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Modelling spatial accessibility to medical care. Case study of the North-Eastern Region of Romania

Mihail Eva[a], **Corneliu Iatu**[b]*

a University François-Rabelais of Tours, France
b Alexandru Ioan Cuza University of Iasi, Iasi, Romania

Providing the entire population with the same accessibility to services of general interest is among the priorities of EU policy. Among these services, those concerned with medical treatment occupy a special place due to their social and economic importance. The study raises the issue of modelling the population's spatial accessibility to medical services in the North-Eastern Region of Romania. A trans-scalar methodology that has been tailored to the specific features of the Romanian medical system was employed for computing indexes of accessibility. The methodology brings together into one synthetic indicator five hierarchical levels of analysis, the geographical proximity of service centres, their degree of attractiveness and the potential need for medical services at local level. The results highlight areas with different levels of accessibility to medical services and their dysfunctionalities according to each variable employed in the analysis.

Introduction

Access to health services is a binary variable that can take two values: 1 if the population can from a theoretical point of view access the service concerned, and 0 if it is impossible for them to do so. Since the Romanian Government is legally bound to ensure that the entire population has access to health services, irrespective of the environment and place where they live, it could be considered that the inhabitants of any town or village in the North-East Region can –

* *Corresponding author*
Address: Professor, Department of Geography, Alexandru Ioan Cuza University of Iasi, 20A Carol I Blvd, 700505 Iasi, Romania.
Phone: 004.0745.374.229 | *Email:* ciatu@uaic.ro

theoretically – access any type of medical services. Furthermore, the importance of the provision of access to medical services is laid down in primary EU documents (e.g. EU Charter of Fundamental Human Rights - European Parliament, 2007; EU Health Strategy - CEE, 2007).

However, the quality and quantity of the services on offer is affected by the anisotropic characteristics of the area concerned, and by the ability of the population to take advantage of them. The latter depends, *inter alia*, on their degree of basic health awareness, the financial resources of each household and the distance between residences and health service providers. Consequently, one needs to approach this issue from the angle of accessibility, a more complex concept in the form of a continuous function, which quantifies the ease with which the population can access a given service.

In the present case, the population's spatial accessibility to medical services will be evaluated in a multi-scalar approach, in terms of a five-level hierarchy, due account being taken of the degree of complexity of the centres involved in providing the North-East Region with medical coverage, the nature of the road communication network and the geographical location and characteristics of population nuclei. Thus, a methodology consisting in computing five accessibility indices (two temporal and three gravitational) was employed, whose role is to favour the analysis of the strength of the polarisation exerted by the various centres that provide medical services (Tabel 1). In order to present a comprehensive picture of the ease with which the population can access health services, the indicators thus obtained have been combined into a single one by the use of the sum of ranks method.

Worth mentioning that in 2011 hospitals in Romania were reclassified by Ministerial Order in one of five categories depending on their level of competence (Ministry of Health, 2011b): category 5 hospitals – with a limited level of competence (provision for the care of the chronically ill, single-specialty provision, or palliative care); category 4 hospitals – with a basic level of competence (serving the population of a limited area and capable of treating non-complex medical conditions); category 3 hospitals – with a medium level of competence (normally serving the population of their own county and capable of treating medical conditions with a moderate level of complexity); category 2 hospitals – with a high level of competence (serving the population of their own county and that of neighbouring counties and capable of treating medical conditions with a high level of complexity) and category 1 hospitals – with a very high level of competence (providing medical care at regional level and treating extremely complex conditions).

Conceptual and methodological framework

Spatial accessibility to medical services is a broad concept used to describe the ease with which the population can access services provided by medical facilities that they do not have in the places where they live. Depending on the particular angle being pursued, this concept may be expressed in multiple ways.

In its simplest versions, accessibility is assessed strictly from the point of view of the infrastructure that facilitates access to health providers, which means that

Tabel 1. Categories of medical services in relation to which accessibility indices have been computed

Category of medical services	Standard/ representative centres	Indicators of spatial accessibility	Distribution of medical centres across the area
Emergency medicine	Ambulance/SMURD (Mobile Emergency, Resuscitation and Rescue Service) (sub)stations	Distance-time to the closest (sub)station	6 ambulance stations, 38 ambulance substations and 26 SMURD units
Primary-level medical services	Family doctor surgeries	Indicators of accessibility will not be calculated in this case because of the almost ubiquitous nature of this provision	97.3% of the administrative-territorial units in the Region have at least one family doctor surgery (2011 figures)
	Pharmacies and basic pharmaceutical outlets	Cumulated distance-time to the three closest pharmacies	12% of the local administrative units (LAU2) in the region have no pharmacies or basic pharmaceutical units
	Permanent centres	Accessibility indicators have not been computed here since plans to establish permanent centres are in the course of being implemented; the position prevailing today cannot, therefore, give a true picture of the situation	These exist in 47 localities
Medium-complexity medical services	Level 4 and Level 5 hospitals (excluding psychiatric and respiratory disease/TB hospitals)	Cumulated potential accessibility to Level 4/5 hospitals;	17 centres in the North-East Region, plus others outside it
	Level 3 hospitals (including those projected but not yet functioning at the corresponding level)	Cumulated potential accessibility to Level 3 hospitals;	10 centres: the county towns plus Barlad, Moinesti, Onesti and Roman;
High-complexity medical services	Level 2 hospitals (including those projected but not yet functioning at the corresponding level)	Indicators of accessibility have not been calculated here since there are no Level 2 hospital centres in the North-East Region, and those that exist outside the region only have an influence on settlements at the edge of the region;	3 centres outside the Region: Targu Mures, Brasov, Galati;
	Level 1 hospitals (including those projected but not yet functioning at the corresponding level)	Cumulated potential accessibility to complex medical centres;	One centre within the region itself (Iasi) and one outside it (Targu Mures);

Source: the authors

it takes the form of the measured road distance between the place of residence and the medical centre concerned or the time needed to travel this distance (Curl *et al.*, 2011). Using tools provided by GIS, the methods most commonly used for this purpose are network analysis and raster analysis, with the advantages and disadvantages of both being matter of intense debate in the specialist literature (e.g. Frizelle *et al.*, 2009, Delamater *et al.*, 2012, Jordan *et al.*, 2004). In the process of pinpointing zones with limited spatial accessibility to medical services, the two approaches appear to give similar results in terms of locating and giving the configuration of problem areas but different results when it comes to their spatial extension (Delamater *et al.*, 2012). In view of the characteristics of each approach and also of the quality of the spatial data available for Romania, it was considered appropriate for accessibility to be calculated using network analysis tools. This method involved processing the figures for the distance-time that separates localities from the nearest ambulance/SMURD station (as an expression of accessibility to emergency medical services) and the cumulated distance-time to the three closest pharmaceutical outlets (as an expression of accessibility to pharmaceutical services).

More complex methodologies for assessing spatial accessibility involve taking into account the attributes of rural localities and polarising centres, resulting in obtaining potential accessibility indices. The use of the gravity model could be necessary when indices of accessibility to hospital medical services are being drawn up. Thus, accessibility to health services provided by hospitals equates to the result of multiplying two vectors: (1) the attractivity exerted by the medical centre in question, which acts in a positive direction and (2) the need to access the medical service concerned, which acts in the opposite direction.

The first of these vectors was calculated as an expression of the ratio between the number of doctors (excluding family doctors and dentists) available in the polarising centre and the distance-time separating the locality in question from the medical centre. The distance-time values computed for each locality were summarised at LAU2 level to give the average number of time-units that separate any inhabitant of the LAU2 from the hospital centre concerned. Choosing the polarising centre for each locality was achieved by identifying which of them exercised the highest attractivity on it (max $_k$).

The second vector is, in fact, an indicator of the likely incidence of illnesses resulting in hospitalisation (I_s). High values for this indicator suggest a greater likelihood of the occurrence of cases of hospitalisation. A low level of attractivity from the part of the health centre combined with a high incidence of illnesses means a low index of the accessibility to hospital medical services. The value of (I_s) was computed as a ratio between the size of the potential need for hospital medical services N_s and the total population of the LAU2. N_s was computed by assigning the population to age groups weighted by coefficients of incidence of illnesses for each age group α, β and γ). The exponent q was introduced for calibrating the statistical distribution in such a way that it matches the statistical distribution of the attractivity index (A_t).

$$A_{hx} = A_t \cdot I_s^{-q} \qquad\qquad (1)$$

$$A_t = \max_k \frac{\log D_k}{\frac{\sum_{i=1}^n T_{ik} \cdot P_i}{P_{LAU2}}} \qquad\qquad (2)$$

$$I_s = N_s / P_{LAU2} \tag{3}$$

$$N_s = \alpha \cdot P_{0\text{-}14} + \beta \cdot P_{15\text{-}64} + \gamma \cdot P_{>65} \tag{4}$$

where A_{hx} represents the potential accessibility of the LAU2 to hospital medical services of Level x (where x is 1, 3 or 4/5); k represents the available hospital centres (including those outside the Region); D_k represents the number of doctors at hospital centre k; Tik represents the distance-time from locality i to centre k; P_i represents the population of locality i in LAU2; n represents the number of localities in LAU2; P_{LAU2} represents the population of LAU2; IS represents the intensity of potential need for hospital medical services; N_s represents the size of the potential need for hospital medical services; α, β and γ are the coefficients of incidence of hospital admissions for each of the age groups. The coefficients were calculated as an average for the 2002-2012 period on the basis of data recorded by family doctors in Neamt county (Neamt Public Health Directorate, 2013).

Since the population's accessibility to higher level medical services is also dependent on its accessibility to lower level services, the principle of cumulative accessibility was employed when computing each indicator (Tudora, 2012, p.59; Tudora and Eva, 2014, p.110). Thus, accessibility to hospital centres of Levels 4/5 was weighted according to accessibility to pharmaceutical outlets and emergency medical (sub)stations, potential accessibility to Level 3 hospital centres was weighted according to accessibility to Level 4/5 hospital centres, and so on:

$$A_{cum\_h5} = A_{h5} \cdot T_{amb}^{-1} \cdot T_{farm}^{-1} \tag{5}$$

$$A_{cum\_h3} = A_{h3} \cdot A_{cum\_h5} \tag{6}$$

$$A_{cum\_h1} = A_{h1} \cdot A_{cum\_h3} \tag{7}$$

where A_{cum_h5} represents cumulated potential accessibility to Level 4/5 hospital centres; A_{h5} represents potential accessibility to Level 4/5 hospital centres; T_{amb} represents the theoretical average ambulance service/SMURD response time; T_{farm} represents the cumulated distance-time to reach the three closest pharmacies/basic pharmaceutical outlets; A_{cum_h3} represents cumulated potential accessibility to Level 3 hospital centres; A_{h3} represents potential accessibility to Level 3 hospital centres; A_{cum_h1} represents cumulated potential accessibility to Level 1 hospital centres; A_{h1} represents potential accessibility to Level 1 hospital centres.

The need for medical services from a territorial perspective

The implementation of any spatial development policy in the medical sector should start from a diagnosis of the likely demand for medical services. However, a demand for medical services, viewed from an economic perspective, should not be confused with the need for these services. While the former of these is closely dependent on the income and level of medical knowledge of the population, the need to access a given service may exist even in the absence of any demand for it and on occasion even in the absence of any consciousness of need on the part of the population concerned. For this reason, the present approach will set out to determine the potential need for medical services.
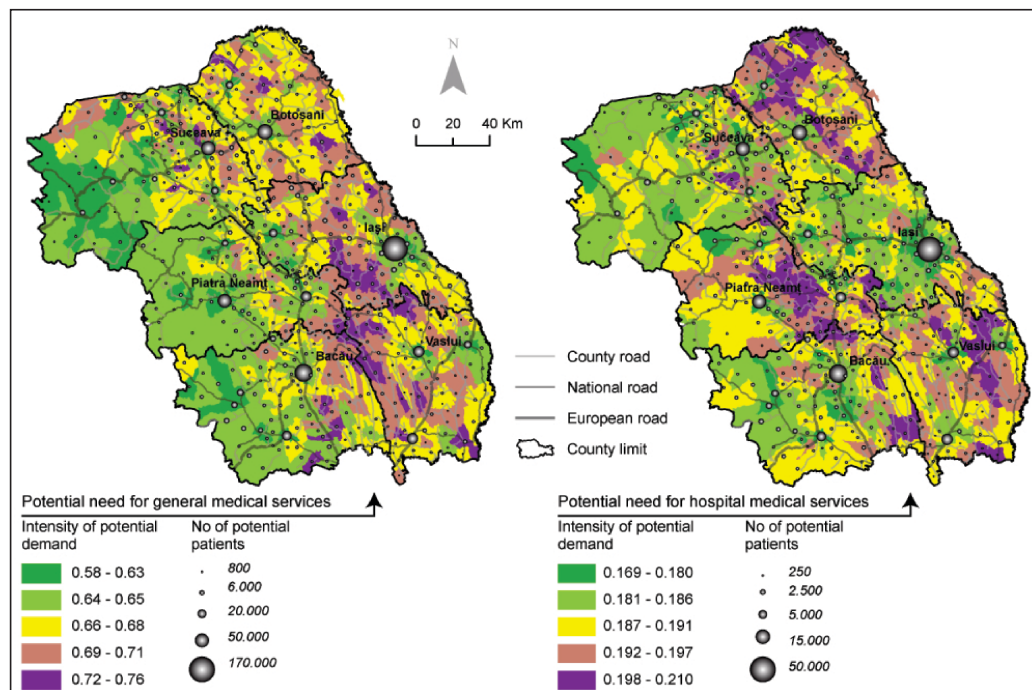
Figure 1. Potential need for general and hospital medical services from a territorial perspective
Source: the authors

The uneven spread over the area of the potential need for medical services (Figure 1) highlights a number of points that are of use to decision makers. The greatest need for general and hospital medical services, expressed in absolute terms, occurs in the main population nuclei and in the areas of greatest population density (urban centres and their adjacent periurban areas, the Siret axis; the Targu Neamt-Iasi axis; the western half of Bacau county, etc.).

The greatest need for general medical services (Figure 1) is found in areas with a high proportion of younger and older population. Furthermore, one may observe a divide between the western half of the county (at present less prone to health problems on account of the very high proportion of the adult population) and the eastern half (with its high proportion of the young population, combined in some areas with large numbers of elderly population). The most extreme instances are found in the rural area lying along the administrative boundary between Bacau, Iasi, Neamt and Vaslui counties, with a more traditional demographic behaviour. In recent decades, these areas have had birth rates above the average for the region and have thus added large cohorts of children presently aged under 15 to the population structure.

On the other hand, the potential need for medical services involving hospital treatment presents a slightly different picture, since it is at its highest in areas in which the peaking of the process of demographic ageing has reached an advanced or extremely advanced stage (Iatu, 2007). Apart from isolated instances, the most severely affected regions are the northern and eastern part of Botosani county (where the proportion of elderly in the population increased rapidly during the 20th century), the Sub-Carpathian part of Neamt county (belonging to an old peripheral area that once lay along the boundary between the former counties of Neamt and Roman), the north-eastern part of Vaslui county and the south-eastern

extremity of Bacau county. The high values for the potential need for hospital-based medical services here might suggest the importance of medico-social centres being set up in these areas. Nevertheless, one should not forget that this indicator is cross-sectional in nature and gives a snapshot-type picture of the situation (in this case for 2011) while long-term ageing trends may in time come to affect other areas as well.

Accessibility to specific medical services

The present configuration of health services represents the accumulated result of public policies implemented over the decades, each leaving as its legacy specific health facilities, a typical level of qualification on the part of the doctors and particular ways in which the population behaves in relation to seeking medical help.

Spatial accessibility to basic medical services

Medical care as provided by general practitioners is the basis of all medical services. To a great extend, both public health and the efficient functioning of hospitals depend on its effectiveness, since the prevention of health problems is less costly than their being treated in hospital. In Romania, these essential services are provided by family doctor surgeries during their working hours and by permanent centres out of working hours.

Although there are family doctor surgeries in almost every LAU2 (Tabel 1), the population's spatial accessibility to them can vary on a large scale depending on how many localities make up the LAU2 (doctors' surgeries are most often found only in the village that functions as the administrative centre) and on the physical distances separating these localities. Nonetheless, previous studies have shown that spatial accessibility to family doctor surgeries does not set the North-East Region apart from the rest of the country (Ciutan and Sasu, 2008). However, the relatively equal distribution of surgeries is overshadowed by the high number of population per family doctor, with the North-East Region being among the most poorly served in the country in this regard – particularly in rural areas, where there is on average just one family doctor per 2,700 inhabitants (Table 2).

There are complicated reasons for this lagging behind of the rural localities in the east of the country (the situation in the South-East Region is almost as bad while the Western Region boasts one family doctor for every 1,600 inhabitants). with the

Tabel 2. Number of people per family doctor (multi-year average for 2004-2011)

Region	total	rural	urban
Bucharest-Ilfov	1320	2072	1278
West	1390	1628	1281
Centre	1613	1908	1461
South-West (Oltenia)	1684	1769	1599
North-West	1756	2093	1536
South (Muntenia)	1946	2303	1597
North-East	2000	2676	1499
South-East	2241	2383	2137
Romania	1742	2153	1506

Source: INS 2012b

historical legacy of infrastructure and of behaviour in regard to seeking medical help being perhaps quite as important as the degree of urbanisation, the polarising effect of urban centres or the dates when health infrastructure came into existence.

From a territorial point of view, besides the issue of classic family doctor surgeries, the policy followed by the public authorities for the past ten years has been one of encouraging the development of a network of permanent centres, as may be seen from the passing of Law no. 63/2004 on the provision of round-the-clock basic care via permanent centres and of Ordinance 7/2011 to modify and supplement Law no. 63/2004. The purpose of the new legislation was, in fact, to reduce pressure on hospital emergency rooms by ensuring that basic medical services would be available 24/24. At the same time, there was an attempt to site these units not only in urban centres but above all in rural areas, particularly in regions that were isolated and had poor accessibility to the hospital and emergency medical services.

Despite the fact that they carry out their assessments from only one perspective (that of infrastructure), previous studies of the spatial accessibility of the population to permanent centres (e.g. Ciutan and Sasu, 2008) demonstrate the lagging position held by Suceava county both within the North-East Region and in a whole country context. The situation has changed little in the past five years, with Suceava continuing to be the county with the poorest coverage in the Region (only three permanent centres in 2013). These units are still in the process of being established and made functional, and, for this reason, no calculation of spatial accessibility to them would be able to make clear the true present situation on the ground in this area, all the more so since each unit is linked with a number of localities grouped together in accordance with Public Health Directorate decisions.

Family doctor surgeries shoulder a large proportion of the social burden since the services they offer are free for all those who have State health insurance. Nevertheless, any assessment of accessibility to medical services also needs to take account of the existence of a class of facilities whose location is selected according to a different logic, more akin to that of private demand for and consumption of services. It was therefore introduced an indicator of accessibility to pharmaceutical outlets. Although this is a service that ought to be ubiquitous, 76% of localities and 12% of LAU2 in the North-East Region do not dispose of such services (according to the list published by the Ministry of Health in October 2013, complemented with information provided by the County Health Insurance Offices of the six counties in the Region).The cumulated distance-time to reach the three closest pharmacies underlines the existence of some marked intra-regional disparities.

There is excellent coverage in urban areas, peri-urban fringes (especially the Iasi Metropolitan Area), intermediate spaces (such as between Iasi and Targu Frumos, Piatra Neamt and Roman, Moinesti and Onesti) and a number of rural areas with high or very high indicators of economic development (for example, the Vicovu de Sus – Radauti – Suceava – Gura Humorului area). These regions may be contrasted with localities that are isolated from a physical geography point of view (such as the villages of the north-western part of Suceava county) and self-sufficient rural areas whose population lacks financial resources (the eastern third of Bacau county, the western third of Vaslui county, small interstitial areas in Botosani, Iasi and Neamt counties and the eastern part of Vaslui county). High concentrations of population inevitably also attract concentrations of medical services.

Spatial accessibility to emergency medical services

Emergency medicine is a particular branch of the medical domain and has its own rationale regarding its sitting and how it functions in an area. In Romania, state-funded emergency treatment is supplied by two categories of facilities: (1) medical institutions that provide emergency medical treatment in specially equipped places, i.e. emergency hospitals, emergency departments in county hospitals, emergency rooms in municipal and town hospitals (Parliament of Romania, 2006) and (2) mobile units that provide emergency treatment at residence and at accident sites and also provide transport to the places in the first category. In the North-East Region, mobile units belong either to the Ambulance Services of the six counties (the County Ambulance Services) or to the Mobile Emergency, Resuscitation and Rescue Services (SMURD), which come under the County Emergencies Inspectorate.

When one looks at the impact of these services on the area, the first matter of concern is the average response time (the time taken for a patient to be picked up from any locality in the region), irrespective of which institution the response units come under. While equipment available in ambulances and the level of training of the medical personnel involved are of course essential aspects of the quality of the delivery of emergency assistance, the present study has concerned itself only with the time taken to cover the distance between localities in the region and the nearest ambulance/SMURD station or substation. In other words, the population's accessibility to emergency medical services has been evaluated quantitatively, i.e. exclusively from the point of view of the (theoretical) average response time. Average response times are calculated on the basis of time taken for the mobile unit to reach the centre of the concerned locality, without taking into consideration the possible traffic jams and the poor state of many roads.

In 2013, the network of facilities in the area was made up of six county ambulance stations, 38 substations co-ordinated by them (with the prospect of these substations being brought under a single regional coordinating centre in accordance with the proposals of a Government decision to set up regional ambulance services), and 26 SMURD points, the vast majority of them operating in localities which also have ambulance services. The only exception to this rule is the SMURD unit in the town of Stefanesti, founded in 2012. In fact, although the SMURD network has been extended over the past ten years, there have also been periods when it has been cut back, with a number of units in Iasi county closing: Bivolari, Harlau (later reopened), Raducaneni, Sipote and Tibanesti.

Even without taking account of the potential impact of winter weather conditions, the study of the territorial coverage provided by emergency medical services highlights the existence of some problem areas that it is very hard for mobile units to reach, with access times frequently exceeding 30-time units. Furthermore, extreme cases of almost isolated localities occur in either upland hamlets lying far from modernised roads, or small villages built in the mini-depressions which pockmark the slopes of the Barlad Plateau (the so-called "eagles' nest" villages, a legacy of the peasant freeholder era, whose rationale for being there had to do with perils that characterised medieval times and which have continued to exist until today in spite of no longer having a practical reason for doing so).

Accessibility to hospital medical services

The existence of hospitals across an area contributes to population's spatial accessibility to medical services, the most important hospitals being those offering services to the broadest possible sector of the population. From this perspective, Level 4/5 hospitals, despite being the poorest in terms of facilities and medical personnel, are the most important (particularly for population living in the countryside and in small and medium-sized towns) due to their closeness to the population and to the fact that the need to go to them occurs more frequently than the need for services provided by (for example) Level 1 hospitals. Level 5 hospitals have a limited level of competence, too but with the disadvantage that the vast majority of them have only one specialty, as in the case of the Neuropsychiatric Sanatorium in Podriga (Botosani county), the Psychiatric Hospital in Murgeni (Vaslui), the Respiratory Diseases Hospital in Bisericani (Neamt) and so on. Worth to mention that spatial accessibility to hospital medical services is influenced not only by hospitals, but also by external departments of some hospitals, sited in a different locality from the hospital they come under administratively but able to provide services that resemble those of a Level 4 hospital (an example would be the former Darabani town hospital, now operating as an external department of the Mavromati County Hospital in Botosani).

The attractivity exerted by these hospitals, calculated in accordance with relationship (2) would highlight a North-East Region with an excellent coverage of medical services along its central longitudinal axis, which is more urbanised and better provided with Level 4/5 hospitals. However, in peripheral regions the attractivity of those hospital centres that have only a small medical staff reduces drastically. For example, the limited facilities on offer at the hospitals in the eastern part of Botosani county (Darabani – eight doctors in 2010; Saveni – thirteen doctors), combined with the closing (in fact a change of use) of the hospital at Trusesti, has had a serious effect on providing hospital medical services along the Prut valley. An even more problematic situation prevails in the area bounded by a line linking Bacau, Roman, Iasi, Vaslui and Barlad, where the fact that there never have been any hospitals in the Tutovei Hills, coupled with the closing of the hospital in Negresti and the weak attractivity exerted by the one in Podu Turcului (only twelve doctors), aggravates still more the local population's very limited possibility of accessing medical services – which one may already observe from the pharmaceutical and medical emergency provision in the area.

Along with access to lower level hospitals, the population may also be interested in the possibility of accessing the medical services provided by Level 3 hospitals. Mapping of their territorial distribution (Figure 2) highlights a relatively unbalanced distribution between the southern and northern halves of the region, with counties with similar populations having different numbers of Level 3 hospitals. For example, to serve a population of approximately 634,000, Suceava benefits from just one medium-competence hospital, in the county town (and there are no Level 1 or 2 hospitals here), whereas Bacau county benefits from three such hospitals, located in the municipalities of Bacau, Onesti and Moinesti, to serve 616,000 residents (2011 census figures).

This apparently paradoxical situation may be explained in part by the differences in the degree of spatial concentration of the population and the
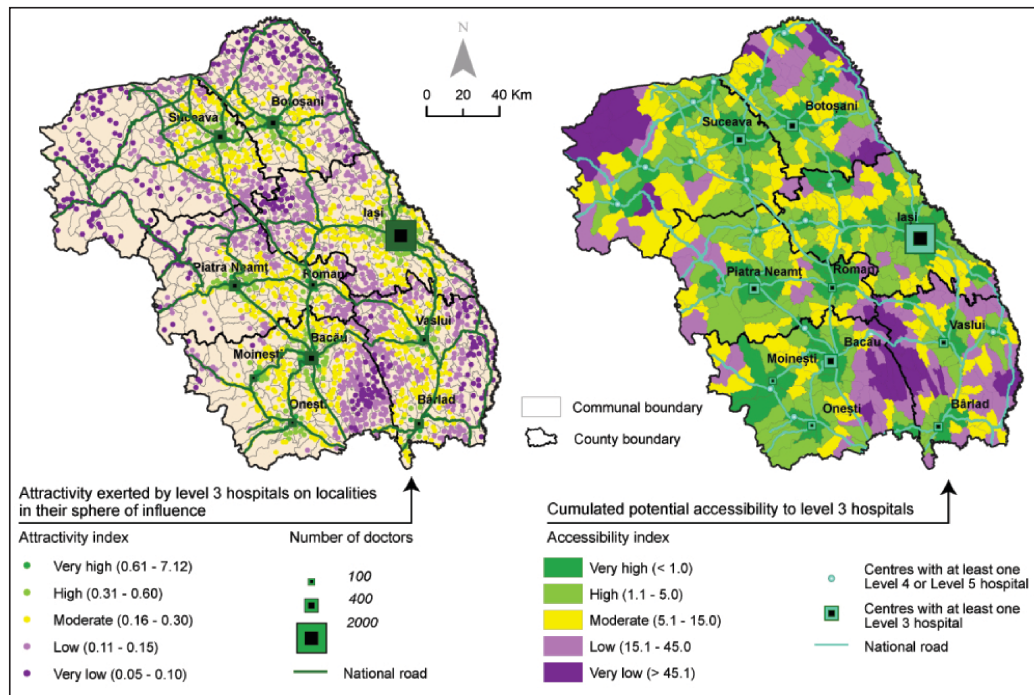
Figure 2. Spatial accessibility to medium-level hospitals as an example of calculating and mapping spatial accessibility to different level hospitals
(the same technique was employed for Level 4/5 and Level 1 hospitals)
Source: the authors

different size of the urban centres in the two counties. However, although this unequal distribution is strongly reflected in the lower attractivity exerted upon the localities in the northern half of the region (Figure 2), it is not reflected in the cumulated potential accessibility to hospital facilities of this level. This is explained by the fact that Suceava county manages to make up for the shortage of Level 3 hospitals by having an excellent local network of basic-level ones, which indirectly facilitates population's accessibility to higher-level hospitals in spite of the greater distance they have to travel. The same phenomenon may be noticed, up to a point, if one compares Botosani and Vaslui counties, where the former slightly outdoes the latter in terms of cumulated accessibility to Level 3 hospital services even though it possesses only one hospital of this class.

Neither potential accessibility to Level 3 hospital services does succeed in making inroads into the very limited accessibility to medical services seen in the region's problem areas: the north-west of Suceava county, the east of Botosani and Bacau counties and most of Vaslui county (with the sole exception of LAU2s situated along the two axes of development that link Barlad to Vaslui and to Husi). The north-western part of Suceava county is a separate case for the reason that although it lacks medical coverage, the local population's standard of living is distinctly above that in the problem areas in Botosani or Vaslui counties. The population can, therefore, afford to travel longer distances to access medical treatment.

The final step in our diagnosis involved assessing potential accessibility to the ultra-complex medical services provided by Level 1 centres. For the North-East region, it is only the hospitals in Iasi and to a secondary degree the services offered
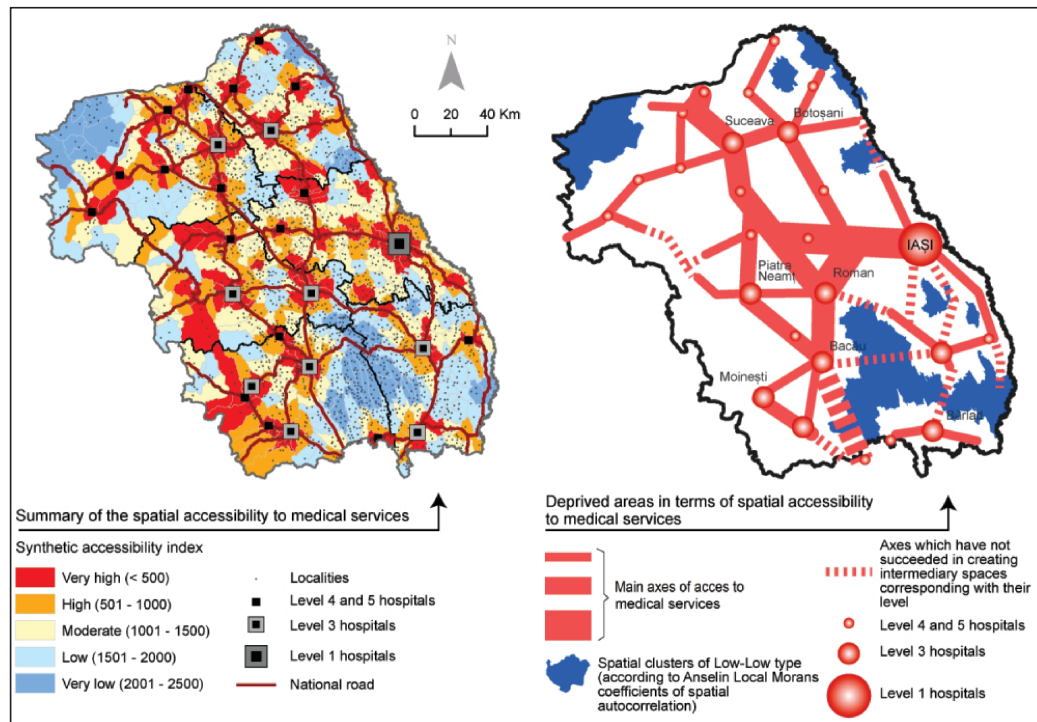
Figure 3. Summary of accessibility to medical services
Source: the authors

by same hospitals in Targu Mures that are of importance. The impact of this kind of accessibility on regional territorial structures is less than that of other categories of accessibility because of the extremely complex services that are needed only rarely.

Synthetic accessibility to medical services

The purpose of modelling the population's accessibility to medical services was to identify failures in delivery in the medical system from a territorial perspective. Awareness of this may be of use in the process of drawing up strategies for local planning. Results obtained complement previous findings on the population's accessibility to medical care facilities of the North-East Region (e.g. Tudora 2012, pp. 58-105; Mareci, 2008) and highlight a number of major challenges (Figure 3).

Firstly, there are many LAU2 that are disadvantaged in that they have problems in accessing all levels of the region's medical system (basic, emergency, different grades of hospitals). Integrating the inhabitants of these LAU2 within a modern health system will be no easy task, and strategies for doing so will need to approach the issue from a number of perspectives at the same time, but first of all from the basic viewpoint.

Secondly, not all the region's centres and axes for the diffusion of medical services are functioning in an efficient way. There are major problems in the south-eastern third of the area and to some extent in the eastern part of Botosani county. The positive influence of the Municipality of Iasi swiftly ceases to manifest itself, both northwards along the 24C national road and in particular towards the south, along the roads towards Vaslui. The Municipality of Vaslui has not managed to

create corridors for the diffusion of development linking it to any of the large municipalities with which it has a direct connection (Iasi, Roman, Bacau or Barlad). Furthermore, the Vaslui-Bacau axis is practically non-existent from the perspective of the spread of medical services, partly on account of poor communications and implicitly of the nature of the relief.

Thirdly, localities with very low spatial accessibility scores are clustered, which makes it even harder to extract them from their medical isolation. The most critical cases, identified by mapping clusters of Low-Low type (spotted by analysing coefficients of spatial auto-correlation; ESRI, 2013), are to be found in the Tutovei Hills (with their eastern extensions in the Falciu Hills and the Elan Depression) and in the upland area in the upper basin of the Suceava, Bistrita Aurie and Moldova rivers. In these areas, an inherited rural lifestyle that is lacking in many ways, isolation brought about by physical geography features and a legacy of underdevelopment that has built up over time put an even more powerful brake on rising population's accessibility to the health system.

Conclusions

The present article formulated a methodology for modelling population's spatial accessibility to medical health care, taking into consideration the particularities of the Romanian medical system. The multi-scalar methodology was tested on the North-East Region of Romania, producing new accessibility indices and conducting to results that can help decision makers in identifying the needs for improving the spatial accessibility to health care facilities.

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