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Women's choices of hospital for breast cancer surgery in Italy: Quality and equity implications

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ABSTRACT

This paper employs mixed logit regression to investigate the effects of providers characteristics on women's choice of hospital for breast surgery. Patient level data are used to model choices in Tuscany region, Italy. In particular, we focus on the effects of travel time and hospital quality indicators including quality standard (volumes of breast surgery), measurement of process (waiting times) and quality of surgical procedures. Variation in preferences related to individual characteristics such as age, education and travel distance from the hospital are also considered. Findings show that, on average, women prefer closer hospital with longer waiting times and higher quality (high volumes of interventions). We found preference heterogeneity associated to education: travel distance affects choice especially among less educated women (regardless of age), while among younger women (<65 years), less educated ones prefer shorter waiting times. These results could be used to optimize the allocation of resources toward breast cancer units that meet quality and efficacy standards to increase the efficiency and responsiveness of breast cancer care.

1. Introduction

Patients where healthcare systems allow for choosing among care providers are confronted with decisions about which hospital to select for the diagnosis and treatment of their conditions. According to the literature hospital choice is based on heterogeneous information, including the quality of services, standard of facilities and technologies, reputation and image of the provider, attitudes and behaviour of personnel, prior experience and recommendations [1–5]. Other dimensions affecting patient-service interaction include acceptability, affordability (costs), availability and accessibility in terms of both physical accessibility (proximity) and adequacy of service supply in relation to the population [6,7]. Previous studies have also shown that certain socioeconomic factors are strong predictors of access and use of health services [8] with impacts on quality of care [9] and outcomes [10].

This study aims to add novel evidence on the determinants of breast-cancer patient choice regarding hospital services, focusing on the influence of waiting times, distance and hospital-based quality indicators for breast cancer treatments (elective surgery) also considering potential differences in preferences among patient subgroups. The analysis is not in the sphere of traditional regional model where the key variable is to understand regional-level characteristics influencing patient choice for hospital care [11] or mobility across administrative regions [12,13] but analyses patient choice within a health care regional system at a micro-level focusing also on patients characteristics (age and education) to consider possible equity implications.

In Italy, the incidence of breast cancer is 53,000 new cases per year representing the most diagnosed malignancy in women and with an estimated prevalence of 800,000 cases [14]. Following international clinical guidelines [15–18] evidence-based qualitative and quantitative requirements have been set out for the identification of Breast Centres in Italy. This includes a multidisciplinary team approach with clinical coordinator, dedicated radiologist, dedicated breast surgeon performing $\geq$ 50 surgeries per year, dedicated breast pathologist, medical oncologist and radiotherapist. Additionally, a minimum caseload of 150 newly diagnosed cases of primary breast cancer to be treated each year by each provider is required [19]. These normative assumptions aim at guaranteeing all women with breast cancer the right to be treated in a network of certified and interdisciplinary breast centres that meet

Abbreviations: BCS, Breast-conserving surgery; EUSOMA, European society of breast cancer specialists; GIS, Geographic information system; LHA, Local health authority; SD, Standard deviation; SLNB, Sentinel lymph node biopsy.

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quality and efficacy standards. Reconfiguring cancer care provision through centralization of cancer care in hospitals performing high volumes of surgeries is therefore expected to improve outcomes for many patients. Nonetheless, although universal coverage should be guaranteed, breast cancer surgical interventions remain distributed across Italian hospitals (less than 70 % of providers from 12 Regions evaluated by the Inter-Regional Performance Evaluation System are above the threshold of 150 incident breast cancer surgery per year – http://performance.sssup.it/netval). Such variations is also reported at an international level both in the United States [20] and Europe [21]. This distribution of surgical activity in Italy is driven in part by patient choice of hospital.

In light of such evidence, there is the need to understand the determinants behind women's choice of hospital for malignant breast cancer surgery in Italy by using patient-level data. Our work explores the determinants of between-hospital choice in Tuscany region (Italy). In particular, we examine the effect of waiting times and hospital quality on provider choice for breast cancer care also accounting for preference heterogeneity for hospital characteristics, by interacting them with patient characteristics (i.e., education) and allowing preferences to vary randomly across patients. Hospital quality indicators include minimum requirements representing necessary but insufficient conditions for delivering a given quality of health care (i.e., volume of treated patients); process measures of care (i.e., timeliness to surgery after clinical evaluation); and, proxy indicators of the quality of surgery (i.e., breast-conserving surgery (BCS), and execution of the sentinel lymph node biopsy (SLNB), used in evaluating the stage of cancer and for planning post-surgical treatments). The model accounts for variation in preferences related to individual characteristics including age, education, and travel distance from the hospital. We found preference heterogeneity associated to observable personal characteristics; indeed, age and education seem to have an influence over the choice of hospital providers by breast cancer patients.

The study is organized as follows. The next section introduces the data sources and study population, the variables selected, and statistical analysis performed. The following section presents the results, followed by discussion and implication. The last section concludes.

2. Methods

2.1. Data sources and study population

The study focuses on Tuscany, a large region in central Italy (over 3.7 million inhabitants or about 6.2 % of the Italian population) characterized by the provision of inpatient services almost exclusively by public providers and where patients are free to choose any provider. It is a non-competitive system, with over 95 % of all hospitalization provided by public hospitals. The regional healthcare system comprises three local health authorities (LHAs) with 38 district general hospitals directly managed by the LHAs, four teaching hospitals and 34 health districts, which are in charge of the organization and delivery of services for local health networks. Each LHAs have large catchment areas (about 900,000 resident). Hospital care is reimbursed using DRG tariffs, although this method is generally complemented with other forms of payments such as global budgets for specific care services e.g. emergency, hospital teaching activities, oncological care. The tariff model is not applied to hospitals run directly by LHAs. Differently from other regional contexts, the Tuscan health system is highly centralized, and its main goal is reducing unwarranted variations among hospitals and health districts to increase value for the patients and the population.

The study is a retrospective analysis that uses individual pseudo-anonymized non-emergency hospital admissions data of Tuscany from January 1 to December 31, 2016. Data were pseudo-anonymized at the Regional Health Information System Office where each patient was assigned a unique identifier applying to all administrative databases. This identifier does not disclose the patient's identity or other sensitive data. The study was carried out in compliance with the General Data Protection Regulation (2016/679) and the Italian Legislative Decree No. 196/2003 ("Italian Privacy Code").

The dataset includes information on patients' individual demographic characteristics (age, place of residence, education level), hospital of admission, diagnosis and indication of surgical treatment (ICD-9-CM codes), date of inclusion in the operating list (conclusion of the diagnosis) and date of surgery.

We focused on breast cancer patients (both primary and secondary tumour) undergoing surgical treatment (mastectomy, reconstruction, or conservative surgery) in all public hospitals in Tuscany. Both resident and non-resident populations are included; outward mobility is estimated less than 7 %, with about 5.5 % inward mobility. We followed the National Outcome Program protocol for the identification of the number of surgical interventions for malignant breast cancer (https://pne.agenas.it/risultati/protocolli/pro_107.pdf). Specifically, we included women aged 18 and older hospitalized with a principal or secondary discharge diagnosis of malignant breast cancer. We use the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes 174 (malignant breast cancer), 233.0 (localized malignant breast cancer – *in situ*) and intervention codes 85.2x (conservative surgery), 85.33, 85.34, 85.35, 85.36 (reconstructive surgery), 85.4.x (mastectomy). 3314 women were included in the study. For the analysis, we excluded public hospitals who registered fewer than 5 breast cancer surgery per year (4 hospitals for a total of 6 patients with breast cancer surgical treatment) and residents from the isle of Elba.

Hospital data were integrated into a Geographic Information System (GIS) environment, in order to visualize the geographical distribution of the healthcare providers (n=22) and population (Fig. 1).

We only model the choice between public providers and did not include the choice to go private or to go outside Tuscany.

2.2. Variables

To analyse the time patients travelled to health care services, studies on patient choice use the Euclidean/linear distance or travel time. For this study, the regional road network, available on the Open Toscana website (http://open.toscana.it/) was used to calculate the travel distances. Dasymetric mapping was used to identify the centroids of the patients. This provides the best estimates of the distribution of aggregated population data within each unit of analysis by weighting the number of patients who live in the area over the real residential area [22–24]. This estimation was calculated by interpolating areal data in order to extract only the residential urban land use areas from the regional land use data obtained from the available online dataset. The travel times between the patients' centroids (origins) and the hospitals (destinations), were obtained by running an OD matrix.

From the hospital administrative data, information on waiting time for surgical procedures was collected. Waiting times are defined by the number of days elapsing between the time the patient is included in the operating list (conclusion of the diagnosis) and the day the patient received the surgical intervention. Median waiting times for each hospital were calculated given that the median is less sensitive to the presence of outliers than the mean.

From the same administrative data source, hospital yearly volumes of breast cancer surgical procedures were calculated. A threshold of at least 135 new interventions per year was considered the appropriate value to discriminate between low and high annual volumes of treated patients following national indication (National Health Outcomes Programme – https://pne.agenas.it/) and available clinical literature [25]. High volume hospitals are proxy of high quality care, indeed a number of studies [26,27], including a meta-analysis have demonstrated better survival (after adjusting for age and tumour grade, stage and adjuvant treatment) among breast cancer patients treated by hospitals performing high volumes of surgeries [21]. The interpretation of these findings has typically been that the higher survival rates of patients from providers

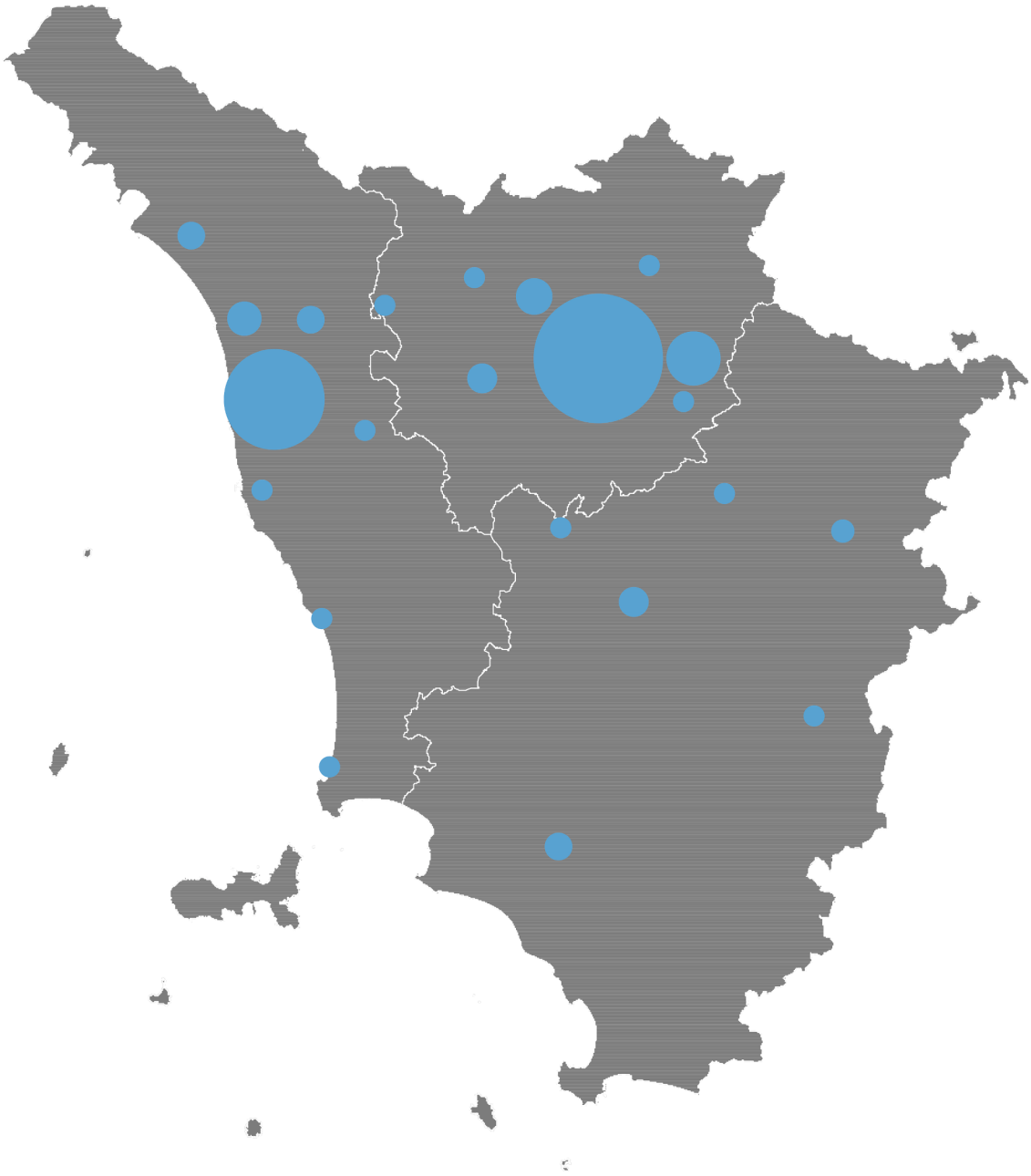

Fig. 1. Tuscany region, map of hospital location.
Note: Bubble's size indicates the number of breast surgery performed by each hospital, with larger bubbles corresponding to higher surgery rates.

performing a significant number of interventions (i.e., high volume) are attributable to greater staff experience and better hospital based services, additionally enabling more cost-effective activity [25]. Finally, we measured two care process indicators - proxies of the quality of surgical intervention - using hospital discharge records following validated protocols. We considered: intraoperative assessment of the sentinel lymph nodes (SLNs) biopsy, used in evaluating the stage of cancer and for the planning of post-surgical treatments [16], and breast-conserving surgery rate (BCS). These are two of the EUSOMA quality indicators measuring the capacity of breast units to ensure high-quality clinical outcomes [17]. BCS indicator includes nipple-sparing, skin-sparing and skin-reducing mastectomies [28].

Following previous studies, quality indicators and waiting times were lagged by one year assuming that hospital choice responds to the quality indicators of the past year, rather than current, and to prevent potential endogeneity [29,30].

The analysis included interactions of hospital attributes with patient education level. Education was categorized as "low education" (none or elementary and secondary education) and "high education" (high school, bachelor and post-graduate). This categorization is consistent with previously published studies [31]. Additionally, to control for effect modification, we stratified patients in two groups by age to display mixed logit model results using the median age as cut-off: women < 65 years and ≥ 65 years.

Individual variables were measured at date of surgery reflecting the patient's circumstances at the time of the incident breast cancer surgery.

2.3. Statistical analysis

We applied mixed logit regression to investigate patients' choice of breast-cancer surgery provider [32]. By merging the information on hospital performance characteristics and patient demographics, we

modelled patient choice between alternative hospitals as a mutually exclusive choice. The mixed logit model was deemed the most appropriate since it enables to account for unobserved preference heterogeneity, and also relaxes the assumption of independence from irrelevant alternatives (IIA) [33,34]. See supplementary material for model specification.

We focused on the effect of travel time (expressed as the natural log of travel time to allow a nonlinear relationship between utility and travel time) and hospital performance indicators (hospital yearly volume of breast cancer surgeries, median waiting time for surgery after clinical evaluation and quality of surgical procedures considering intraoperative SLN biopsy and percentage of BCS). The analysis included interactions with patient education level.

Moreover, following the probability weighted elasticity model proposed by Sivey [35], we presented estimates of the effect of a change in travel time and waiting times on hospital choice in the form of elasticity of demand. Further insights are provided with marginal utilities of distance, waiting times and quality computed across age groups and education level.

All the statistical analyses were run using SAS version 9.4 (SAS Institute), the mixed logit regressions were estimated via maximum simulated likelihood by using user-written "mixlogit" STATA programme [36] and the geographical analyses were run using ArcMap version 10.3.1 (Esri).

3. Results

In 2016, 3314 resident women underwent breast surgery for a primary diagnosis of cancer in public hospitals of Tuscany. On average, patients were 63.1 years old (SD 13.8), with 58.4 % of women at low education level (none or elementary and secondary education) and the remainder with a high school, bachelor or post-graduate degree (Table 1). Most patients aged 65 years or more had a low education level (77%), while younger patients register a lower share of low educated women (44%).

For our patient cohort, 22 public hospitals provided breast cancer surgery in Tuscany with average numbers of treated patients per year of 163 (SD 186.5). On average, women waited 29.3 days (SD 10.5) for surgery - in line with the national maximum waiting time standards for the diagnosis and surgical treatment of oncology-related diseases. The mean travel time to the chosen hospital was 18.2 minutes (SD 16.3). Two mixed logit models were fitted, one for women aged below 65 years and the other for those aged above or equal to 65 years (Table 2). Additionally, for each age group, the first model included only hospital' characteristics (Model 1); the second model was adjusted for patients' education (Model 2) to explore how the sociodemographic background modified the effect of travel times, waiting times, and the other hospital attributes considered.

Results reveal that in Model 1 all coefficients are statistically significant. Specifically, breast cancer patients in both age groups preferred hospitals nearby, delivering high-volume of interventions ($\geq$ 135 per year), an appropriate surgical approach and with longer waiting times. A significant preference heterogeneity among women was found for the distance travelled and a less invasive diagnostic approach to lymph nodes (SLN) treatment.

After accounting for patient education (Model 2) the coefficient for waiting times is no longer significant for women aged $\geq$ 65 years. Moreover, the interactions show that among younger patients less educated women were less prone to travel further to receive surgical treatment and waiting times are a significant determinant of hospital choice, indeed more educated women are more prone to wait longer for the surgical intervention compared to their less-educated counterparts. In general, the higher the level of education the higher the likelihood of selecting high-volume hospitals.

The rate of conservative breast surgery performed is no longer significant factor determining hospital selection across age groups, whereas intra-operative SLN biopsy is still slightly significant showing a preference for less invasive and gold standard procedure (intra-operative SLN biopsy avoids more extensive lymph node surgery and associated complications).

Table 1
Patient age by education level.

	Observations	Mean age (SD)
Low education	1871	67.6 (13.0)
High education	1405	55.7 (12.1)
Total	3276	62.5 (13.9)

Table 2
Results from mixed logit estimation of hospital choice.

Varaible	Model 1		Model 2 Interactions	
	Age >=65	Age <65	Age >=65	Age <65
Waiting time	0.011**	0.025***	0.010	0.030***
	(0.004)	*(0.003)*	*(0.006)*	*(0.004)*
Ln (Travel time)	−3.601***	−3.263***	−3.415***	−3.102***
	(0.129)	*(0.131)*	*(0.187)*	*(0.137)*
Volume	1.456***	2.187***	2.121***	2.367***
	(0.097)	*(0.121)*	*(0.224)*	*(0.161)*
% BCS	0.061***	0.062***	0.067***	0.067***
	(0.006)	*(0.007)*	*(0.016)*	*(0.009)*
% SLN	0.037***	0.072***	0.074***	0.079***
	(0.006)	*(0.009)*	*(0.018)*	*(0.010)*
Interaction terms				
Waiting time*Education (Ref. High)			0.001	−0.015**
			(0.007)	*(0.006)*
Ln (Travel time) *Education (Ref. High)			−0.179	−0.358**
			(0.180)	*(0.141)*
Volume* Education (Ref. High)			−0.835***	−0.407*
			(0.244)	*(0.195)*
% BCS* Education (Ref. High)			−0.007	−0.013
			(0.017)	*(0.013)*
% SLN* Education (Ref. High)			−0.045**	−0.019*
			(0.018)	*(0.009)*
SD of coefficient				
SD of Ln (Travel time)	1.370***	1.448***	1.326***	1.418***
	(0.103)	*(0.106)*	*(0.099)*	*(0.105)*
SD of SLN	0.018**	0.043***		0.041***
	(0.007)	*(0.006)*		*(0.006)*
Observations	35,310	37,598	35,310	37,598
Log-likelihood	−1804.54	−2299.57	−1788.16	−2280.17

BSC= Breast-Conserving Surgery
SLN= Sentinel Lymph Nodes
Notes: Estimates obtained using the Stata mixlogit command (Hole, 2007a).
All hospital specific indicators are lagged by one year. No. of patients age>=65:1605; No.of patients age <65: 1709. No. Of hospital:22.
Standard errors in italics. SD of individual heterogeneity are included when significant.
Significance levels: *** p $\leq$ 0.001; ** p $\leq$ 0.01; * p $\leq$ 0.05; ns > 0.05

Table 3
Average elasticity of demand with respect to waiting times and travel time.

	Average elasticity of demand	
	Age >=65	Age <65
Waiting times (days)	0.161	0.428
	(0.153)	*(0.324)*
Ln (Travel time)	−1.287	−1.382
	(1.077)	*(0.979)*

Notes: Results based on the mixed logit regression of Table 2 with no interaction.
Standard deviations in parentheses.

Table 3 shows the estimates of the effect of a change in travel time and waiting times on hospital choice in the form of the elasticity of demand. Elasticities are calculated at the individual level and results are summarized with average elasticities. We followed the probability weighted elasticity model as proposed by Sivey [35]. The number of surgical interventions performed by each hospital are the associated weights.

The elasticities can be interpreted as the percentage change in demand associated with a 1 % change in waiting times and travel (with travel time we use a 0.01 increase in the natural logarithm of travel time to simulate a 1% increase in travel time, [35]. Mean elasticities are averaged across all hospitals. As expected, distance has a negative elasticity with respect to hospital choice and has a much higher weight as a determinant of choice than waiting times, confirming previous literature [35]. The results hold constant for both age groups.

Further insights into how the estimated marginal utilities of distance, waiting times and quality vary with education level and across age groups are provided in Table 4.

The second and third columns of Table 4 displays the estimated marginal utilities obtained from the mixed logit without interactions, the other columns the marginal utilities derived from the mixed logit with interactions and consider two "patient-types": one with low education and one with high education. The analysis was stratified by age groups. There are no notable differences in models with and without interaction except for a small increase in the coefficient of volume of surgery for patient with low education and age greater than 65 years. Indeed, the different types of women seem not to differ in terms of change in preferences due to variation in all indicators except for a slight change in volume. This result is in line with the findings of Table 2.

4. Discussion

We explored the association between patient and hospital characteristics and the choice of provider for breast cancer surgery. Evidence reports that high-volume hospitals suggest a better application of recommended care processes, justifying the centralization of breast cancer care in such hospitals [25]. From our data, the willingness of being treated at a reference hospital with a breast unit and a workload $\geq$ 135 cases per year decreased with increasing age and distance between residence and these hospitals. Whereas women seem to choose hospital with longer waiting times, ceteris paribus (Model 1). As suggested by Borowitz et al. longer waits for an elective surgery can be perceive by patients as a proxy of higher quality of care where higher caseload are a measure of attractiveness and reputation [37].

Our results are in agreement with the prior literature on hospital choice that shows that proximity plays a central role in selection of hospital for elective care [3,5,38–40], while evidence so far have highlighted mixed results about sensitivity of patient to wating times and quality information in the choice of providers [29,30,41].

Our results suggest the existence of preference heterogeneity related to observed personal characteristics on the hospital choice for breast cancer surgery despite the introduction of quality standards on breast cancer care which should grant the same level of quality to the patients with the same need independently by their socio-economic characteristics. Indeed, age and education seem to have an influence over the choice of hospital providers by breast cancer patients. Older and lower educated women appear to be less sensitive to higher quality care for surgical breast cancer treatments. Indeed, high-volume hospitals are selected with lower extent by women with less education compared to those with higher levels of education. Additionally, less educated women younger than 65 are less prone to travel further to receive surgical treatment and to wait longer (Model 2).

Differences by age are well documented in the literature, with older women less frequently receiving a high standard of care, and possibly being exposed to worse outcomes [42], or less willing to trade-off distance and waiting times with quality [30].

Education is also reported as a factor associated with quality of treatment, where less educated women are more likely to be treated at hospital with lower levels of specialization and, indirectly, are more likely to receive suboptimal care [40]. Moreover, prior literature show that patients living in greater income deprived areas, or with less healthy or educated population, care more about distance and less about quality for hospital choice for elective surgery [29] or for choice of doctors [43]. Also, older patients that belong to the lowest socioeconomic groups, and non-white patients, are more likely to receive treatment from their nearest provider [44] and at hospitals with a higher proportion of patients with similar race/ethnicity [45].

These findings contribute to highlight the importance of using administrative data to provide valuable information for understanding patient choice of care provider but also are useful to shed light on inequities in access to appropriate medical care. The disaggregation of administrative healthcare data on breast cancer surgery by education and age level highlights the existence of horizontal inequity in access to high performing hospitals in Tuscany. Identifying groups of people who do not benefit equally from our health system, and identifying possible causes of these differences provides important evidence on how to reduce health disparities [46].

These findings could be used to optimize the allocation of resources toward Breast Centres that meet quality and efficacy standards to increase the efficiency and responsiveness of breast cancer care towards

Table 4
Marginal utility: main effect and effects by type of patient.

	Mixed logit without interactions		Mixed logit with interactions			
			Age >=65		Age <65	
	Age >=65	Age <65	Education = Low	Education = High	Education = Low	Education = High
Waiting time	0.002***	0.002***	0.001	0.001**	0.003***	0.004***
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*
Ln (Travel time)	−0.332***	−0.288***	−0.321***	−0.316***	−0.273***	−0.282***
	(0.010)	*(0.009)*	*(0.016)*	*(0.009)*	*(0.008)*	*(0.005)*
Volume	0.151***	0.225***	0.216***	0.225***	0.236***	0.246***
	(0.009)	*(0.006)*	*(0.018)*	*(0.018)*	*(0.012)*	*(0.011)*
% BCS	0.007***	0.007***	0.007***	0.007**	0.007***	0.008***
	(0.001)	*(0.001)*	*(0.001)*	*(0.002)*	*(0.001)*	*(0.001)*
% SLN	0.004***	0.008***	0.008**	0.008***	0.009***	0.009***
	(0.001)	*(0.001)*	*(0.003)*	*(0.001)*	*(0.001)*	*(0.002)*

BSC= Breast-Conserving Surgery
SLN= Sentinel Lymph Nodes
Notes: ML without interactions: results based on the mixed logit regression of Table 2 model 1. ML with interactions:results based on the mixed logit regression of Table 2 model 2.
Boostrap standard errors in parentheses. Significance levels: *** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$; ns > 0.05

less educated and older women. Among the requirements of a specialist Breast center, we recall a sufficient number of cases to allow effective working and continuing expertise, dedicated specialists working with a multidisciplinary approach, providing all services throughout the patients pathway, and data collection and performance evaluation [19]. Indeed, efficacy and compliance have to be constantly monitored to evaluate the quality of patient care and to allow appropriate corrective actions leading to improvements in patient care.

4.1. Limitations and strengths

The findings present various limitations due to data availability which could improve the model and explanation of patient choice. The study could benefit from improved information on additional clinical variables, such as tumour stage and primary tumour diagnosis, as well as patient characteristics, such as patient knowledge of alternative providers, occupation, income, migrant status, family circumstances (e.g., cohabitation status), and social networks, although the mixed logit model allows to overcome this data limitation by accounting for unobserved preference heterogeneity. Overall, the model only ascertained where patients had been treated and not whether they made an active choice [38]. Furthermore, we were not able to determine to what extent primary care physicians or other specialists such as radiologist or oncologist influenced these choices, or whether prior hospitalization or a recommendation by family or friends influenced the decision. For a meaningful understanding of patient choice, future study should direct attention towards the patient, embracing the value creation paradigm whereby performance systems for coordinated care include the systematic assessment of patient experience, the level of participation in shared decision-making between patients and providers [47], and taking into account differences in patient characteristics.

Finally, quality indicators intended to assess the capacity of the Breast Centers might still suffer from variability in coding practices in the hospital discharge records databases (see Murante et al. in relation to BSC coding practice variability across hospitals in Tuscany [28]), thus limiting their validity and interpretation. Despite these qualifiers and future improvements, one strength of this study is that administrative datasets were used at the individual level to highlight hospital choice decision for a complex care pathway with recognized quality standards. We were able to include disease-specific quality indicators to assess quality of surgical procedures. Moreover, the availability of administrative datasets for Tuscany offers a regional perspective on the geographical access to elective surgical care where evidence-based clinical and appropriateness standards should apply.

5. Conclusion

Understanding how women with same needs but different demographic and socio-economic characteristics behave in the selection of hospitals for breast cancer surgery can offer key insights on patients' preferences for hospital choice and can help managers and policy makers identify strategies to ensure high quality care across subgroups of patients. Findings show that on average, women are sensitive to distance, waiting times and quality (in particular standard of volumes) in the hospital choice. The interaction between hospital attributes and patient education show that waiting times is no longer significant driver of hospital choice for elderly women, whereas among younger women (<65 years), less educated ones prefer shorter waiting times compared to high educated. We also found some variations across subgroups of patient regarding preferences for quality and in particular volumes and intra-operative SLN biopsy, while travel distance affects choice among less educated women (regardless of age).

Overall, there is a need for decision support especially for complex care such as breast cancer care among less educated and older women to move to more equitable, appropriate, and sustainable care. Decision support strategies may include greater information to the population about what is a high-quality breast cancer care, easy recognition of Breast Centres and means for reaching such centres via subsidies to overcome the travel burden especially for population in remote areas that have older population. Moreover, at the system level this evidence should guide the organization of hospitals and team of professionals to achieve high quality care by supporting the regional breast cancer network to adhere to quality standards across the region, paying particular attention to establishing dedicated units for breast cancer offering treatments according to multidisciplinary competencies and patient-centred approach. Policies should also consider increased information to physicians in referring patients to high performing hospitals, often bypassing local providers.

CRediT authorship contribution statement

Francesca Ferré: Conceptualization, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Chiara Seghieri:** Methodology, Data curation, Formal analysis, Writing – review & editing. **Sabina Nuti:** Conceptualization, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no conflicts of interest.

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Ethics Approval and Consent to Participate

N/A

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Supplementary materials

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