

Research Article

Network and Spatial Analysis to Assess and Guide Decisions about Equitable Accessibility to Health Services: The Public Palliative Care System in Extremadura (Spain)

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ABSTRACT

Background: More than 50 million people die every year in the world. A vast majority, however, does not have access to minimum measures to alleviate unnecessary suffering, or even less, to palliative care. Even in places where such care exists, availability of services does not mean, automatically, that they are equally accessible to the population that needs them.

Methods: With data from the Autonomous Community of Extremadura in Spain, we generated a mapping model using ArcGIS 10 as a network and spatial analysis tool, which takes into account estimating time to access physical facilities and professionals, and equity indices, to illustrate how potential accessibility could be affected by the presence or removal of administrative, policy-driven restrictions.

Results: The approach allowed multiple levels of analysis of administrative restrictions impact on potential accessibility of services. First, it was shown how the minimum average access time to the closest palliative care services in the eight administrative areas of the Autonomous Community was much shorter than the national average. A similar picture was shown in relation to access times to the nearest hospital-based teams. As the measures used did not take into account the population of the municipalities, a third analysis considered potential demand levels, and involved Gini indices and Lorenz Curves, revealing that administrative restrictions may lead to inequity in access to palliative care services.

Conclusion: The simultaneous use of maps of accessibility and coverage, illustrating the relative distribution of the resources in a population, while displaying the levels of coverage according to access time to physical facilities and professionals, with and without administrative restrictions, could be of great value to decision makers attempting to promote optimal levels of equity in a large, low-density geographic areas.

Keywords: Equitable accessibility; Network and spatial analysis; Medical geography; Rural health; Modeling

Background

Only less than 8% of the 100 million people who would get benefits from palliative care worldwide in each year can access the service [1]. Even though we all wish for a pain-free and dignified death, this is denied to the majority of humans today as 90% of the world's morphine is used by 16% of the population. This is a shameful reflection and situation on our species, which is revealing our entrenched emphasis on curative treatment while ignoring the inevitability of death.

Throughout the world, policy makers and clinicians faced with limited resources, favour strategies and actions that prioritize the diagnosis and treatment of illnesses wherever they can save lives. Thus, even in many high-income countries, end-of-life care is left to the charitable and voluntary sector, which have to underscore its importance and are responsible for the majority of the funding [2]. As a result, dying is still seen as a sign of the failure in practically all health systems, leaving as a remote possibility the realization that dying well is an essential duty of a caring and civilized society [3].

Even in places where palliative care exists, availability of services does not mean, automatically, that such services are equally accessible to the population that needs the services. One of the key elements that needs to be taken into account during the study of disparities, particularly at the end of life, is geography, as accessibility of health services is often influenced by the distances that people have to travel, and the time it takes them to reach them, as well as by the spatial distribution of health care providers and the patients who could benefit from their services [4].

Location-related issues, however, are rarely addressed by health equity research, as most efforts tend to focus on describing and analyzing the distribution of social determinants of health [5]. The methodology we describe here attempts to fill current niche, by bringing together, simultaneously, mapping technologies, indices of equity and estimates of time to access physical facilities and professionals, with and without administrative restrictions. Such approach could be of great value to anyone interested in optimizing potential accessibility of services (the aggregate health resources that are available in the area, regardless of their use), to ensure that the actual use of the services available in a given location matches the needs of the population at end of life equitably [6].

Extremadura (Spain) is a region with clear geographical and demographic handicaps, as defined by the European Union (EU) itself. This region is defined by a very low population density (26 in hab/km^2), motivated by the dispersion of its inhabitants and the concentration of most of them in small towns, taking only one exceeds the 150.000 inhabitants. In addition, demographic ageing, reduced or zero average annual population growth rate, the emigration of the young population, the high unemployment rate, or the large proportion of population occupied in the Administration, are other factors that make the daily evolution of the Extremadura region [7].

Only few references have been found in areas of study with similar characteristics and features (albeit density), such as some works developed in the coastal counties of Australia [8,9]. The remaining corresponds to crowded cities and with a very different demographic and economic dynamics or to regions with similar characteristics. Hence, the fact that the methodology used based on the literature review carried out, to deviate from the existing literature today briefly. In rural and more remote areas, there is a need to provide services for palliative care due to the long distance and time of access to the resource population. In the region of Canada, study has shown the need for resources of CP in nearly 50 regions [10].

Methods

The geographic context for the study was the Autonomous Community of Extremadura, Spain. This region has had a palliative care program fully integrated into the public health care system since 2002, which resulted from a decision by local health care authorities to guarantee full palliative care coverage as a basic right. Services are organized in eight “health areas”, with a palliative care team each, which operates under the direction of a regional coordinator, and is supplemented by mobile teams operating from eight acute care hospitals (Figure 1). The provision of palliative care in Extremadura is based on need alone, and is not conditioned by the patient's geographical location, his or her condition or disease, or on the ability to pay.

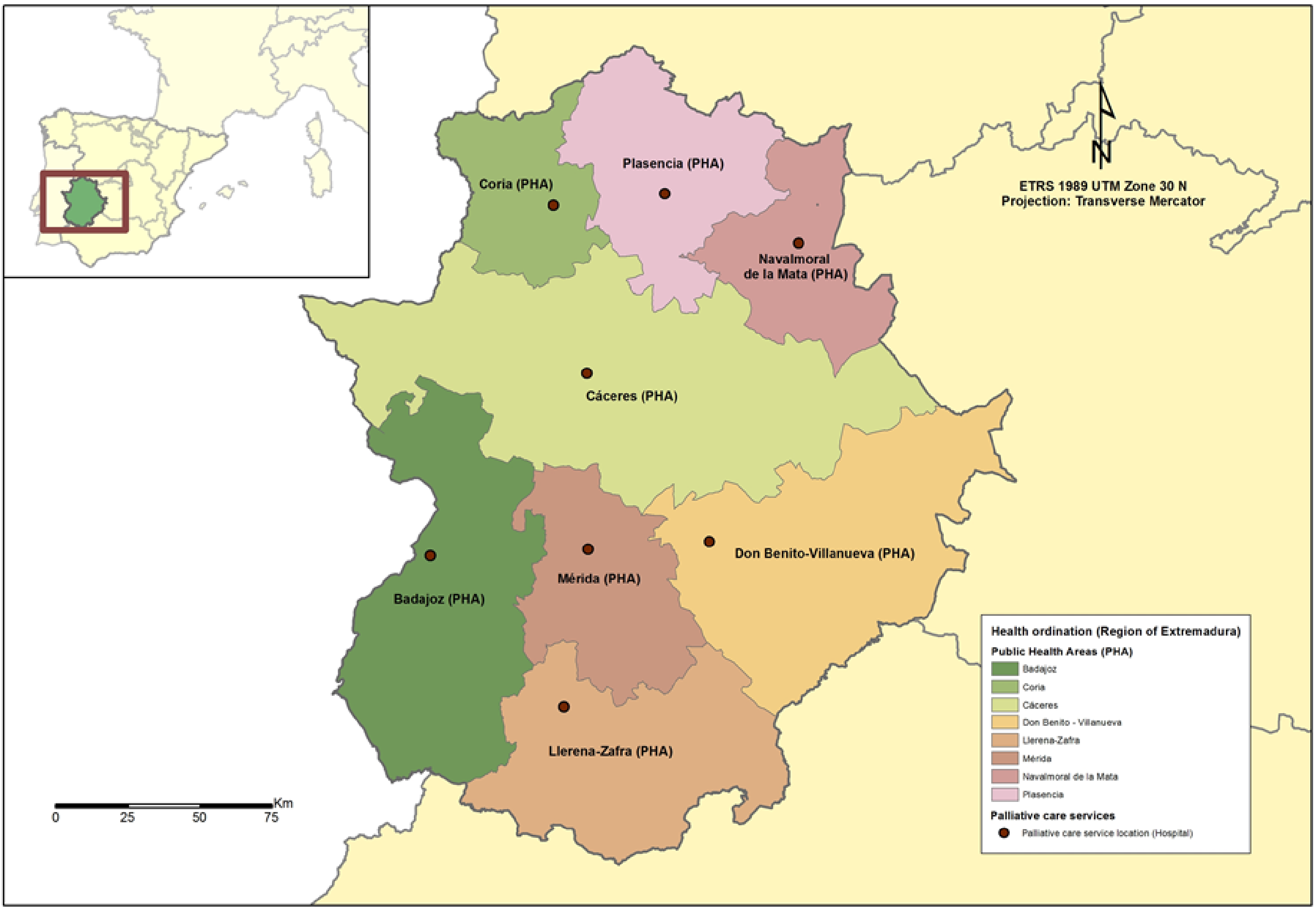

Figure 1: Health ordination in the region of Extremadura: Public health areas and palliative care services.

Achieving this goal has been challenging, not only because of the limited resources available, particularly since the beginning of the economic crisis, but also because of the negative growth and low density of a rapidly ageing population (Figure 1) [7].

The software used to generate the model and mapping was the generic geographic information system, ArcGIS 10, used as a network and as a spatial analysis tool.

The spatial data were drawn from the geodetic system ED50 (European Datum 1950) and the Universal Transverse Mercator (UTM) cartographic projection, projected in the 30 spindle for the study area.

The basic unit of analysis was the municipality, including relevant data in both the supply and demand side. Each municipality was represented by the centroid of the urban core; using coordinates provided the National Geographical Institute in each case [11]. The total population of each municipality was estimated based on data from the 2009 Municipal Register [12].

The limits of each of the health services areas were set by aggregating data included in the inventory of Primary Care Centers of the Spanish Ministry of Health and Social Policy [13].

The tolerance used to project the punctual elements on the network was 2.5 km. The impedance was calculated by dividing the span length between the same specific speeds, obtaining the time that takes to pass through a given road portion.

The road network mapping used in this study was based on data generated by our research group during the evaluation of the accessibility of centers of economic activity in mainland Spain in 2008 [14].

The cartography included all the roads of Portugal and other regions of Spain to allow the generation of an open communication model.

From the above elements, a transport model was established by defining the tolerance to project-specific elements on the network and by assigning impedance to each segment of the network. From the impedance data, the time separating two locations within the transport model was estimated, enabling the creation of a matrix of origin-to-destination times for the entire region.

The matrix of origin-to-destination times is defined by the municipalities (as a source) and palliative care services located in the hospital of reference (as a target). The centroids of the municipalities have been weighted on the basis of the claimant population, although only has been conducted in those with more than 10,000 inhabitants. On the other hand, in these municipalities it has been considered also the weight of the population that each one of the census districts defined by the INE, aiming at much closer to the reality of the density and flow that present major cities in its different spaces. The weighting has been held in the municipalities of less than 10,000 inhabitants because it has been considered that the population entity, the density or movement of these flows would not effect on the results of the matrix, especially when they are having the lower socio-economic dynamism of the region.

The estimate of the urban time has been calculated considering this travel time as variable depending on the characteristics of the urban core. Since the time analysis carried out in this research considers all the urban areas of Extremadura and the peninsular centres of economic activity. In considering the density of resident population, the running speed and radius of the urban surface, so much for the urban nucleus that receives the station of departure as that of arrival, are departing from the premise from that all the urban areas are considered to be circular. The population of each municipality is obtained from the municipal census relative to the year of 2011 and the urban surface of the National Cartographic Base, 1:200,000 scales. These travel times are estimated based on the population density of the areas, through a linear fit that allocates a maximum of 80 km/h to the areas of lower density and a minimum of 20 km/h to the more populous ones [14,15].

For estimates of the time to access a particular service located within the same municipality, the urban displacement time in that municipality was counted only once. Calculations of the time required to access a health facility that requires transportation across municipalities were obtained from estimates of the time by road between them, as well as the time urban time within each of them.

Data on each of the palliative care services were obtained from existing official directories, including:

- Name and location of the site, equipment or resource
- Resource type: Palliative care unit, clinical support teams (hospital-based, home-based or mixed), psychosocial support teams, service coordination, research teams, day units or rehabilitation facilities
- Financing model: Publicly-funded hospitals, private hospitals in agreement with the National Health Services or private hospitals without agreement
- Staffing: number of physicians, nurses, psychologists, social workers and other health professionals
- Number of beds, whenever relevant
- Expected level of population and geographic coverage assigned by the regional health authority [16].

The accessibility indicators were selected based on a typological classification proposed for key health services in Mexico, modified to account, simultaneously, for determinants of supply (professionals and physical resources) and demand (population) (Table 1) [16].

The geographical indicator of accessibility (A_m), per 100,000 people, was calculated thus:

$$Am = \frac{\sum U_{mu} \times P_u}{Pop_m} 100{,}000$$

where A_m is the accessibility in *Municipality m* ($_{mu}$); U_{mu} is the users accessing the resources available in *Municipality* ($_{mu}$); P_u is the partition of the resource by users who have access to the same resource; Pop_m is the population of *m*.

Table 1: Abbreviations of the variables/indicators.

A_m	Indicator of accessibility
(mu)	Municipality *m*
U_{mu}	Number of user in Municipality m accessing the resource of *u* for all the municipalities that are within the time limit of resource *u*
P_u	Partition of resource by users who have access to the same resource
Pop_m	Population in each municipality
Td_{mu}	Time required by municipality m to access resource u
Tl	Time limit (1 h)
R_u	Number of professionals available in unit u
M_c	Municipality coverage
j	Services available in a municipality
Osp_j	Occupation rate (expressed as a percentage) of a given service
Mdp_j	Population serviced by each municipality
N_s	Number of services
A_t	Access time expressed in minutes

This approach avoids having to assign a population exclusively to a single resource and to consider the distance or access time involved in each case.

The level of user access to a resource (U_{mu}) was estimated as a function of time. It was assumed that municipalities that are more than one hour away were not used; that is, the population accessing it was equal to 0 min. Similarly, it was assumed that municipalities that were 0 min away from a resource could serve the entire population. For the rest, direct interpolation in time function was achieved thus

$$U_{mu} = Pop_m \times \left(1 - \frac{Td_{mu}}{T_l}\right)$$

where Td_{mu} is the time required by municipality *m* to access resource *u*; *Tl* is the time limit (1 h).

As the friction of the distance causes likely following a complex curvilinear pattern, with less marked falls in very long and very short distances, it was assumed that a linear loss could provide a reasonable easy-to-understand approximation, particularly given the lack of actual data on which to apply a friction component model.

Finally, the participation of a resource according to the number of users accessing it (P_u) was assumed to depend on its size and the total number of users that can access all the municipalities that were within the time limit as shown below:

$$P_u = \frac{R_u}{\sum_{m=1}^{y} U_{mu}}$$

where R_u is the number of professionals available in unit *u*; U_{mu} is the number of users in *Municipality m* accessing the resource *u* and all the municipalities that are within the time limit of resource *u*.

Although, in principle, any resident can attend any health facility, anywhere in the region, a number of additional assumptions about accessibility were made. The actual accessibility level, for instance, depends not only on geographical factors but also on administrative ones. Thus, two equity models were established: one estimating coverage with barriers created by internal management and another without such barriers.

The level of municipality coverage, M_c, was obtained on the basis of the distance between the municipality of residence of the potential user and the location of the service as follows:

$$M_c = \sum_{j=1}^{n} \frac{Osp_j \times Mdp_j}{Pop_m}$$

where *j* corresponds to the services available in a municipality; Osp_j is the occupation rate (expressed as a percentage) of a given service; Mdp_j is the population serviced by each municipality; Pop_m is the population in each municipality. The level of service occupation (in percentages) is given by:

$$\mathrm{Osp} = \frac{\mathrm{N_s}}{\mathrm{Mdp}}$$

where N_s is the number of services. So, the population serviced by a municipality is calculated thus:

$$Mdp = Pop_m \times \left(1 - \frac{A_t}{60}\right)$$

This is only calculated by a service if it takes less than 60 min and is included within the established administrative barrier. Access time (A_t) is expressed in minutes. If it is true that most of the literature advocates locked in 30 min the limit or the uptake of health services demand barrier, it is no less true that there are also other authors which extend this up to 60 min, especially when the study area presents a considerable expansion and a low population density as it is the case [8,9,17,18].

The indicators can be used to calculate the level of accessibility with administrative restrictions imposed by internal management decisions, or without such barriers. In the restricted model, residents can only be supported by the service/equipment/resource, organizationally assigned by their corresponding municipality. In the unrestricted model, mapping and graphical representations of the potential accessibility for the population remove internal administrative constraints for services, ensuring that hospital-based teams would always be available to patients within 60 min of travel time, while assuming a linear loss.

The variables can then be displayed in exposed thematic cartography with perceptive properties well suited to represent the type of quantitative information generated by the formulas. In addition, a manual interval method is used to illustrate the variables in the legend as a logical and statistically consistent way.

The distribution of the values on the map follows an interpolation method based on the inverse of the distance weighted (IDW), assigning weights to the data in inverse function of the distance to a particular service point. In relation to the accessibility of the population to the resources, the indicator of minimum time access allows to determine how long it takes to reach the nearest service.

To improve the ease of interpretability of the maps, Lorenz curves and Gini indices were added [19,18,20]. The former was obtained by dividing the coverage range into ten equal parts and representing each decile of coverage along the horizontal axis with the percentage of the total available to the population on the ordinate axis. The Gini index was estimated according to the methods proposed by for grouped data, with zero corresponding to perfect equality (everyone has access to the same resources) and 1 corresponding to perfect inequality (only one person has all the resources and the others have nothing) [20,21].

Results

The first analysis we conducted focused on potential accessibility based on the time required to reach a service from the municipality of origin. Here, the findings for hospital-based teams is shown in Figure 2. In this map analyzed, the color scheme allows the differentiation among time ranges, in minutes, across municipalities that have the same distance to a particular resource. In Extremadura (Spain) as a whole, the minimum average access time of all municipalities to the closest palliative care services was estimated at 33 min, while the maximum was 81 min, much better than the national figures (minimum average time of 41 min and maximum average time of 130 min). As it could be seen in the same map analyzed, in the frontier territory there are also areas with very low values of potential accessibility. These areas have less developed communication channels or more rugged terrain. As expected, accessibility decreases the farther municipalities are from a city with palliative care services available (Figure 2).

The map describes the access times to the nearest hospital-based teams, averaged over all municipalities in a given health area, disregarding their population size. In this case, the minimum average of the eight health areas is 33 min, while the maximum is 64 min (in the Don Benito–Villanueva area). Once again, these data compare favourably with the national average times, where the maximum average times shoot up to 98 min. This measure of accessibility, which does not account for the population in the municipalities, could be a fair measure of localization in equidistance terms, but not in relation to the level of service demand. Obviously, this approach favours smaller areas, provided that they are adequately equipped (or supplied) (Figure 3).

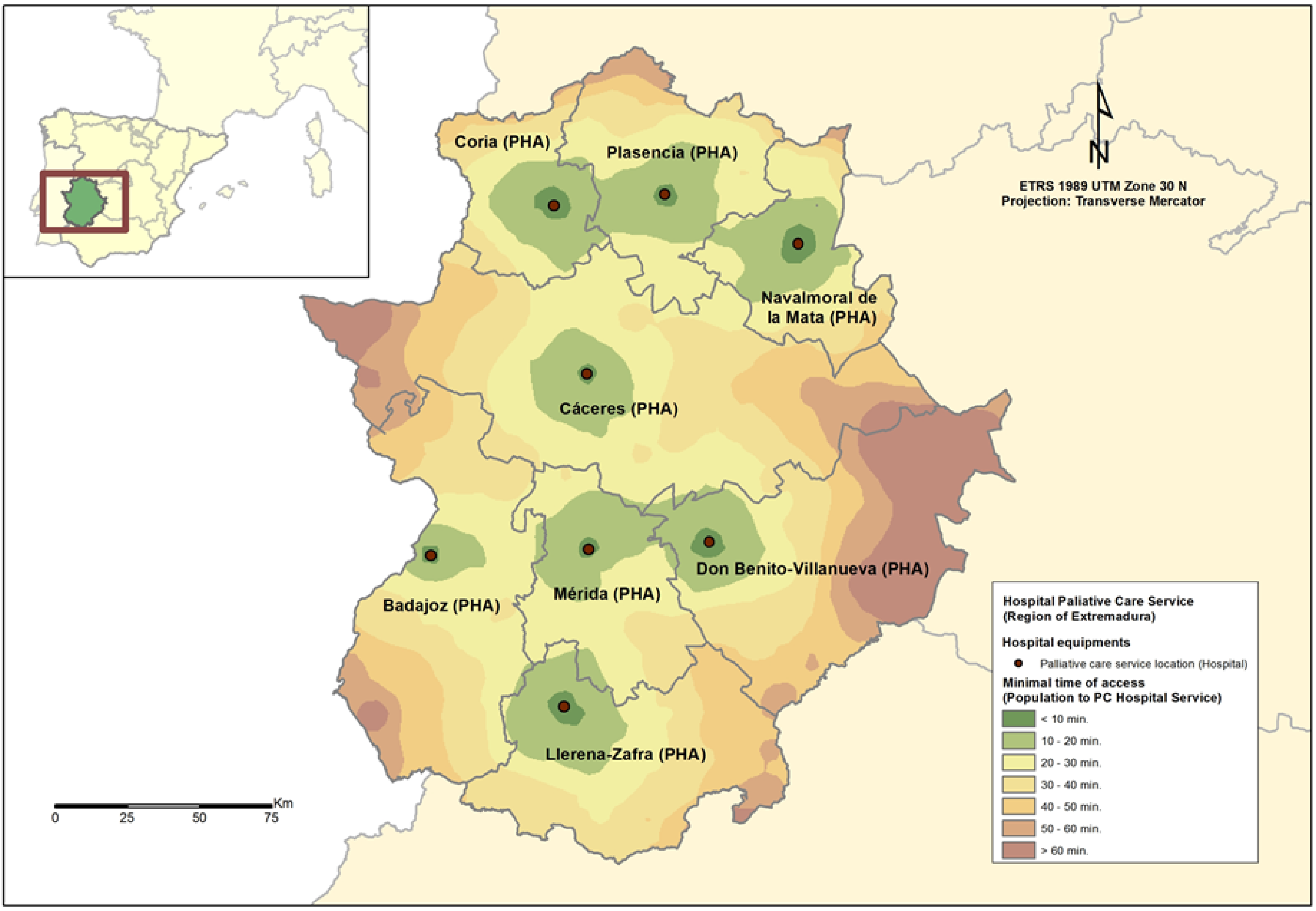

Figure 2: Minimal time of access: Population to the palliative care hospital service.

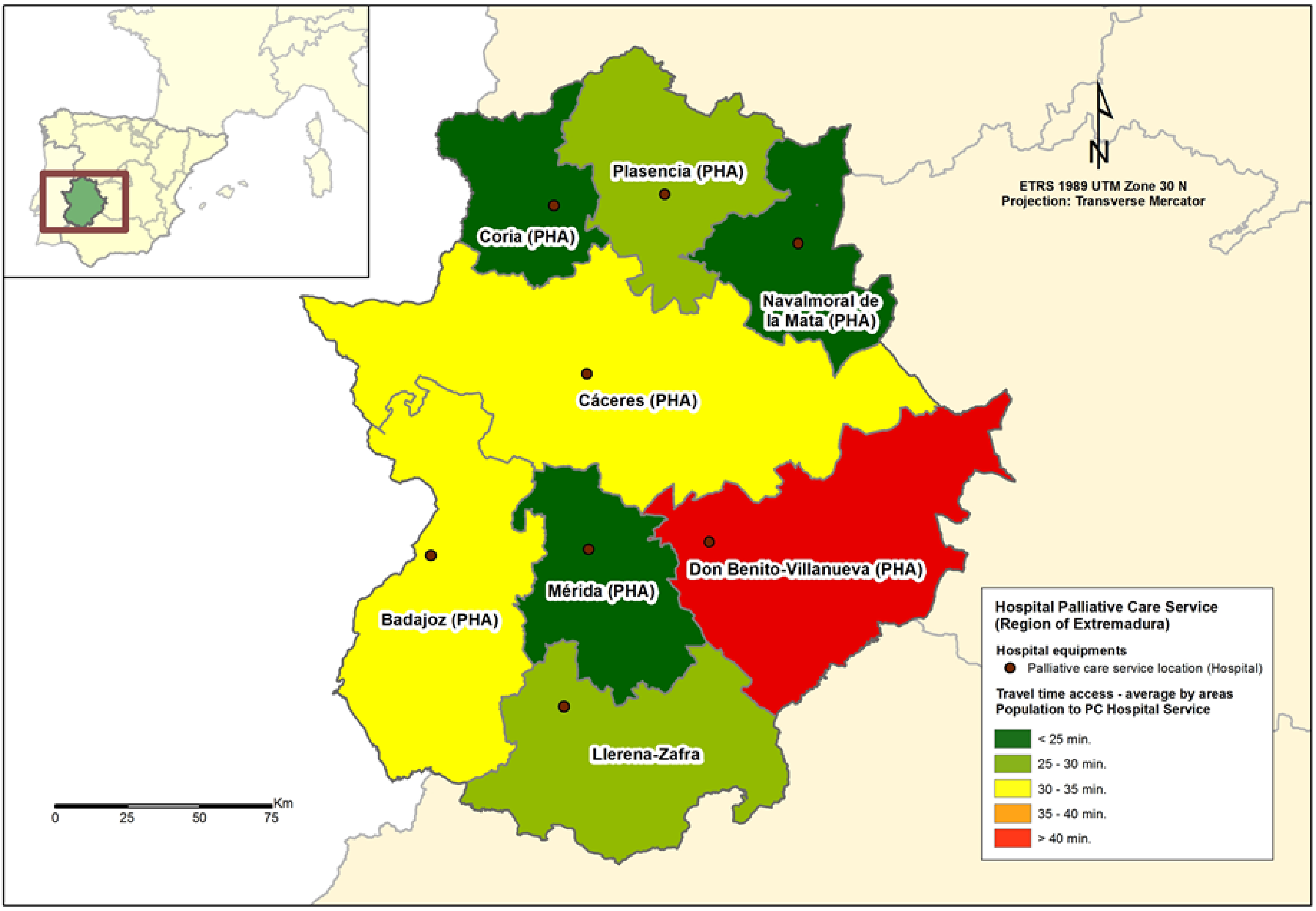

Figure 3: Average by areas of travel time access: Population to the palliative care hospital service.

The various accessibility levels for the population when internal administrative constraints for services were removed and the corresponding Gini indices and Lorenz curves. The average number of accessible resources within 60 min of travel time was 0.6 with a maximum of 1.4. When compared with national estimates, the mean value is slightly lower at 0.5, with a much greater difference in relation to the maximum number, 2.6, for mainland Spain as a whole (Figure 4 and 5).

Administrative constraints were associated with reduced accessibility in terms of the proportion of the population that could access the nearest resource within 30 min, or that had to travel more than 60 min to do so, as compared with the natural, unrestricted conditions (Figure 5 and Table 2).

To conclude, it seems essential to include a table that compares the total population residing in each of the areas of health and the population that accesses the services of palliative care with or without administrative barriers in the analysis. Only in this way the politicians and managers linked to the health services in the Extremadura region can use the valuable information presented here. The tremendous illustrator of the differences that exist applying barriers defined by the administration with regard to access to health services, in this case offered palliative care in referral hospitals, and if the same shall not apply. The claimant population of the services with or without barrier in each of the areas of health can be seen in the table. Likewise, it can be also shown in the same degree of coverage. There is no doubt this table would be of greater assistance to policy makers in the face of their actions in order to promote equity in access to health services (Table 3).

Table 2: Comparative access indicator in Extremadura.

Comparative access indicator in Extremadura		
	Without restrictions	**With restrictions**
Average Coverage (resources per 100,000 inhabitants)	0.82	0.82
Gini index	0.27	0.32
Mean time to the nearest resource (min)	21.6	21.6
People needing to travel less than 30 min to reach the nearest resource	76.9%	69.6%
People needing to travel more than 60 min to reach the nearest resource	2.6%	4.9%

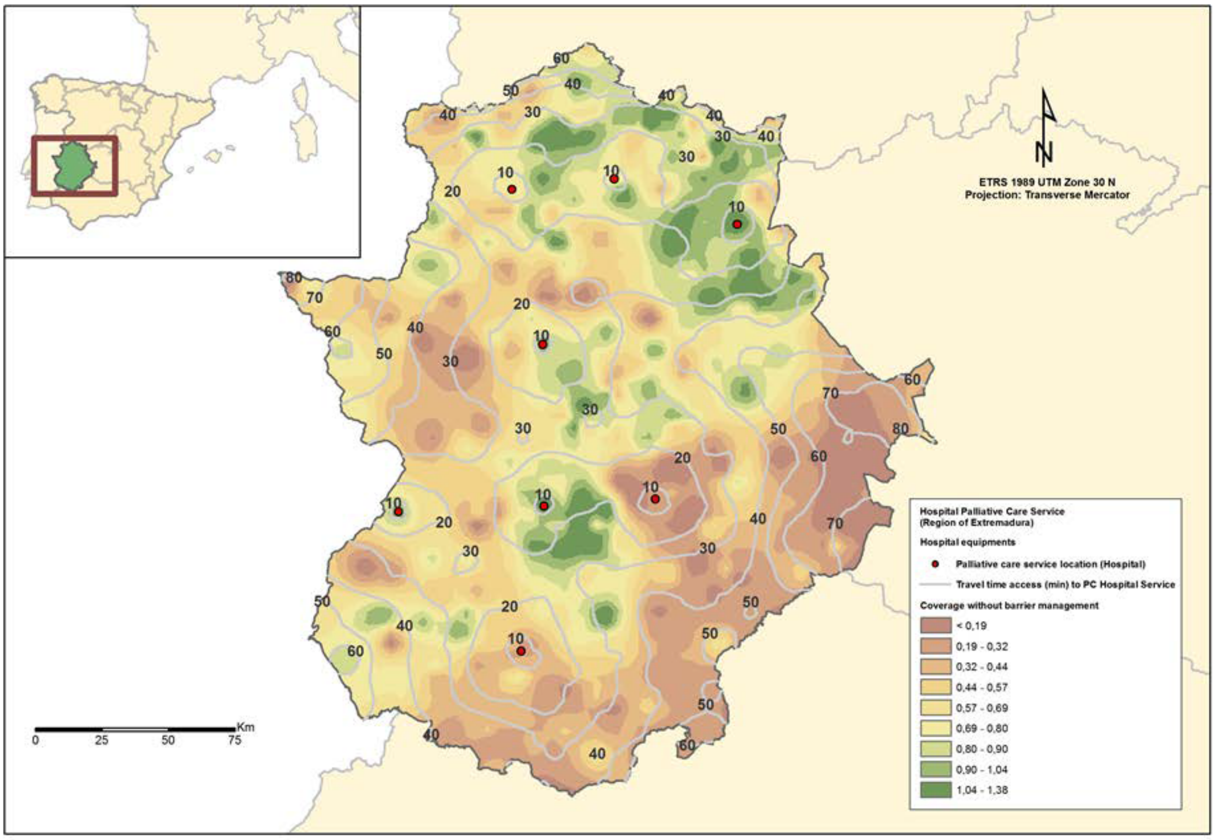

Figure 4: Coverage without barrier management of palliative care hospital service.

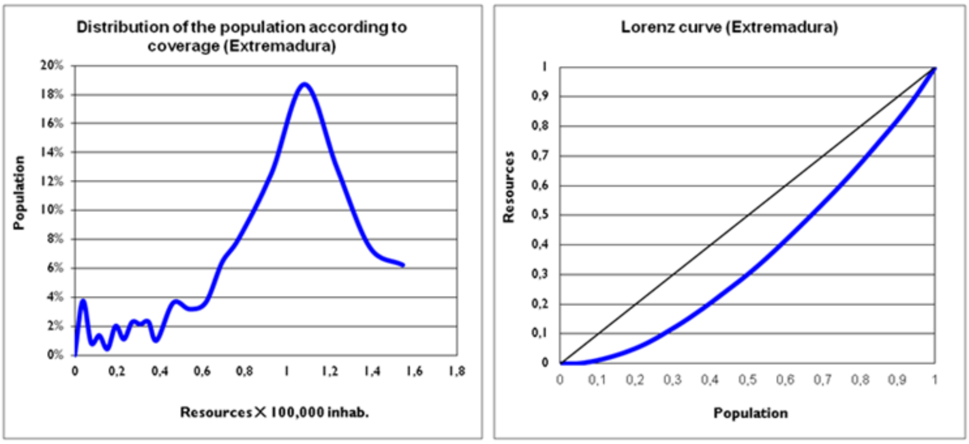

Figure 5: Distribution of the population according to coverage.

Table 3: Differences that exist applying barriers defined by the administration with regard to access to health services.

Public health area	Population 2009	Demand without barriers (Population)	Coverage without barriers	Demand with barriers	Coverage with barriers
Badajoz	270,317	296,737	1.098	175,269	0.648
Caceres	198,409	243,548	1.228	123,504	0.622
Coria	47,979	52,110	1.086	34,216	0.713
Don Benito-Villanueva	142,040	113,951	0.802	81,841	0.576
Llerena-Zafra	106,731	83,220	0.780	64,674	0.606
Merida	166,158	281,818	1.696	112,084	0.675
Navalmoral de la Mata	54,630	56,049	1.026	41,415	0.758
Plasencia	111,480	148, 067	1.328	77,006	0.691
Total	1,097,744	1,275,499	1.162	710,009	0.647

Conclusion

The methodological approach we have described here illustrated with real-world data, complements more traditional, descriptive and static methods that rely on the absolute amount of resources in a given region to plan and deploy palliative care services. The simultaneous use of maps of accessibility and coverage, illustrating the relative distribution of the resources in the population, while displaying the levels of coverage according to access time to physical facilities and professionals, with and without administrative restrictions, could be of great value to decision makers attempting to promote optimal levels of equity in a large, low-density geographic area.

It was intriguing to see how administrative constraints may lead to decreased access to services and equity. If confirmed by prospective studies, this finding could act as a cautionary message to well-intentioned policy makers hoping to level the playing field for people at the end of life.

The methodology we have presented here could also be of value to decision-makers interested in equitable provision of other kinds of services in other regions of the world [10,22].

The user-friendly process could also make it attractive as a means to simulate future scenarios before the deployment of services in vast geographic areas. By enabling the "virtual" manipulation of modifiable variables such as the geographic boundaries of a service area, or the number of health professionals in a particular facility, this approach could help ensure that potential accessibility does, in fact, reflect the level of received accessibility, without additional cost, while reassuring the public about the value added by political and administrative decisions that intend to promote equitable access to crucial services.

The proposed methodology is a theoretical model that has not been validated by health professionals or political managers from the modification of the guidelines that indicate the existence of administrative barriers in access to health services. The proposed theoretical foundation must be validated for comparison with cases that already have been implemented in other regions or cities in the world.

However, it remains less certain that this research is based on a study commissioned by the Ministry of Health in 2009 consultant, expert managers of the health systems of the different Autonomous Communities and teachers from many Spanish nationwide universities. On the other hand, while it developed work, aiming to go by participant to the national health community, several interviews and surveys were conducted to know their opinions. In the case of Extremadura, interviewed the five heads of the Extremadura Health Services in issues related to palliative care, which not only opined about the State of the Service at that particular moment, but it is also involved in the development and the first results of the theoretical methodological proposal was carried out in the region showing at all times compliance with the process followed. Obviously, political decision-makers are ultimately responsible for applying or not all the studies that are carried out on questions as delicate and difficult to implement as the health-related. However, having the support of leading practitioners in the region is already an important step towards possible encounters and meetings to discuss its implementation.

To conclude, it is necessary to accept the patent limitation that defines, in a way, the scarcity of sources for regions with socio-economic characteristics such as exposed here. However, this research continues to be evident the need of studies as the here exposed face to alleviating healthcare deficiencies of the population resident in these most depressed areas. The same National Government, as expressed in the evaluation of the national strategy for palliative care of the national system of health, speaks of the need to expand the range of resources throughout the country and improve its efficiency and territorial cohesion [23,24].

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

FJJC drafted the manuscript, made the analysis and interpretation of data and performed its statistical analysis. JAGG participated in the design of the study, made substantial contributions to the acquisition of data, performed the statistical analysis and helped to draft the manuscript. EHM conceived the study, participated in its design and coordination and helped to draft the manuscript. SLF participated in the design of the study, revised it critically and helped to draft the manuscript. JSJ and ARJ revised the manuscript for important intellectual content and provided linguistic support. All the authors read and approved the final manuscript.

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References

1. Worldwide Palliative Care Alliance.
2. Hughes-Hallett T, Craft A, Davies C (2011) Creating a fair and transparent funding system; the final report of the palliative care funding review. Department of Health, United Kingdom.
3. Hughes-Hallett T, Murray SA, Cleary J (2013) Transforming end-of-life care through innovation. World Innovation Summit for Health.
4. Wang F, Luo W (2005) Assessing spatial and non-spatial factors for healthcare access: Towards an integrated approach to defining health professional shortage areas. *Health Place.* 11: 131-146.
5. Pons-Vigués M, Diez È, Morrison J (2014) Social and

health policies or interventions to tackle health inequalities in European cities: A scoping review. *BMC Public Health.* 14:198.

6. Khan AA (1992) An integrated approach to measuring potential spatial access to health care services. *Socioecon Plann Sci.* 26: 275-287.

7. Herrera E, Rocafort J, De Lima L (2007) Regional palliative care program in Extremadura: An effective public health care model in a sparsely populated region. *J Pain Symptom Manage.* 33: 591-598.

8. Schuurman N, Fiedler RS, Grzybowski SCW (2006) Defining rational hospital catchments for non-urban areas based on travel-time. *Int J Health Geogr.* 5:43.

9. Pilcher J, Kruske S, Barclay L (2014) A review of rural and remote health service indexes: Are they relevant for the development of an Australian rural birth index? *BMC Health Serv Res.* 14: 548.

10. Cinnamon J, Schuurman N, Crooks VA (2009) Assessing the suitability of host communities for secondary palliative care hubs: A location analysis model. *Health Place.* 15: 822-830.

11. Centro Nacional de Información Geográfica - CNIG (2010) Información Cartográfica de España, 2010 (Spanish Cartographic Information, 2010). Madrid: Instituto Geográfico Nacional, Ministerio de Fomento.

12. Instituto Nacional de Estadística - INE (2008) Estadística del Padrón Continuo, 2008 (Municipal Register Statistics, 2008). Madrid: Ministerio de Ciencia e Innovación.

13. Secretaría General de Información Sanitaria e Innovación (2010) Ordenación Sanitaria del Territorio en las comunidades autónomas. Sistema de Información de Atención Primaria (SIAP) (Territorial management health in the regions. Primary Health Care Information System). Año 2010. Madrid: Ministerio de Sanidad y Política Social.

14. Gutiérrez J, Condeço-Melhorado A, López E (2011) Evaluating the European added value of TEN-T projects: a methodological proposal based on spatial spillovers, accessibility and GIS. *J Transp Geogr.* 19: 840-850.

15. Gutiérrez-Gallego JA, Naranjo-Gómez JM, Jaraíz-Cabanillas FJ (2015) A methodology to assess the connectivity caused by a transportation infrastructure: Application to the high-speed rail in Extremadura. *CSTP.* 3: 392-401.

16. Enterprise Solutions for Health (2010) Estudio sobre la equidad y la accesibilidad en el desarrollo de recursos de cuidados paliativos en el Sistema Nacional de Salud (Study on equity and accessibility in the resources development of palliative care in the National Health System). Madrid: Ministerio de Sanidad y Consumo.

17. Garrocho C, Campos J (2006) Un indicador de accesibilidad a unidades de servicios clave para ciudades mexicanas: Fundamentos, diseño y aplicación (An indicator of accessibility to key service units in Mexican cities: Fundaments, design and application). *Revista Economía, Sociedad y Territorio.* 22: 349-397.

18. Wan N, Zou B, Sternberg T (2012) A three-step floating catchment area method for analyzing spatial access to health services. *Int J Geogr Inf Sci.* 26: 1073-1089.

19. Donaldson D, Weymark JA (1980) A single-parameter generalization of the Gini indices of inequality. *J Econ Theory*. 22: 67-86.

20. Gupta MR (1984) Functional form for estimating the Lorenz curve. *Econometrica.* 52: 1313-1314.

21. Ahmad Kiadaliri A, Najafi B, Haghparast-Bidgoli H (2011) Geographic distribution of need and access to health care in rural population: An ecological study in Iran. *Int J Equity Health*.

22. Ferreira E, Garín MA (1997) Una nota sobre el cálculo del Indice de Gini (A note on the calculation of the Gini index). *Estadística Española.* 39: 207-218.

23. Dixon J, King D, Matosevic T (2015) Equity in the provision of palliative care in the UK: Review of evidence. Personal Social Services Research Unit, London School of Economics and Political Science.

24. MHA (2012) Evaluación de la estrategia de cuidados paliativos del sistema nacional de salud. Agencia de evaluación y calidad. Ministerio de Hacienda y Administraciones Públicas.

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