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TERRITORIAL CHARACTERISTICS OF THE VACCINATION PROCESS IN ROMANIA. EVIDENCE AT A LOCAL LEVEL

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In the context of the SARS-CoV-2 pandemic crisis, declared by the World Health Organization in March, 2020, a sustainable and permanent solution was the development of an efficacious and safe vaccine against the virus. This study aims to be a picture of the vaccination process (VP), performed at the end of February, 2021, on the subject of the "population at risk – e.g the elderly" (one category of persons targeted by the second stage of VP). The present paper aims to analyze several geographic features of the VP in Romania, such as: ***(i)*** the territorial distribution of vaccination centers (VCs); ***(ii)*** their capacity to cover the potential needs of the local population in terms of the anti-COVID-19 vaccination; ***(iii)*** the spatial itineraries induced to the elderly population by the overly-busy VCs; ***(iv)*** the effect of a VC on local economy, especially in rural settlements and small towns. The used research methods are of a qualitative and quantitative nature (e.g. official statistical public documents analyses, interviews) and the analysis is performed at the lowest territorial level at which statistical data are available, namely the Local Administrative Units (LAU). The main conclusion is that the topic of the VC's geographic position should be studied on a local scale, for that the VP to have a positive impact on population, wherever it may be.

Keywords: Romania, vaccination process, local level.

INTRODUCTION

The onset of the new Corona virus (Severe Acute Respiratory Syndrome Corona virus 2 - SARS-CoV-2) infection has led to the rapid worldwide spread of COVID-19. On March 11, 2020, the World Health Organization "made the assessment that COVID-19 can be characterized as a pandemic"[1]. One year later, in February 2021, there are 109,206,497 new confirmed virus infection cases globally, 2,407,469 deaths caused by the SARS-CoV-2 infection, and 63,281,007 persons declared cured[2].

In Romania, patient zero infected with SARS-CoV-2 appeared on February 26, 2020 and after one year, on February 24, 2021, the Strategic Communication Group declared 788,048 cases of people infected with COVID-19 (the real numbers likely far surpass this figure due to insufficient testing[3,4]), 731,049 patients cured, and 20,287 deceased. In Romania, the onset stage of the COVID-19 pandemic, in terms of territorial and numeric dynamics, was deeply influenced by epidemiological accidents (*e.g.* the Suceava County Hospital had become the source of the infection outbreak and the main vector of SARS-CoV-2 infection spread outside the hospital, in the Suceava Municipium and in the entire county [5]), the areas where migrants returned from European outbreaks. Thus, given that approximately 4 million Romanians work abroad, in Italy (over 1 million), Spain, Germany, UK and France, dozens of Romanians returned to the country after the lockdown imposed by the COVID-19 pandemic in Western Europe, creating a source of "imported cases" which was very difficult to control[6]. Also, the early territorial traces of the COVID-19 pandemic in our country were linked with the location of the main economic, transport and large communications centers from different counties (Timiș, Cluj-Napoca, Bucharest)[7].

The development of an efficacious and safe vaccine against the virus is the sustainable and permanent solution for stopping or mitigating the spread of COVID-19 worldwide. The European Union established the *EU Strategy on vaccines*

against COVID-19[8] whose main objective is ensuring the quality, safety and efficacy of vaccines and ensuring rapid and equitable access to the serum. This *Strategy* is based on two pillars: 1) ensuring vaccine production in the EU and sufficient reserves for Member States through the Emergency Support Instrument; 2) adapting the EU regulatory framework to take account of the current emergency situation and using existing regulatory flexibility mechanisms to accelerate the development, authorization and provision of vaccines.

Each country should evaluate different strategies and allocation schemes based on local epidemiology, population health status, projections of available vaccine doses, and establish a vaccination strategy that leads to direct or indirect benefits[9]. In Romania, as in other European countries, but perhaps more than in other EU member states, major challenges regarding the deployment, distribution, and administration of COVID-19 vaccines were expected[10,11,12]. The dedicated hospitals have been set up in the country to treat COVID cases and support regular hospitals in order to minimize the risks and ensure a separation of the flows of patients infected with COVID-19 from those who have not contracted this type of virus. Thus, in May 2020, 231 hospitals were designated for the fight against SARS-CoV-2. Support hospitals are municipal health units, mainly those with infectious disease departments, as well as hospitals from other networks: Ministry of Transport, Ministry of National Defense, private health units[13].

Romania benefits from the provisions of the *EU Strategy on vaccines against COVID-19* and established their own *Strategy on vaccines against COVID-19* (Decision no. 1,031/November, 27, 2020[14]). Alongside all the other EU member states, Romania benefits from one of the most important provisions of the *EU Strategy on vaccines against COVID-19*, namely that all Member States will simultaneously have access to the vaccines. To ensure fair and simultaneous access, the distribution of vaccines will be based on the number of inhabitants of each country. From the 10 candidate vaccines in clinical trials in mid-2020[15], in the EU, a number of three safe and efficacious vaccines against COVID-19 have been authorized, within the span of two months, between December 2020 and January 2021, based on the European Medicines Agency's positive scientific recommendations: BioNTech–Pfizer, Moderna, and Astra-Zeneca. All these vaccines have arrived in Romania, during different timelines[16]. On Februray, 2021, in Romania were vaccinated with BioNTech–Pfizer a total number of 1,297,346 persons, with Moderna just over 73,000 persons and with Astra-Zeneca almost 87,880 persons[17].

The aim of the vaccination campaigns is to maintain the essential core societal services, to reduce the severe crisis caused by the SARS-CoV-2 virus and to stop the virus transmission. The vaccination process (VP) should be adapted to the territorial differences of the population in terms of groups at risk, professions at risk or professions which ensure vital societal services. In Romania, the territorial dimension of the VP is reflected in the official documents, such as the main one, namely the *Order for establishing rules for the authorization, organization and operation of vaccination centers against COVID-19*[18]. Ensuring free, equitable access for all population groups to vaccines is a major challenge[15]. The responsibility for the VP's implementation follows the principle of the subsidiary, setting and assigning tasks to the actors of the three hierarchical levels, from the central ones to the local ones: at national level we have the National Committee for the Coordination of Activities of Vaccination against COVID-19 (NCCAV), in each of the 41 counties as well as in Bucharest Capital City there function County Centres for Coordination and Management (CCCM) and in each local administrative unit there acts a Local Coordination Nucleus (LCN) (Fig. 1).

This study intends to be a picture of the VP, performed in the end of February, 2021, of the subject "population at risk – e.g elderly" (one category of persons targeted by the second stage of VP). The present paper aims to analyze several geographic features of the VP in Romania, such as: ***(i)*** the territorial distribution of vaccination centers (VCs); ***(ii)*** their capacity to cover the potential needs of the local population in terms of the anti-COVID-19 vaccination; ***(iii)*** The spatial itineraries induced to the elderly population by the overly-taxed VCs; ***(iv)*** the effect of a VC on local economy, especially in rural settlements and small towns.

MATERIALS, DATA AND METHODS

The data base and all the information used and exploited in this paper are built and collected for "February, 2021" and for the 2nd stage of the VP, being focused on the elderly.

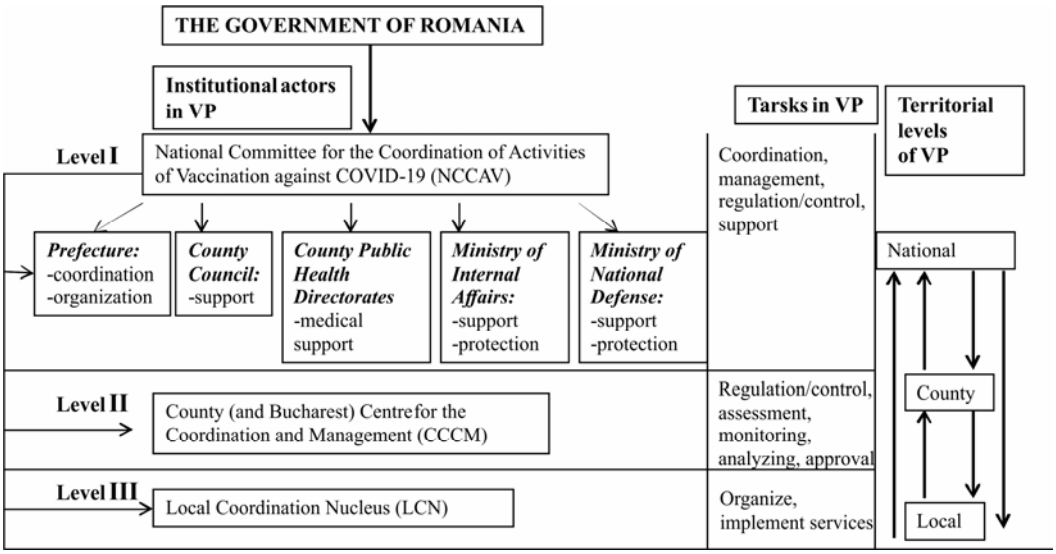

Figure 1. Institutional actors responsible for the VP in Romania.

The information about the territorial characteristics of the VP in Romania is sparse and the majority derives from web-based material and grey literature. This paper uses ***(1)*** the formal official data (Ministry of Health, National Committee for the Coordination of Activities of Vaccination against COVID-19, National Appointment Platform for Vaccination against COVID-19[19], Strategic Communication Group) and ***(2)*** informal data.

– ***(1)*** The formal official data, meaning different types of statistical data collected and structured by each 41 counties and Bucharest Municipium, are the followings:

– ***(1.1)*** General data on COVID-19 cases (i.e. total number of confirmed cases, the coefficient of COVID-19 infections cumulated over 14 days/ 1,000 inhabitants);

– ***(1.2)*** Specific data on the VP against COVID-19 (i.e. total no. of VCs, no. of VCs in towns, no. of VCs in rural settlements, total no. of available places for vaccination, no. of available places for vaccination in urban VCs, no. of available places for vaccination in rural VCs). This data covered the aspects linked to the territorial distribution of VCs.

The analysis is realized at the lowest territorial level at which statistical data is available, namely the Local Administrative Units (LAU).

The statistical data was complemented by informal data ***(2)***, which were collected from ***(2.1)*** local newspaper and municipalities' websites and from ***(2.2)*** brief questionnaires.

– ***(2.1)*** Since a VC was established in a rural settlement or small town, the local authorities found themselves in totally new situations in terms of financial resources and free spaces for the improvement or the arrangement from the beginning of VCs, according to very strict standards, imposed and verified by the County Public Health Directorates. The survey of local newspaper and municipalities' websites intends reveal precisely these situations, as the effect of the VP at local level.

– ***(2.2)*** The brief questionnaire[20] was applied at local level scale conducted during February, 2021 and they were applied face-to-face and by telephone[21,22]. The questionnaire was focused on the elderly people scheduled for vaccination in VCs established in rural settlements and small towns, throughout different counties (*i.e.* Mehedinți County – VCs in Baia de Aramă, Buzău County – VCs in Smeeni). Furthermore, the questionnaires were submitted to the persons who accompanied the elderly. These types of results are important for this study due to their potential to spring up several territorial local features of the VP, which are not reflected by the first set of data. The questionnaire is structured into three main parts: – the general aspects linked to the journey between the place of residence and the VC's location (*e.g.* distance, means of transport); – the personal interaction with the new location (*e.g.* any previous information about the place, interest about the location, the opportunity to meet daily needs, such as the accommodation, the leisure time, the general opinion on the location, intention to return for the holidays); – the opinion and comments about the VP. A total number of 10 questionnaires were applied in February 2021.

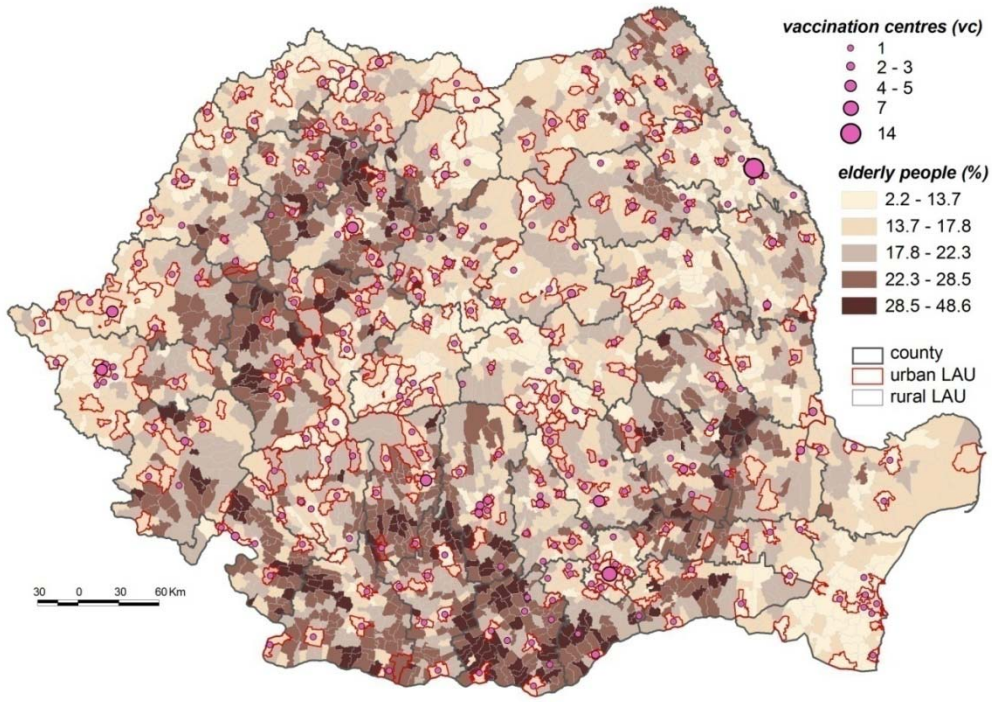

Figure 2. The territorial distribution of vaccination centers (VCs) and the areas with many elderly people (*Source:* processed and mapped data from[19, 23]).

Table 1

The distribution of vaccination centers (VC) according to numbers and types of LAU

a) no. of VC in a single LAU	14	7	5	4	3	2	1
b) no. of LAU registering ***a)***	1	1	2	3	14	13	246
c) % of ***a)***	0.3	0.3	0.6	0.8	4	3.7	69
d) % of urban LAU in each category of ***a)***	100	100	100	100	100	92.3	75.2

(*Source:* data processed by authors based on the National Appointment Platform for Vaccination against COVID-19[19])

RESULTS AND DISCUSSIONS

The results are mentioned following the aims specified in the first part of the paper.

The territorial distribution of VCs (i) (Fig. 2) shows a concentration in urban settlements (83.2% of total of 357 VCs operating at the end of February 2021, but not all the Romanian towns had VCs (e.g. Zlatna, Baia de Arieş, in Alba County, Însurăței, în Brăila County have no VCs, despite having the highest percentage of elderly, as mapped in Fig. 2). Table 1 synthesizes the distribution of VCs by numbers and types of LAU. Thus, we showed that the highest numbers of VCs are territorially amassed in 21 large and medium towns, and in Bucharest (a total of 85 VCs, meaning almost a quarter of total VCs operating in Romania in February, 2021). There are the cases of Iași (14 VC), Bucharest (7 VC), Cluj-Napoca and Ploiești (each having 5 VCs), Arad, Timișoara and Râmnicu Vâlcea (each having 4 VCs) and 14 county-seats (each having 3 VCs). The rural areas are less favoured, in all rural LAUs operating one single VC (with the exception of Mărăcineni, Argeș County, where there are 2 VCs).

In this paper, the distribution of VC is territorially correlated with the distribution of the elderly, as one of the categories of populations targeted by the 2nd stage of the VP and with the degree of accessibility by road. The elderly population registered high shares (over 30%) in the rural settlements located in the southern half of Romania, as well as in the western ones, especially within the mountain areas[24, 23]. Taking into consideration these essential aspects, we issue the observation that the mentioned areas are particularly poorly covered by VCs, as shown in Fig. 2: the VCs are only in towns (e.g. Alba and Hunedoara counties have no VCs in rural LAUs

but both register some of the highest percentages of elderly population of the total rural population in the entire country, i.e. Râmeți – 36%, Ohaba – 40.4% in Alba and Cerbăl – 36,4%, Bătrâna – 35% in Hunedoara County), especially in county-seats and in small towns (although not in all of these); vast rural areas, inhabited by a significant proportion of aged population, have no VCs in their neighbouring area. Moreover, the lack of VCs is doubled by the low degree of road accessibility (Fig. 3). Numerous VCs seem to follow the main roads and highways, as shown by the territorial distribution of those located in the southern and eastern areas of Romania. This is a positive aspect because the spatial accessibility to VCs becomes a reality, but in rural areas, as well as in the case of small towns, there are many other factors that restrict the access of population (especially of the elderly) to the vaccine against COVID-19. In the national, regional and local newspapers and on the rural LAU's websites diverse factors are mentioned as impacting negatively the VP. Thus, they are synthetically mentioned as follows: 1) the lack of physicians in the local medical centre and the undersized medical staff in many rural settlements; 2) the lack of real communication between the territorial level of VP management (many local authorities name the issue of financial resources for the payment of all persons involved into the VP and for the improvement/equipment of spaces dedicated to the VP as reasons); 3) the difficult accessibility of the VCs; 4) the lack of personal financial resources for pay for the transport to the VCs; 4) the fictitious functioning of some VCs (*e.g.* Bivolari, Iași County, Ștefănești, Botoșani County).

The VC capacity to cover the local population needs in terms of anti-COVID-19 vaccination (ii) is analyzed at the level of Buzău County, using the official information published by the Buzău County Public Health Directorate in different local newspapers, and by specialized local health and medical publications.

Following the principle of the subsidiary, în Buzău County 18 VCs were established, of which 8 are operational. The last 8, and especially those located in county-seats or in other towns in the county, were overwhelmed during the 2nd stage of the VP. Thus, the local elderly were forced by this situation to await the arrival of other vaccine doses or to accept to travel to different VCs located in Buzău County or in another county. Despite the fact that the density of population over 65 years of age was the main reason for the establishment of VCs[25], there are many cases mentioned by local newspapers (e.g. in Iași, Bacău, Botoșani, Hunedoara) where large areas and elderly persons remain far from any VC. The situation of Buzău County is shown in Figs. 2, 3 and 4: the areas with a high density of the elderly (*i.e.* the mountain and hilly regions as well as parts of plain areas) and with a low road accessibility remain without VP coverage, which means they are non-assigned to any current and planned VC.

Obviously, the VP is not restricted by this territorial assignment, and rural population from Scorțoasa (*e.g.*) could make a journey to VC Berca but other aspects are involved, which render the VP more complicated than a simple move to the VC. This "theoretical" territorial design in terms of VC distribution and responsibility shows, in certain situations, the lack of correspondence between the local reality and the central intention in managing the VP. We find relevant the case of a rural settlement almost isolated in the plain area (i.e. Rușețu) which is assigned to the VC located in Buzău Municipium, the distance between these two settlements being of almost 60 km. In the Carpathian area, the "theoretical" territorial design seems to be more balanced; however, the surface of mountain rural administrative units there is quite large (*e.g.* Gura Teghii has 46.6 km^2 and is made up of 7 villages), with transportation being difficult, especially when the potential travellers are persons of advanced age with low financial resources.

The spatial itineraries induced to the elderly population by the overly-busy VCs (iii). The 2nd stage of the VP debuted on January 15, 2021, with the people's possibility to schedule their vaccination session on the National Appointment Platform for Vaccination against COVID-19. In the beginning of February 2021, there was a disturbance in the supply process of vaccines from the EU, but on March 1, 2021, a total number of 190,710 BioNTech–Pfizer doses arrived in Romania and were evenly distributed between the 5 regional storage centres (Iași, Cluj-Napoca, each of them receiving 28,080 doses, and Brașov, Timișoara, Constanța, each getting 24,570 doses) and the Bucharest National Storage Centre (60,840 doses)[27]. This discontinuity in the VP was responsible for the strategy to access the vaccine by the elderly, namely to be more dynamic in the field in order to avoid overwhelming the VCs located in important towns of people's residence

counties. The spatial itineraries induced to the elderly population by the overly-busy VCs were difficult to identify due to the lack of information and statistical data. For all that, the questionnaires submitted to 2 persons who accompanied the elderly and to 8 scheduled elderly people for vaccination in VCs established in rural settlements small towns and allowed us to identify two itineraries: a long one and a short one. The longer one (350 km) is between Bucharest and a VC located in Baia de Aramă, a small town in Mehedinți County, while the shorter one is between Buzău County-seat and a VC from Smeeni rural municipality (19 km). Internet research reveals anothers itineraries, namely between a VC located in Gurghiu rural settlement and two towns from Mureș County, i.e. county-seat Târgu Mureș and Reghin (the distance between them is 41 km and, 13 km, respectively) and between the rural settlement Hotarele (Giurgiu County) and the county-seat (distance is 59 km) and Bucharest (40 km). The long journey was made by elderly persons accompanied by their younger relatives, whereas the shorter one was made only by aged couples who were vaccinated. Both types of journeys were made by personal car. Studying the internet news about issues appearing during the VP, we reveal that, for the elderly inhabiting rural settlements far away from VCs, transport represents the main reason for access or lack of access to the vaccine.

The effect of a VC on local economy (iv), especially in rural settlements and small towns, is strongly linked to the spatial itineraries induced to the elderly population by the overly-busy VC. Thus, this issue is revealed by the questionnaires submitted to the elderly people scheduled for vaccination in VCs established in rural settlements and small towns (8 persons), and to the persons accompanying them (2 persons).

The results of questionnaires could be summed up as follows:

– ***(iv.1)*** for the long journey: the place was not completely new for the persons who made the journey. The distance (about 350 km) between their place of residence (Bucharest Capital City) and the Baia de Aramă VC involves several aspects with effects on their personal daily life and less on the town and its surroundings. The effects were in terms of time and money spent locally. The two families questioned were formed by the elderly scheduled for vaccination (4 persons) in the Baia de Aramă VC and by younger relatives (2 persons) accompanying them. One of the younger persons had general information about the place and its surroundings and had chosen it for the purpose of combining the vaccination with several leisure activities (e.g. visiting God's Bridge, Zăton Lake and Tismana and Horezu monasteries). They have accommodation near Baia de Aramă, in Comănești village (8 km south from the small town where the VC functions), at a tourist villa totally rented for them with 400 RON/80 Euros per night). They select this tourist villa because in Baia de Arama the existing tourist units were closed, the tourism season not having started, and the restrictions during the pandemic having deeply affected this type of economic activity. For the "vaccination tourists", the small town seem to be "an empty" place, animated only while the pupils leaving the "Constantin Brâncoveanu" Technological College and going to their homes. The Baia de Arama VC is located within the high school gym, a fact that allowed the persons questioned to observe the place. In town, there is just one single supermarket (in which they spent 270 RON, that is almost 50 Euros) and a few family shops for daily necessities. The two families were interested to find different details about the surrounding mountain area (natural tourism attractions, local products fairs, folkloric events etc.) and their host offered them this information. All the details, among others, which were found on tourism websites, represented the reason for the decision to return there during the summer holidays. Also, three weeks later, for the second phase of the vaccination, they intend to return to the same accommodation place and visit other tourist attractions located in the Mehedinți Plateau Geopark (e.g. Obârșia Cloșani, Corcoaia Gorges, Cerna Valley).

– ***(iv.2)*** for the short journey: the place was well known to the 4 persons questioned, scheduled for vaccination in the Smeeni VC. The people in question live in Buzău Municipium and they were obliged to travel to Smeeni to get vaccinated because of the overly-busy VC from their place of residence. Given the short distance between Buzău town and Smeeni (19 km), the effect on the local place was minimal: no accommodation was necessary, no shopping wither, because of the very short time spent in the village. What's more, the rural settlement is located in an area with no tourism potential and the persons questioned have no interest to return to Smeeni or its surroundings for any reason, except for the second phase of vaccination.

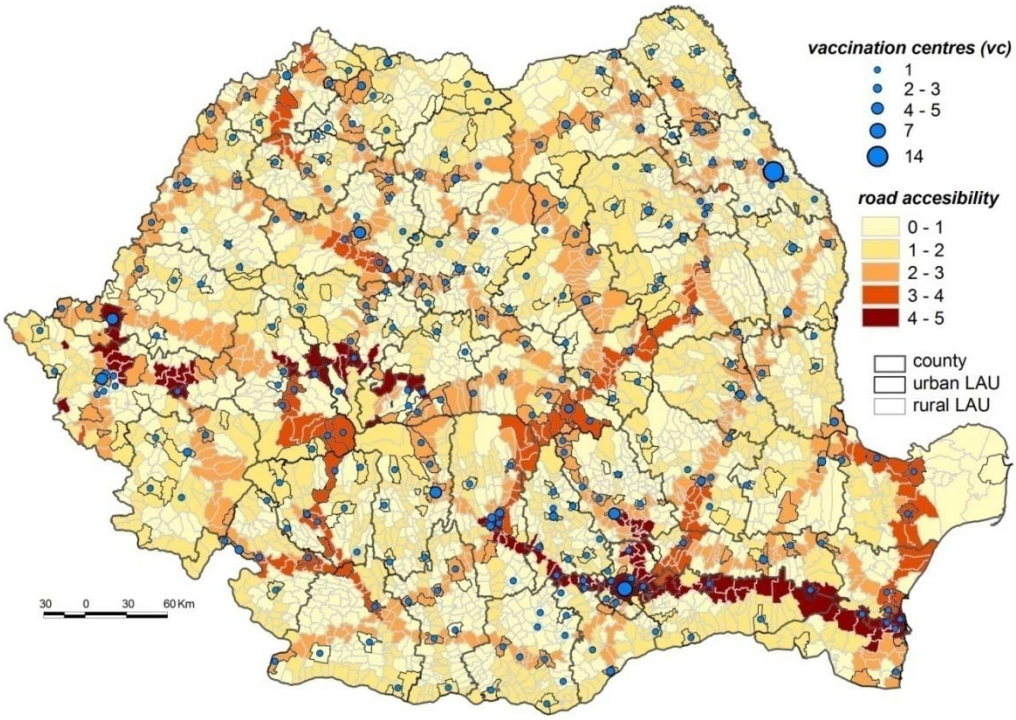

Figure 3. The territorial distribution of vaccination centres (VCs) and road accessibility
(Source of Road accessibility map, Ministry of Regional Development and Public Administration, 2014 and [20]).

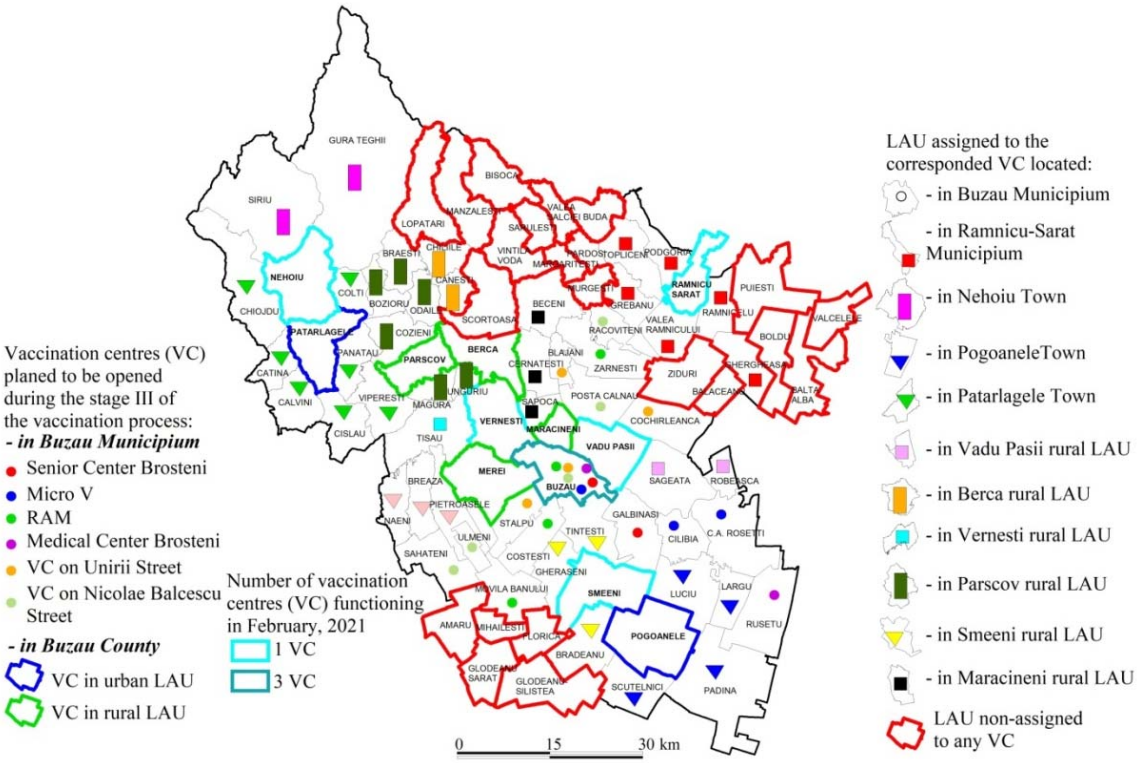

Figure 4. Buzău County – territorial design in terms of current and planned vaccination centers (VC)
(Source: processed and mapped data[26]).

In both cases, the opinions and comments about the vaccination were positive in terms of the circuit of persons inside the VC and the main procedures of the VP (*e.g.* initial triage and registration, medical triage/waiting, vaccination, post-vaccination waiting time).

Another effect of the establishment of VCs in a rural settlement is detected in terms of impact on the local budget. The improvement or the arrangement from the early days of the VC, according to very strict standards, imposed and verified by the County Public Health Directorates, is a financial effort for the local budget. This could be an endeavour not only for small local administrative units, such as small towns or rural municipalities, but also for large towns, *i.e.* Cluj-Napoca, whose mayor estimated that the costs of setting up the 13 VCs (the expected operational number of VCs in the 3rd stage of the VP) will be about 5 million[28]. The mayor of Gurghiu rural municipality (Mureș County), estimated that the organization of the local VC would cost between 15,000 and 20,000 RON (3,000–4,000 Euro)[29]. The amounts will be settled from the national budget, but the vaccination campaigns commenced by the local authorities have not yet received reimbursement, which is a major dissatisfactory point for them.

CONCLUSIONS

The territorial distribution of the VCs analyzed at a national scale, but on a territorial level, has allowed us to reveal some aspects hidden by the general statistical figures about the COVID-19 pandemic. Thus, the data collected at Local Administrative Units (LAU) shows a concentration of VCs in urban settlements, despite the fact that the elderly are territorially concentrated in rural settlements. Unfortunately, it is precisely these areas which are poorly covered by VCs or remain non-assigned to any VC. As expected, the VCs located in large towns and in county-seats registered high and very high road accessibility, but some of those functioning in rural settlements are poorly connected to the national and county road network. For the future progress of the VP, it is paramount to highlight the misalignment between the localization of VCs, especially in large urban settlements, and the territorial concentration of the elderly in rural municipalities, and to minimize it or to fix this discrepancy.

The VC capacity to cover the local population needs in terms of the anti-COVID-19 vaccination was approached with the help of a case study which shows that there exists a lack of a match between the local territorial reality and the central managerial intention in terms of the establishment and organization of the VP.

Likewise, the spatial itineraries induced to the elderly population by the overly-busy vaccination centers are based on internet research and questionnaires. This study reflects the fact that the issues of transport and accessibility are the main reasons for the access or lack thereof to the vaccine. Furthermore, the disturbance in the supply process of vaccines from the EU to Romania shows the importance of the central coordination of the vaccination process.

The effect of a VC on the local economy is minimal but there are several aspects that could outline a possible link between the vaccination process and other economic activities, such as the tourist endeavor.

Before starting the anti-COVID-19 vaccination campaign in Romania, the ways in which our society will respond to it were appreciated to be contingent on appropriate and timely actions[4]. The localization of VCs represents an important action because of its territorial implication linked with and, simultaneously, influenced by demographic and economic driving forces. For the safe management of the vaccination process, the number of active vaccination centers allocated to the population will be supplemented, gradually and effectively, in accordance with the volume of applications from the eligible population. In all likelihood, the number of VCs will be sufficient but their geographic position will be an issue to be studied for the progress of the VP and for the VP to have a positive impact on the population, wherever it may be.

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