

Spatial modelling of medical reform strategies

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Abstract *Regardless of their type, public policies and strategies are developed in relation to a defined geographic space and they result in changes visible in territory. In this context, the effectiveness of public strategies is conditioned by the access of decision makers to analysis tools able to simulate the impact of political decisions. These tools must be able to transpose coherently and efficiently in the spatial-temporal context the legislative decisions. The main recipient of any public strategy or policy is the citizen who uses or is directly impacted by the effects of decisions taken at central level. At the same time, the society is the tool that allows the most objective measurement for strategy efficiency by using life quality indicators. Unfortunately, any such assessment can only be done in the period following strategy application, a moment when any methodology or execution correction will fail to redress the impact already in effect. This outlines both the principles that are the foundation of this research as well as the methods which can be used to evaluate the efficiency of this study.*

Key words strategy, performance, public policy, G.I.S., spatial modelling

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Introduction

The efficiency level of public strategies or policies can be assessed by a multitude of financial, social or economic indicators, specialists and researchers for the respecting fields advocating their relevance (DeGroff et al., 2010). Most of the time, indicators with geographical background, used mainly by urban planners and spatial economics specialists, are not found in substantiation studies or impact analysis created while implementing strategies or public policies. The causes that create this type of unusual situation are multiple and the solution that eases use of spatial arguments on a large scale for creating and assessing strategies is discussed in this study.

We can discuss about an effective, qualitative and reproducible study just in case the results are materialized into exact and delivered in timely manner information for the decisional factors. Equity (territorial), impartiality, efficiency are the basic principles underlying this study that presents the general approach describing how the spatial analysis captures territorial effects generated by the strategy of streamlining hospitals in Romania.

Following this complex process, the most important structural and functional changes in the past 25 years took place for the national network of hospitals. The paper doesn't aim to analyze the quality of the strategy, the aim of the study was to reinforce the spatial analysis as an integrated element in all stages of a strategy, starting with the feasibility studies and following with applying the strategy and result assessment. In addition, a strictly geographical approach of the topic can produce arguable conclusions considering the complexity of the problem. Apart from the purely spatial valences that geographers can debate and point out, the decisional process is based on functional, economic - financial, political and social reasons.

Methodology

From the very beginning we need to point out the fundamental differences, existing between the medical services analyzed in this study and the emergency medical services. In the first category the interaction is done through movement of citizens as beneficiaries to a unit able to provide the requested health service, the effort required to travel is a measure for evaluating the probability of interacting. The emergency medical services (ambulance, S.M.U.R.D. - represents the Romanian Service of Emergency for

Resuscitation and Extrication) are based on the movement to the cases reported, the traveling time required being able to evaluate the effectiveness of these services. In both cases the movement is accomplished most often through the use of the road network as a transport infrastructure. In a smaller proportion, insignificant on the scale of analysis chosen, it is used the railway transport system, or air ways.

Considering the issues presented and to accurately capture the spatial behavior of individuals, for the purpose of this study, the national roads and highways network was modelled at GIS level. The network is presented as a vector structure optimized for calculating the shortest routes. Specifically, the waterways of the Danube Delta and all the services for water crossing (ferries) were also included in the database along the road transportation infrastructure.

This structure has allowed the incorporation of computer-wide principles regarding the ways individuals move in the geographical space (Homo oeconomicus, the principle of minimum effort, etc.), principles that evidently apply in the case of medical services as well. In similar conditions of quality and specialization levels, the individuals will consistently access the closest service supplier, in this case the closest hospital. Using this premise, calculating the accessibility to medical services indices can be effectively done by identifying the relation between the individuals and the medical units that act as polarization centers.

The accessibility to a medical unit cannot be interpreted without considering the cost concept, one that objectively reflects the behavior of individuals on the territory by providing metric methods for evaluating the distance between two spatial entities. Usually, when conducting such analysis, the cost can be measured in distance (kilometers), time (minutes necessary for reaching the destination) or money (which is the financial effort to get to the desired service).

Applying any of the methods listed above allows a quantitative approach substantiation that insures people's access to health services is efficiently calculated. After considering the state of the national transport infrastructure and the analyzed services typology, calculating the accessibility indices was done by using the time values as assessment element of the individual effort. To ensure a higher level of realism, the roads were differentiated by category and each of their types associated with the average travel speeds rendered by infrastructure quality (Tab. no. 1).

Table 1 – The average travel speed by infrastructure type

Infrastructure Category	Travel speed
Highways	110 km/h
National Roads	80 km/h
County Roads	50 km/h
Local Roads	30 km/h
Waterways transport	15 km/h
Water crossings	1 hour/crossing*

* The travel speed and the time needed to use a ferry (water crossing) were calculated using a survey on a sample of 163 drivers

Results and discussion

Based on information provided by the Romanian Ministry of Health, 433 medical units operating various specializations were identified for this research at national level. According to the same source, these units can be differentiated based on categories, specialization or performance level, a classification that doesn't result in significant differences relevant to this study. However, a different classification was elaborated for this study, distinguishing the hospital into two vast categories:

- Medical units that offer diverse and usual medical services;
- Medical units that offer niche services (nursing homes, recovery hospitals, neuropsychiatric hospitals etc.) (Fig. 1).

Since the study aims to capture the general characteristics determined by the territorial accessibility to health services, and the frequency with which people access medical services offered by niche health units is extremely low, the second category was ignored in all analyzes.

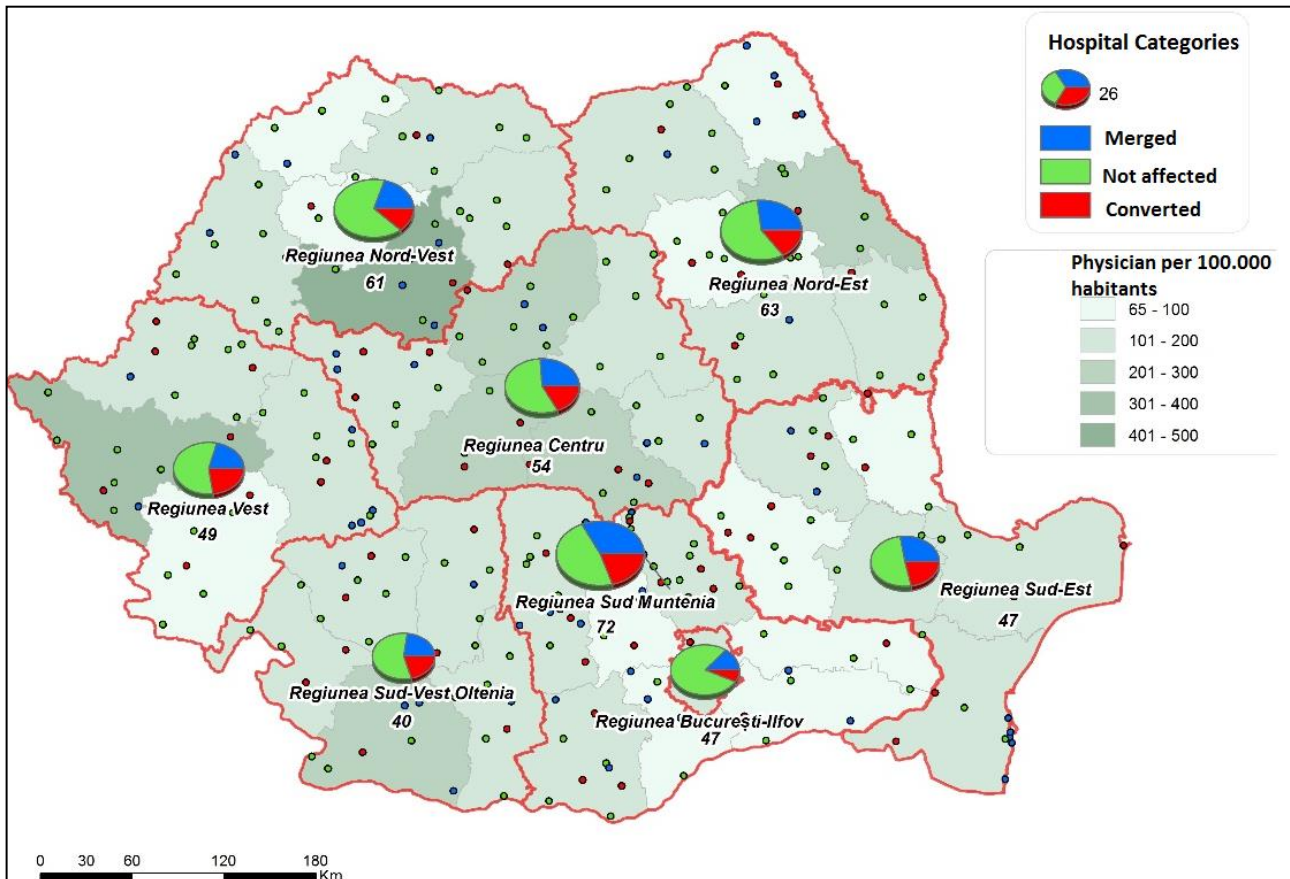


Figure 1. The spatial distribution of hospitals in Romania (2011)

Data from: National Cadastre Agency, Ministry of Health, National Institute of Statistics

Following a functional analysis two distinct categories of action were adopted by the Ministry of Health: merging units and changing their business profile. Merging medical units was achieved by having the higher ranked units assuming administrative responsibilities from the lower ranked ones, thus, as concatenated units providing continuous basic medical services to the citizens. This measure has been applied to 105 hospitals from the total of 433 health units analyzed. Changing the business profiles of health units meant turning a number of hospitals into homes for the elderly and de facto terminating provision of public health services in these units. Largely this can be equated with the dissolution of these hospital units.

Accessibility indices used:

The accessibility indices used for the spatial analysis can be grouped in three major categories according to the territorial aspects they capture:

- Cost indices;
- Diversity indices;
- Interaction potential calculation indices.

For the approached theme, using the cost and diversity indicators was considered optimal, thus leaving the potential accessibility as a shaping policy for the restructuring of the health system to be included in later studies. Through the two categories of indicators used we obtained two territorial x-rays on the population access on the health services in distinct moments. The first image reflects the situation of the accessibility to medical services prior to the reform when all the health units were available for the public. A second scan shows the characteristics of the same indicators in the period following implementation, a strategy that had about 30 % of the hospital units merged or their business profile changed (Fig. 2).

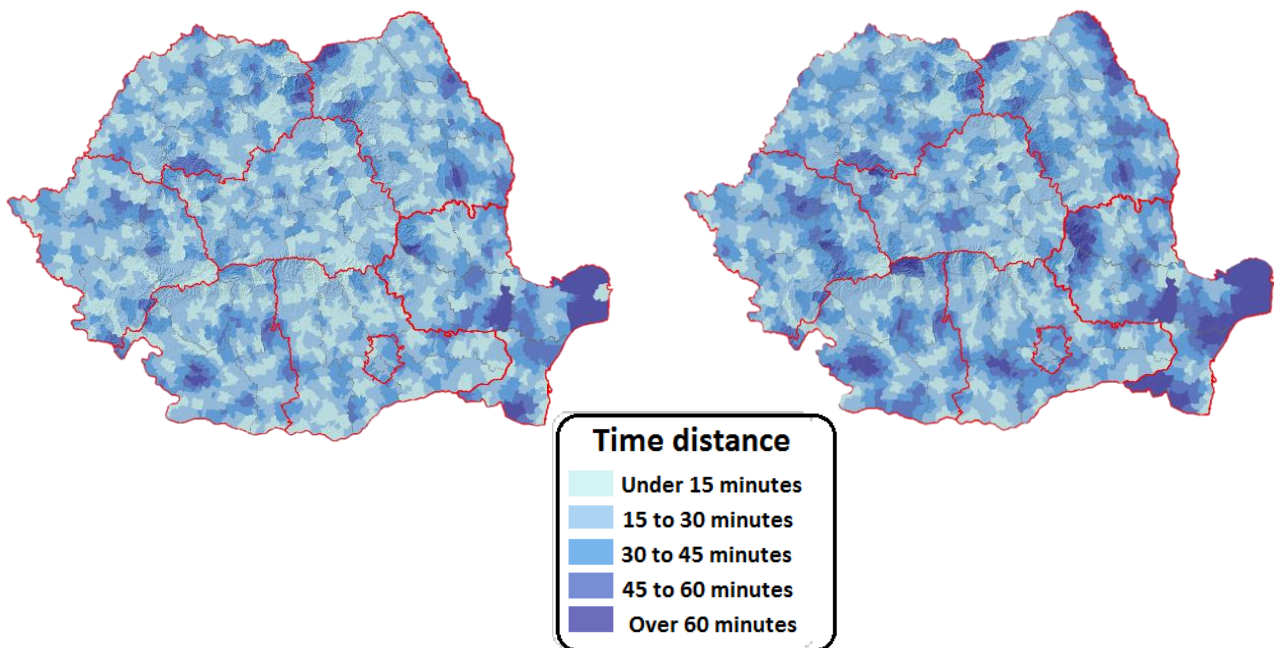


Figure 2. The spatial accessibility to medical services

Data from: National Cadastre Agency, Ministry of Health

All the accessibility indices values were calculated at territorial unit level for all the 13600 villages and urban settlements in Romania, and the results were aggregated at higher ranking unit level (Municipalities and rural areas). The analysis includes the entire national territory with a basis of information calculated for the territorial units with the lowest granularity.

Comparing this detailing level with the European practices regarding the territorial statistics, we conclude that this study not only manages to identify the values at regional or county level, but also their variations at village and local level. From this perspective, the geographical analysis based on spatial elements insures the precision and territorial detail levels necessary to the modeling of achieved results of a national strategy implementation.

The general approaches that eliminates local aspects renders a superfluous analysis at county or regional level, that often lead to conclusions far from the reality of the territory. An example of this can be deduced from the differences that occur between local and general approach when the North-East and North West regions are analyzed (Fig. 3).

The general approach shows that both regions own the same number of health units, merging units and changing their business profile affecting a similar number of units. The local approach captures significant differences of the impact generated by the implementation of the national strategy of streamlining hospitals in Romania, the North East region is strongly affected by the strategy. These effects are rendered faithfully benchmarking ante/post implementation in which are captured accessibility index variations at the level of commune.

The main reason that level of detail ensures the veracity of the study is that the most significant impact of the hospital reform policy impacted the communities that were in direct dependency relationship with a single medical unit.

A number of examples of this type can be identified by conducting a comparative spatial analysis of the prior and post implementation state that show the differences resulted from closing a number of medical units. In the case of the "Distance to the nearest hospital in minutes" indicator, the largest differences between prior and post rationalization analysis are around the 60 minute value. This means that once the policies of the rationalization strategy are applied a larger number of citizens in Romania will reach the closest hospital in over an hour! These situations can be identified in the east area of the Danube Delta as well as in the south western area of Constanta County. The examples can continue, but it's not the

number and intensity of these phenomena that give this type of analysis relevance but their spatial logic captured by analysis of the territory distribution. Over 80% of the areas significantly affected by the decrease of accessibility are areas located near county borders, areas that comparing to the county territory borders can be identified as peripheries.

This territorial characteristic highlighted by the comparative analysis captures the fact that the policy of hospital rationalization directly determined the decrease of accessibility degree in areas that already had low values. This type of approach determines profound social effects on population, favoring territorial exclusion and isolation of low desirability areas.

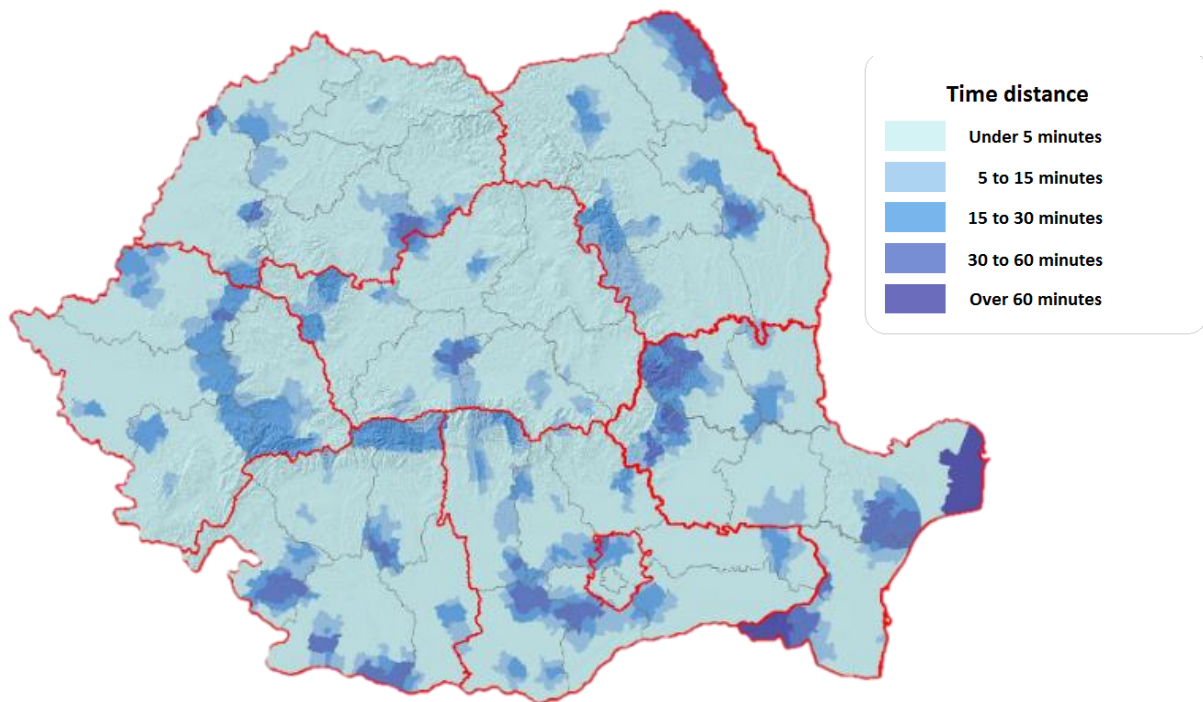


Figure 3. The time variation before/after implementing the strategy

Data from: National Cadastre Agency, Ministry of Health

The second indicator used for this study is calculated based on the number of units available for the citizens in less than 60 seconds. Based on this indicator the diversity degree of medical services available to citizens is highlighted, its values showing the variety of options or on the contrary, the dependency relations. Predictably, the larger values of the diversity indicator are in the vicinity of university centers that have traditional medical study schools: Bucuresti, Iasi, Cluj and Brasov (Fig. 4).

In the category of cities that are not found in the areas with a large variety of public medical services is Constanta, an urban center where there are only two medical units that offer general medical services. The two comparative analyses completed at this indicator level highlight a basic feature for accessibility indicators, the axis concentration-orientation. Considering that the movement of individuals is done via a road network the geographical characteristics of phenomena organized by this logic are more apparent along the transport axis. The entire Sub-Carpathian area as well as the territorial units placed in the proximity of the transport ways that tie Ploiesti and Brasov to the Capital City are highlighted in both the map showing the initial situation and in the one showing the effects of the strategy implementation (Fig. 5).

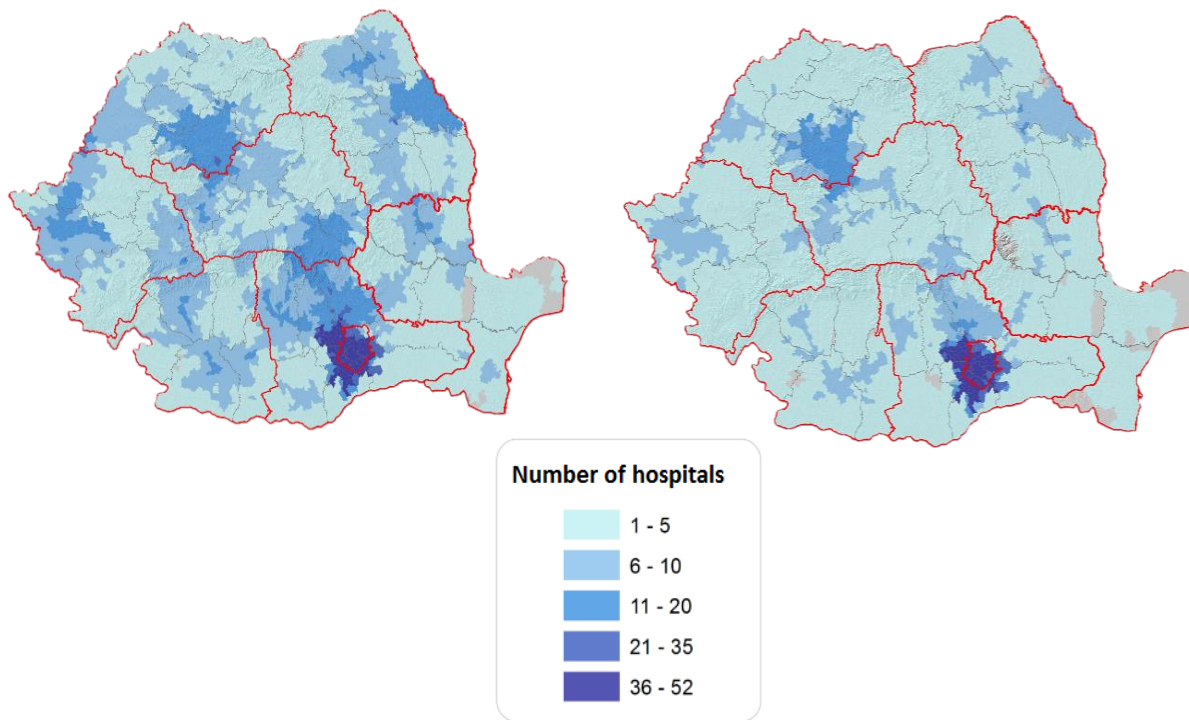


Figure 4. The choice set indicator (before and after)
Data from: National Cadastre Agency, Ministry of Health

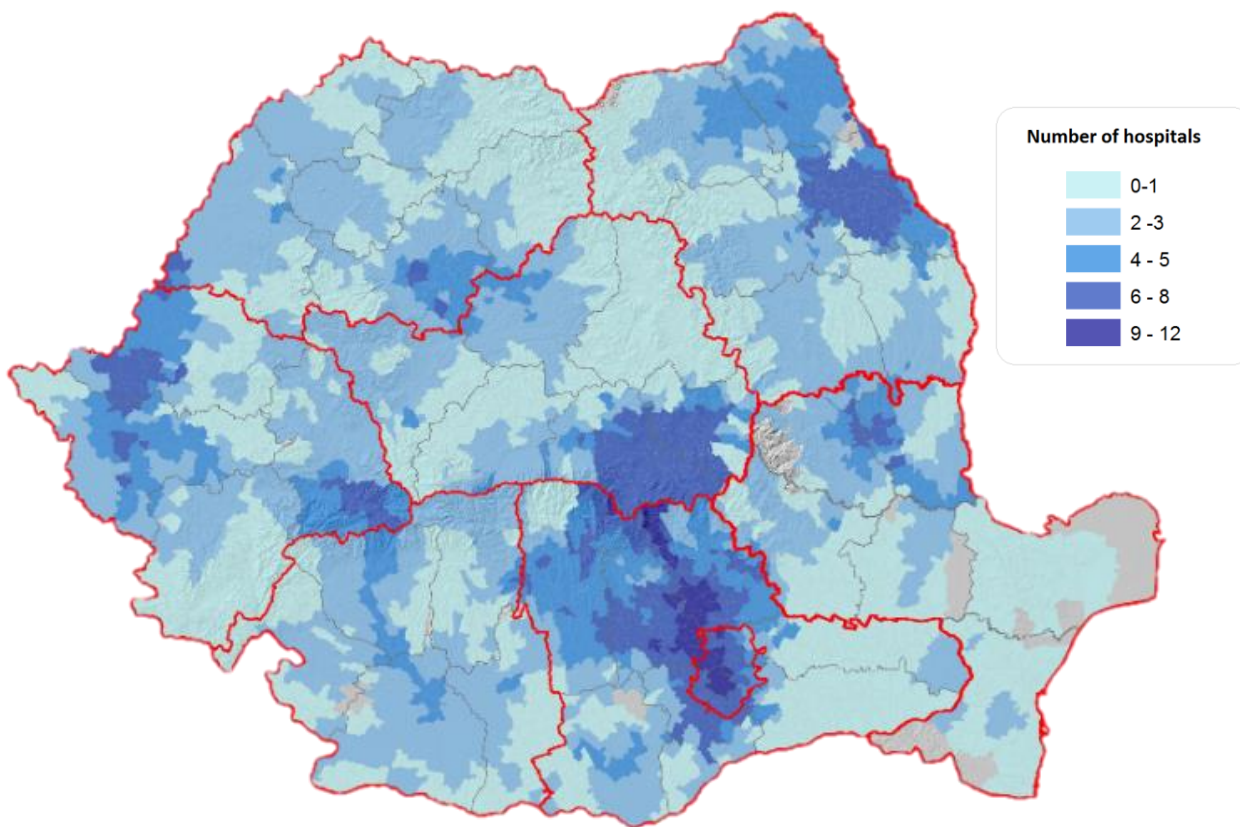


Figure 5. The choice set indicator variation before/after implementing the strategy
Data from: National Cadastre Agency, Ministry of Health

Following the strategy implementation, we can identify extensive areas, where the diversity degree decreased by more than 5 units. The variation of the index of diversity indicates the degree in which a variety of medical services that can be accessed by the citizens fell once the strategy was implemented. The values of the index are quite high, the maximum is 12 but we must observe that the areas where the values are high, tend to interfere in areas over which prior of the implementation of strategy held also large values. This aspect indicates that at the main level, the strategy has taken into consideration the preservation of sanitary units which are creating dependency for territorial unit that polarizes. This type of sanitary units is represented by the centers that are the only option for health services, accessible to the citizens of certain administrative and territorial units.

Conclusions

The methods used in the study manage to evaluate the territorial impact of the policy of reforming the health system by using geographical accessibility as an indicator of reference. This creates the prerequisites and framework of the spatial analysis methodology that can be included as an active element in the course of a process of elaboration and implementation of strategies and public policies. Replicable nature of analyses carried out ensure the access of decision-makers to tools through which the territorial effects generate by the strategies and public policies are valued at the level of the finest administrative units. The territorial element holds particular characteristics highlighted by including the spatial analysis as an integrated element in the studies substantiating public strategies and policies. All this contributes to the increase of quality of life indicators, the substantial savings in the state budget, in a sector of public services affordable and efficient citizen-oriented.

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