione	Dichotomous (dummy)	Independent	1 = same region; 0 = different region
confine	Dichotomous (dummy)	Independent	1 = bordering regions; 0 = non-bordering regions

Methodologically, the analysis is structured on multiple levels. To construct composite indicators, or to aggregate the multidimensionality of the LEA score (preventive, community-based, and hospital care), Principal Component Analysis (PCA) was initially applied. This technique allowed for the reduction of informational complexity with maximum preservation of explained variance, with a single composite variable remaining to be included in the gravity models.

The empirical study is based on the application of four different specifications of the gravity model; this method is widely applied in the literature for the study of spatial flows, and specifically for the study of health mobility.

The Poisson Model was initially applied to examine the relationship between healthcare mobility flows and regional structural determinants. However, evidence of overdispersion - where the variance exceeds the mean - indicated that a Negative

Binomial model would be more appropriate, as it better accommodates such data characteristics. To allow for greater flexibility in modelling dispersion, a Generalized Negative Binomial model was ultimately adopted, in which the dispersion parameter ($ln\alpha$) was modelled as a function of the population of the origin region and the log-transformed distance between regions.

4. The LEA scores

The evaluation of the Essential Levels of Care (Livelli Essenziali di Assistenza, hereafter referred to as LEA) is one of the most important tools for analyzing territorial disparities within the Italian National Health System. Established by the Ministry of Health, the LEA defines the set of healthcare services and provisions that must be guaranteed uniformly to all citizens across the national territory, regardless of their region of residence. Its primary goal is to ensure a minimum, standardized level of health protection, financed mainly through general taxation and, in part, through user co-payments (ticket)1.

The choice to include the LEA score as a key explanatory variable in the model stems from its nature as an official composite indicator developed by the Italian Ministry of Health. The LEA score integrates a wide range of dimensions related to healthcare quality, accessibility, and resource allocation across regions2. It encompasses several structural components of supply - such as hospital bed availability, coverage of primary and community care, number of medical staff per patient, adherence to prevention protocols, and unmet health needs - thereby providing a holistic and standardized measure of healthcare system performance. Including individual indicators (e.g., hospital beds per capita, staff density, or specific morbidity measures) alongside the LEA score would have risked redundancy and multicollinearity, as confirmed by Spearman correlation tests and VIF diagnostics performed in preliminary analyses. Furthermore, the inclusion of selected indicators - such as elderly mortality or specific chronic disease rates - might fail to capture the broader spectrum of morbidity and service provision relevant to older populations, thereby introducing a partial and potentially biased representation. For these reasons, the LEA score was retained as the primary proxy for regional healthcare quality, ensuring parsimony, coherence, and conceptual robustness within the model

[1] https://www.salute.gov.it/new/it/tema/livelli-essenziali-di-assistenza-lea/ accessed on May 2025

[2] As a robustness check, additional model specifications were tested by including individual variables commonly used in the literature to account for healthcare needs and supply, such as mortality rates among older adults, the number of hospital beds per inhabitants, and regional public expenditure on health and social care services. While descriptively relevant, these variables showed a high degree of correlation with the dimensions already incorporated within the LEA score, leading to multicollinearity and conceptual redundancy.

specification and representing an innovative indicator compared to relevant studies that have not used it such as Fabbri & Robone (2010) and Balia *et al*. (2018).

Figure 1 - *Italian map of LEA scores calculated using Principal Component Analysis and the Min-Max Scaling technique.*

Source: Italian Ministry of Health, National Health Report 2025.

The "LEA scores" are constructed based on indicators grouped into three functional macro-areas: collective prevention and public health, district-level care (including primary and community-based services), and hospital care. These dimensions are monitored annually across all regions and autonomous provinces, producing a composite index that ranges from 0 (indicating maximum inefficiency) to 1 (indicating maximum efficiency), expressed on a normalised scale. In this study, LEA scores were further synthesised using Principal Component Analysis (PCA), in order to reduce redundancy among sub-indicators and generate a single standardised index, subsequently transformed through Min-Max Scaling.

The map in Figure 1 clearly illustrates the territorial distribution of the LEA scores across Italy, showing a very high territorial gradient.

The best scores are recorded in northern regions such as Emilia-Romagna (0.94), Veneto (0.93), and Lombardy (0.92), indicating high overall efficiency in their regional health systems. In these cases, services tend to be more accessible, delivered more promptly, and are widely perceived as more reliable by citizens, as highlighted in recent studies (Signorelli *et al*., 2017, 2020; Alfiero *et al*., 2021; Spano *et al*., 2022; Betti *et al*., 2023).

Conversely, southern regions such as Calabria (0.24), Sicily (0.28), and Campania (0.30) rank at the lower end of the index, reflecting persistent structural shortcomings - from shortages of medical personnel and inadequate healthcare facilities to limited managerial capacity and inefficient resource allocation. This imbalance plays a

significant role in driving outbound healthcare mobility flows and stands among the primary factors contributing to health disparities based on place of residence.

5. Results

The analysis of healthcare mobility flows among the elderly population (aged 65 and over) between Italian regions was conducted using gravity models adapted to the healthcare context. These models estimate flows between two territories based on their attractive or repulsive characteristics, such as population size, geographical distance, and quality of healthcare services. Three model specifications were tested: the Poisson model, the Negative Binomial model, and the Generalized Negative Binomial model.

The dataset comprises 441 directional observations, capturing all "from–to" combinations among the 21 Italian regions (19 regions with the autonomous provinces of Trento and Bolzano), including intra-regional flows (i.e., movements within the same region).

5.1 Initial Modelling Attempts: From Poisson to Negative Binomial

The baseline model applied was the Poisson specification, which assumes equality between the mean and the variance of the dependent variable. Initial results revealed significant associations between healthcare mobility flows and key regional characteristics, such as the LEA score of the destination region and the presence of a shared border.

$$E(Y_{ij}) = exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)$$

were Y_{ij} is the expected number of hospitals flows from region *i* to region *j*; *X* is the vector of independent variables; β is the vector of estimated coefficients.

However, the analysis of standardised residuals and the Pearson chi^2/df ratio (366.4) indicated substantial overdispersion, violating the Poisson model's core assumptions. This outcome is consistent with the broader literature on healthcare mobility, which notes the limitations of the Poisson framework in contexts characterised by high heterogeneity and spatial dependency (Silva & Tenreyro, 2006; Burger *et al*., 2009).

To account for overdispersion, the Negative Binomial model was subsequently adopted. This specification introduces a dispersion parameter (α) to better capture unobserved heterogeneity.

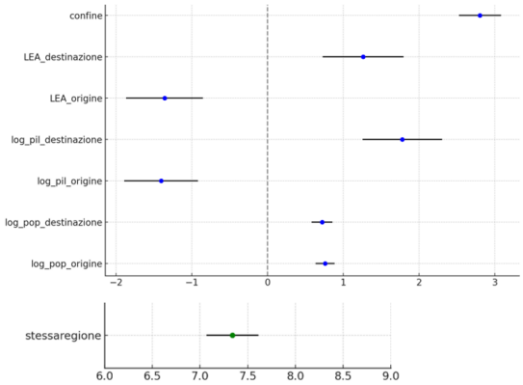
$$Y_{ij} \sim NegBin(\mu_{ij}, \alpha)$$

Where μ_{ij} is the expected mean of the healthcare flow from region *i* to region *j*, modelled through an exponential function of the socio-economic and structural characteristics of the origin and destination regions.

The model fit improved substantially, as shown by a significant drop in AIC (5,280) and BIC (5,313), as well as a marked increase in pseudo-R^2 (0.1247). Residual analysis revealed a more symmetrical distribution with fewer outliers. However, one notable finding was that the log-transformed geographical distance variable lost its statistical significance, suggesting a complex interaction between spatial proximity and unobserved regional factors.

These limitations highlighted the need for a more flexible modelling approach capable of directly incorporating structural sources of dispersion into the estimation process (Burger *et al*., 2009).

Figure 2 - *Generalised Negative Binomial estimates for elderly hospital mobility.*



5.2 The Generalised Negative Binomial Model: A Robust and Comprehensive Solution

To overcome the limitations of the previous specifications, the Generalised Negative Binomial model was applied. This approach allows the dispersion parameter (α) to be modelled as a function of one or more covariates. Such a specification not only helps to control for residual heterogeneity but also enables the identification of variables that may be driving the overdispersion.

$$Y_{ij} \sim NegBin(\mu_{ij}\alpha_{ij}) \quad \text{with} \quad log(\mu_{ij}) = X_{ij}\beta, \quad log(\alpha_{ij}) = Z_{ij}\gamma$$

Where *Zij* is the vector of predictors used to model overdispersion (in this case: *log_pop_origine*, *log_pop_destinazione*, and *log_distanza*).

The results show a further improvement in model fit: both the AIC and BIC are the lowest among all estimated models, confirming the model's high parsimony and statistical coherence. The boxplot of residuals reveals an almost complete absence of outliers, with minimal residual dispersion and no evident skewness.

This model also demonstrates that a portion of the overdispersion can be attributed to the logarithmic distance between regions ($P>|z|$***) and to the logarithm of the elderly population in both origin ($P>|z|$***) and destination regions ($P>|z|$***). When included in the *lnα* component, these variables contribute to a more accurate modelling of dispersion (Silva and Tenreyro, 2006; Burger *et al*., 2009). Meanwhile, the LEA and GDP variables remain statistically significant, with the LEA score of the destination region exhibiting a particularly strong effect.

6. Discussion and conclusion

This study investigated hospital healthcare mobility among the population aged 65 and over in Italy, employing gravity models to assess the impact of regional structural differences on interregional patient flows. The primary objective was to determine whether regional healthcare performance, as measured by LEA scores, and economic prosperity, proxied by per capita GDP, influence mobility patterns among elderly patients seeking higher quality and more accessible care.

The findings confirmed that regions with high-performing healthcare systems act as strong attractors, whereas lower-performing areas tend to experience patient outflows. Economic development also plays a complementary role: wealthier regions with better infrastructure are more effective in attracting and retaining patients.

To empirically validate these patterns and quantify the role of structural determinants in shaping mobility flows, three gravity model specifications were tested. The Poisson model was inadequate due to overdispersion; the Negative Binomial model improved the fit, while the Generalised Negative Binomial model offered the best balance of simplicity, robustness, and explanatory power.

However, despite consistent results, the study has limitations. It excludes zero-flow observations and overlooks social, cultural, and individual factors, such as trust in local services, family support, or indirect costs, that are crucial to understanding elderly patients' decisions. Nevertheless, even within these constraints, it provides valuable evidence on the underlying structural drivers of elderly healthcare mobility. These choices go beyond service quality, highlighting broader structural divides, access issues, and subjective perceptions. Reducing these disparities remains a central challenge for regional health policy in Italy.

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Giuseppe VENERE, Università degli Studi di Bari Aldo Moro
giuseppe.venere@uniba.it