



Research Article

Spatial analysis of the healthcare system at a regional level: A case study of the Kyustendil district

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Abstract

Healthcare is an activity of great humanitarian and social importance. Good health is a right of every human being, an asset and a source of economic and social stability. The health status of the population is crucial for reducing poverty and at the same time contributes to sustainable territorial development. Despite the established principles of accessibility and equality in the use of medical assistance and the existence of a valid health card, our research has shown that the population has different access to facilities and centers for medical assistance at the regional and local level. The localization and concentration of healthcare facilities and all other elements of the healthcare system in the studied Nomenclature of territorial units for statistics (NUTS) 3 area—the Kyustendil region, Bulgaria—are tied to the largest cities in the region and the administrative centers of the municipalities. This poses a problem for the population from the remote settlements of the district, which has considerable difficulties in obtaining medical care even in emergency cases and in accessing specialized hospitals, laboratories, etc. The geographical characteristics of the area have a significant impact on the time needed to cover the distance between the villages and the towns where the health facilities are located. Hence the specific case study to solve this problem at the local and regional level. The conducted research tries to solve this case study, which was made in the studied area, but is also relevant for many other areas in Bulgaria. It is important to note that the Kyustendil region has very good indicators of health infrastructure and supply of health professionals, which make it one of the leading places in Bulgaria. However, part of the population of the district has very difficult access to the healthcare system, which is the main reason for the higher premature mortality due to diseases, especially among the population living in the villages. An in-depth spatial analysis of the territorial location of all elements of the health system and the provision of specialist doctors was carried out. The results obtained are visualized through graphics and a map created with GIS software.

Key words: Bulgaria, children healthcare, economic and social security, emergency healthcare, NUTS 3, sustainability, total and premature mortality



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1. Introduction

The right to health is an inviolable human right and one of the fundamental goods that give meaning to human life. People's state of health affects their

participation in social and economic life and their productivity in the workplace. Staying healthy and active for longer and promoting a healthy lifestyle has a positive impact on the competitiveness and productivity of the economy and the labour market and can be a source of potentially significant savings in the public budget for the population's healthcare. In this way, healthcare directly supports economic growth and is crucial for poverty reduction, while contributing to and benefiting from sustainable economic and social development (Simeonov 2013; Dimitrova 2018; Dimova et al. 2018; Vrachovski and Kancheva 2018; Kandilarov 2019). "While the quality of health affects the quality of life" (Borisova 2022), any research related to the healthcare system that provides solution to one of the health problems is relevant and important.-

The current health and demographic state of the Bulgarian population is the result of the long-term effects of many factors and influences. Some of them are related to general trends in the demographic development of European countries, others to the specifics of Bulgaria's historical, socio-economic and cultural development (Pickard 2013; Rohova 2014; Todorovska 2017; Koulov 2018; Amlaev et al. 2022; Eurostat 2023). Demographic processes that are common in industrialized countries have an impact on the demographic development of the population—lower birth rate, fewer marriages, striving for a successful professional career and material stability, increasing urbanization. Countries that have made the transition to a market economy and democracy—higher mortality rates, intensive external and internal migration, growing regional differences in socio-economic development (Chankova 2003; Ninov 2013). As Stoicheva notes (2011) the changes in health care are inspired by the changed socio-economic model of public development in our country, as well as by the accession of Bulgaria to the European Union, with the resulting from these obligations to harmonize all spheres of public life, including the health care system. In his analysis, Miran (2021) defends the position of rapid changes in health care. Some of these changes are related to an increase in financing and the appearance of the private sector in the system, but the results are defined as "dubious and unsatisfactory".

In Bulgaria, the deepening demographic crisis is taking place simultaneously with an insufficient and unsustainable improvement or deterioration of some indicators showing the health status of citizens (Nikolaeva 2019). The analysis of the data on the main health demographic indicators in the annual reports on citizens' health clearly shows that Bulgaria faces much greater challenges compared to the countries of the European Union.

Those challenges are related to the deterioration of the demographic structure and the aging of the population, an unfavorable ratio between births and abortions, a high maternal and infant mortality rate, a high overall mortality rate, a high premature mortality rate, a lower average life expectancy in years and years of good health, an increasing incidence of lifestyle-related chronic non-communicable diseases, a high level of mental disorders, a high relative proportion of people with some degree of disability and permanent incapacity to work (TSB-Kyustendil 2021; NSI 2021).

Such challenges have a negative impact on the labor market, which is increasingly suffering from labor shortages, as well as on the costs of healthcare and treatment of the population, which are rising as the country's population decreases. Therefore, the trend that there are fewer and fewer people

in work to pay for the rising social costs caused by the deteriorating health of the population is worsening and will lead to a crisis. It is therefore important to seek solutions to these problems through regional and local studies of the healthcare system—infrastructure and services.

In Bulgaria, there are healthcare facilities for medical care at three levels: national, regional and local. At the national level, specialized and highly qualified medical care is provided in multidisciplinary and specialized hospitals, which account for 11.2% of the total number of inpatient beds in the country (NSI 2021). At the regional level, 37.3% of hospital beds are in specialized hospitals, health centers, and in the departments of the 28 multi-profiles active treatment hospitals (MBAL) in regional cities (NSI 2021). Of the 342 medical facilities for hospital care, 122 hospitals (35.7) are located at the municipal level, i.e. near the potential users of health services, with 27.8% of the inpatient beds available in the country (NSI 2021). Thus, the Bulgarian healthcare system has a very well-developed, dispersed spatial structure, with a pyramidal character in terms of the hierarchy of healthcare facilities for hospital care. Why do the health demographic indicators of the population nevertheless show undesirable, unfavourable values? The discrepancy between the very well-developed health infrastructure and the high levels of general and premature mortality of the population in Bulgaria provokes our interest. For this, we conducted a study of the state of the health infrastructure and the services provided to the population by the health system at the regional and local levels. We chose the Kyustendil region (NUTS 3) and the nine municipalities on its territory Local administrative units (LAU 1) as a case study.

The motivation to conduct the study was complemented by a series of reforms of the health Bulgarian system in the last three decades since 1995 (Regulation No. 26/11.2008 on the arrangement of nurseries, children's kitchens and the health requirements for them (Ministry of Health 2008); Regulation No. 8/11.2016 for Screening and Dispensations (Ministry of Health 2016); Law on Medical Facilities (State Gazette 2019); Law on Health Insurance (State Gazette 1998); National framework contract for medical activities for 2020–2022 (State Gazette 2021)). Attempts to free the Bulgarian healthcare system from excessive dependence on hospital care at the expense of prevention and disease prevention and to increase its efficiency have not brought the expected results. Challenges related to access to the health system and the quality of the services provided remain unresolved.

The expected benefits of Bulgaria's 17-year membership in the European Union (EU) and its positive impact on the country's socioeconomic development have not had a serious impact on the level of health demographic problems that are important to society. For example, the mortality rate among newborns, infants, and women in childbirth in Bulgaria is highest in the EU. Despite the decline in infant mortality rate (5.6%, 2021) in the country, it is higher than the EU average. Bulgaria ranks first in the EU in terms of the number of terminated pregnancies (NSI 2021). The lack of a consistent family planning policy and inadequate health education in certain population groups in the country expose many girls and women from these population groups to the risk of early pregnancy, jeopardizing their health and creating problems of public importance that will manifest themselves in the weather for decades to come.

The purpose of the research is to analyse the health care system of the Kyustendil district in Bulgaria and to answer key questions about its current state and problems. The study seeks to answer the following questions:

- While the population in Kyustendil district is distinguished by a very high level of health insurance, why some of the health-demographic indicators are aggravating and below the average values for the EU?
- While the region is distinguished by a very well-developed health infrastructure and collateral of general practitioners, does this guarantee a high quality of health services for the entire population of the district?
- How the age structure of the population affects the differences of the total and premature mortality of the population in the region?

2. Data and methods

2.1. Case study area

For this study we selected Kyustendil district. It is one of the 28 administrative-territorial units of the NUTS 3 level (Fig. 1). It belongs to the southwest region (NUTS 2), the most developed in Bulgaria, and is 60–100 km from the capital. The transport connection with Dupnitsa, the second-largest city in the district, is via the Struma highway, and the distance is covered in less than an hour. Further away from Sofia are the regional town of Kyustendil and the western part of the district, which is also a border. The mountainous appearance of the area is due to the Osogovska, Konyavska, Zemenska, Milevska and north-western Rila mountains, which makes transportation between municipalities and settlements difficult. The Kyustendilska and Dupnishka river valleys and the Struma, Jerman, Dragovishtitsa valleys etc., are characterized by favourable features.

The population of Kyustendil region is just over 100,000 inhabitants and is declining. (Table 1). It is distributed among seven towns and over 170 villages.

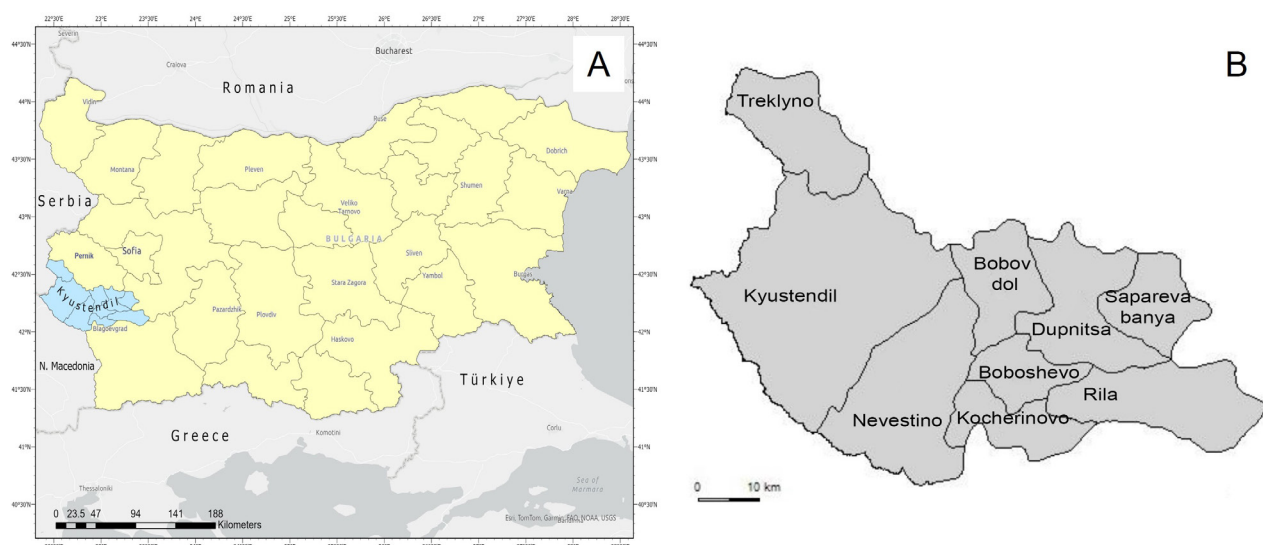


Figure 1. The Kyustendil region **A** Location of the Kyustendil region in Bulgaria **B** The Municipalities in Kyustendil region.

Table 1. Change in the population of Kyustendil region. Source: National Statistical Institute (2023).

Years	2020	2021	2022
Population in thousands	116,619	111,736	108,703

In the western and mountainous parts of the district, there is a pronounced depopulation process, that began in the second half of the 20th century, as well as an aging population. In two (Treklyno and Nevestino) of the nine municipalities (Fig. 1) in the district, the population is completely rural, and depopulation and aging of the population are the most pronounced. The proportion of the urban population is 70% (2021) which is therefore slightly below the national average (73%). Almost 84% of this is concentrated in the two largest cities in the districts Kyustendil and Dupnitsa (NSI 2021). The remaining 16 % of the urban population is evenly distributed among five small towns with populations between 1,100 and 4,500, which are also the centers of municipalities (LAU 1).

2.2. Data

The study used official information from the National Statistical Institute and the Territorial Statistics Bureau of the city of Kyustendil on healthcare infrastructure at the regional and local levels, as well as information from the local municipal administration and various regional and local departments on specific public health services provided to the population (Table 2). In the analysis of the healthcare system in the Kyustendil region, information from own observations and studies through the in-depth interview method is also included.

When providing data from various sources, we endeavoured to synchronize them, that is to relate them to the period 2020–2021. The aim is to present the

Table 2. Types and sources of data used in the study.

Nº	Data types	Source	Access type
1.	Demographic statistics	National Statistical Institute (NSI 2021)	publicly available
2.	Health infrastructure (hospitals, hospitals, emergency centers)	Territorial Statistical Bureau (TSB) Kyustendil, General hospital for active treatment (MBAL) Kyustendil, General hospital for active treatment (MBAL) Dupnitsa, Health Insurance Fund (NHIF) - Kyustendil	publicly available on demand
3.	Other elements of the health infrastructure	TSB Kyustendil, municipal administration	publicly available
4.	Morbidity of the population	Regional Health Inspection (RHI), Specialized hospital for active treatment (MBAL) Kyustendil, MBAL Dupnitsa, National Health Insurance Fund (NHIF) - Kyustendil	publicly available on demand
5.	Provision of the population with medical specialists	National Statistical Institute (2021), TSB Kyustendil, municipality, Health Insurance Fund (NHIF) - Kyustendil	publicly available on demand
6.	Structure of emergency medical care	Centre for Emergency Medical Assistance - Kyustendil	on demand
7.	Activity of the Bulgarian Red Cross	Bulgarian Red Cross	on demand
8.	Child and school health care	RHI, Regional Inspectorate of Education	on demand

current state of the problem with a view toward 2021, the year in which the last census was conducted in Bulgaria. At the same time, the data on the health status of the population for the year 2021 are considered more reliable than for the year 2022, which was much more affected by the COVID-19 crisis in the country. The data were mainly taken as absolute values from the respective sources, and the calculations were performed by the authors themselves. The impact of COVID-19 on various sectors of the economy is explored by Nekova (2023). Belias (2022) focuses on the post-COVID-19 roles of robots in keeping healthy the people working in hotels as well as their customers.

2.3. Methods

The research carried out is based on the systems approach, which allows the health system to be analysed in its entirety and diversity of elements and their related infrastructure and services. At the same time, it is perceived as an element of the public system, because the development and state of the health system depend on a set of socio-economic factors. The present research is organized in three main stages in its implementation (see 2.3.1–2.3.3).

2.3.1. Data selection

Three main types of data were used. We use the functioning administrative-territorial structure in Bulgaria, because this hierarchy is the basis of the territorial organization of the health infrastructure and services. Through it, a system is created and functions to satisfy the interests and needs of the population at the local level—in the city, municipality and district in which it lives. In this way, we determine the place of Kyustendil region (NUTS 3) in the national space. We collected data on the elements of the health system, the types of medical specialists, and determined the time of observation—focus on the year 2021. The third type of data that we collected and processed are population data—number, distribution by place of residence, age structure, access to the elements of the health infrastructure.

2.3.2. Data analysis

Spatial analysis gave us the opportunity to determine the distribution of health facilities in the studied territory, by municipalities and by settlements. The analysed data showed us significant differences and unevenness in the area, related to the territorial distribution of the individual elements of the health system by types and by number; in providing the population with medical specialists; in the types of additional health services; in terms of demographic indicators, etc. We established and defined another level of territorial imbalance between individual categories of settlements and the field of their influence. It depends on their size and localization in the studied area. After the analysis of data on the health system, we obtained results that in homogeneous groups of municipalities there is a concentration of elements of the health infrastructure and related services. The structure and interrelationships between the individual elements of the system were revealed. We have shown the dependencies between the hierarchy of settlements and the regularities in the localization of the elements

of the healthcare system. We found similarities and differences between the municipalities in the study area regarding the distribution of elements of the health system and services compared to the national ones.

To calculate the average driving time from emergency medical care centers The Network Analyst toolbox and the service area function were used. This function allows drive time polygons to be created based on the network dataset. The source of the network dataset is the ArcGIS Online routing services. The method for visualization is polygons and lines. The input facilities are the locations of the emergency medical centers the method of the estimations is driving time away from the facilities and the defines cuts off the driving time is 5; 10; 15 and 20 minutes. The upper limit of the driving time was chosen to be 20 minutes because this is the maximum time for providing the emergency medical care according to the medical standards for emergency care in Bulgaria.

2.3.3. Data visualization

Using the capabilities of the specialized Arc GIS Pro software, we combined and extracted new information by visualizing the spatial differentiation and related elements of the health system. We created a map of the territorial distribution of the health infrastructure in the district, which showed great differences between municipalities and between settlements regarding the provision of the population with elements and services of the health system. Through statistical graphics, we visualized the structure, dynamics, dependencies and territorial location of the totality of elements of the health system in the Kyustendil region, as well as the supply of health professionals.

We linked the spatial aspects of the health infrastructure and the relevant services with the spatial characteristics and peculiarities of the studied territory. The main types of relief, the geographical density of the population, the territories of depopulation and aging of the population, features of the settle-

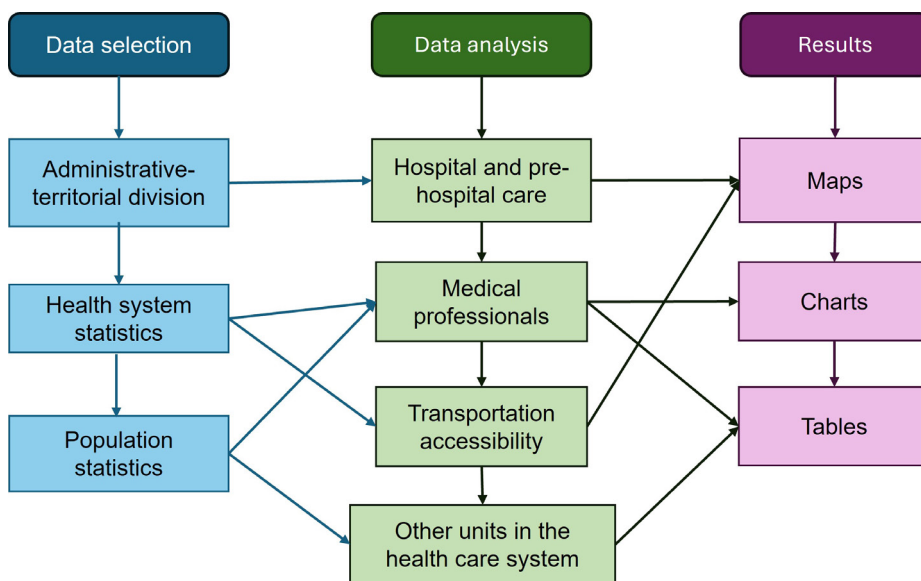


Figure 2. Graphic representation of the methodology used.

ment network and the categories of settlements, configuration of the transport network by classes, etc. Software's such as Corel DRAW Graphics Suite X5, Adobe Photoshop 2020 were also used to process the graphic images. Using Microsoft Excel and Word software tools, we created the tables and charts in the study. Through clustering, as with other authors (Ravnachka and Stoyanova 2022), we found relatively homogeneous groups of municipalities in terms of the concentration of elements of the health infrastructure and services, as well as the lack thereof.

The statistical analysis of the state of the health system (infrastructure and services), the geographical analysis and the visualized territorial organization of the health system are preceded by the application of the described methods for collecting, analysing and presenting information from local and regional sources (Fig. 2). The summaries are based on this.

3. Results

Medical facilities in Bulgaria are divided into three categories: hospital care, prehospital medical/dental/nursing care, and medical facilities with special functions (Bulgarian Healthcare Act (Ministry of Health (2024))). The analysis of the statistical information and the information provided through own studies showed specific features of the state of the health system in the studied territory—Kyustendil region, which will be presented in the following paragraphs. There are healthcare facilities of the following categories in the territory of Kyustendil district (Fig. 3) Hospital care is provided by five health facilities, and outpatient care unites 21 facilities and nine laboratories.

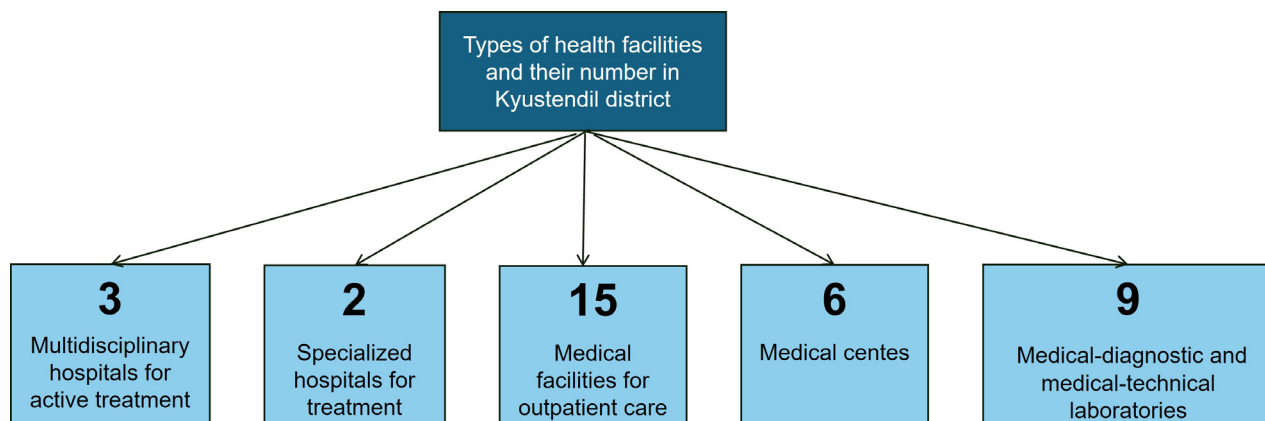


Figure 3. Types of hospitals and their number on the territory of Kyustendil region for 2021.

Health facilities are divided into hospital and non-hospital. Hospitals include multi-specialty hospitals for active treatment and specialized hospitals for treatment. Out-of-hospital health facilities are divided into several types according to the services they offer.

3.1. Hospital care

The number of hospitals in the Kyustendil region has decreased from seven to five between 2010 and 2021. These two medical facilities were closed in 2014. The functioning hospitals belong to two categories: three specialized hospitals with a total capacity of 648 beds, two of which are in Dupnitsa municipality and the third in Kyustendil municipality. The second category includes specialized rehabilitation hospitals of national importance. In the district there are two specialized hospitals with a total capacity of 356 beds, located in the city of Kyustendil and the city of Sapareva Banya (NSI 2021). The functioning multispecialty hospitals in the city of Dupnitsa serve the population of the municipalities of Dupnitsa, Sapareva Banya, Boboshevo, Rila and Kocherinovo, and the one in the city of Kyustendil serves the population of the municipalities of Kyustendil, Bobov dol, Nevestino and Treklyno (Fig. 4).

Although the number of hospital facilities remained unchanged during the study period, the number of beds in these facilities increased by 4.5%, which was a more favourable result. The supply of hospital beds to the population in the district at the end of 2021 is 858.7 per 100,000 inhabitants, placing the district in fifth place nationally for this indicator. The total hospital capacity of 1,004 beds for 113,440 inhabitants of the district shows a high level of care for the population, but also a high concentration in just two settlements.

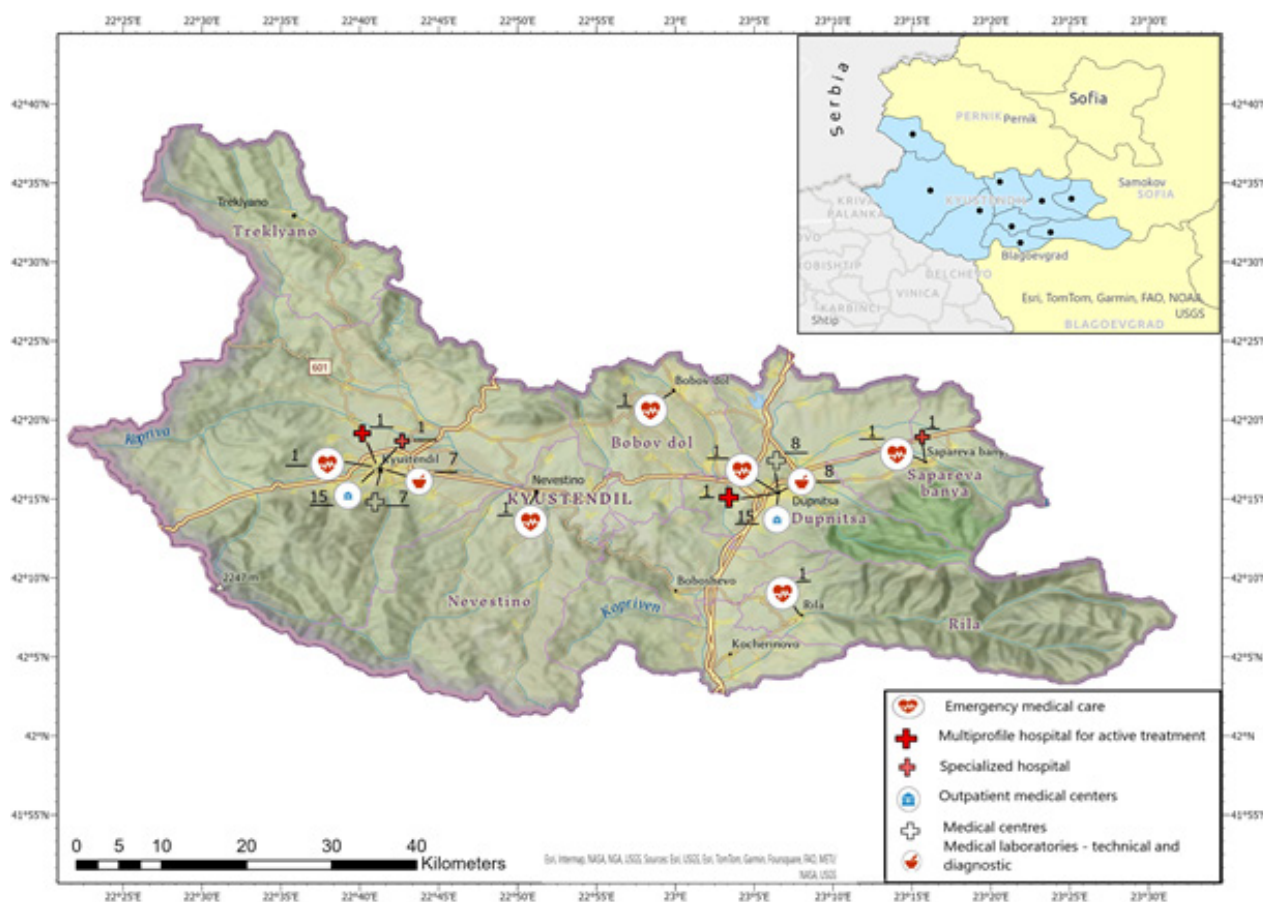


Figure 4. Territorial structure of the healthcare system in the Kyustendil region for 2021.

3.2. Outpatient care

There are 15 outpatient facilities in the district with up to ten beds for short-term observation and stay. Six are medical centers with clinical medical activities. The healthcare infrastructure was complemented by nine medical-technical and medical-diagnostic laboratories (Figs 3, 4).

Kyustendil district is one of the leading places in the country in the assessment of the healthcare system according to several indicators. It ranks second in terms of the number of patients per general practitioner: 1,429 (2021). Against the background of the huge shortage of doctors throughout the country, as well as in many EU countries, the Kyustendil region is in an enviable position in terms of providing the population with doctors. According to our own research, this is the case for two main reasons: on the one hand it is the tradition associated with the recent past. The town of Dupnitsa (Stanke Dimitrov in the second half of the 20th century) was a regional center of hospital care in the southwestern part of the country. During the period of socialism, a Military Hospital and a Transport Hospital were located, where members of the army and transport services were hospitalized and treated—important areas of the service and defense sector. There is also a Municipal Hospital. In this sense, the economic profile of the city and the employment of part of the population are closely linked to the healthcare system. The built infrastructure and several dozen hereditary medical families in the city and the surrounding area have also influenced the current level of general practitioner supply, concentration of healthcare infrastructure and other indicators of the healthcare system. This is also confirmed by the fact that two of the three multispecialty hospitals in the district are in Dupnitsa and not in the district center of Kyustendil. The second reason is the proximity to the capital in the geographical sense (60 km away) and the very good transport infrastructure (Struma highway), which makes it possible to live in one settlement and work in another. The high concentration of doctors in Sofia is why some of them choose to work in Dupnitsa without changing their place of residence. The supply of the population not, only with general practitioners, but also with specialists, confirms our studies. There are 513 people per specialist in the district, slightly above the national average of 424 people per specialist (Fig. 5).

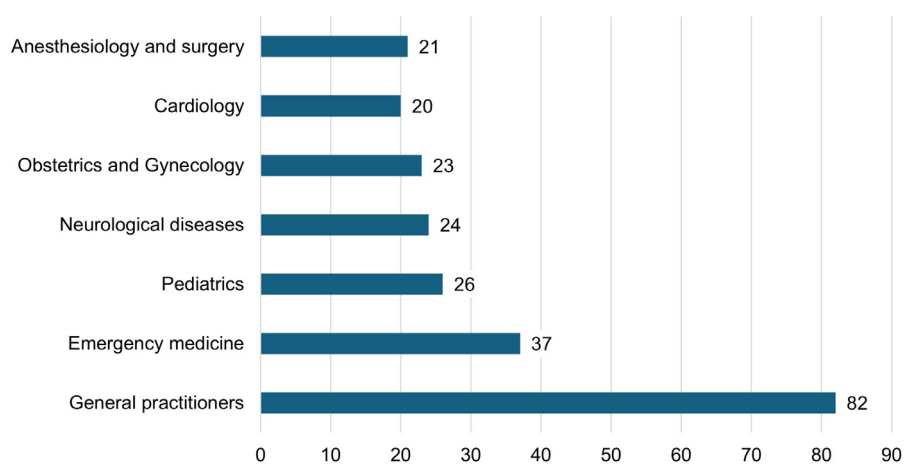


Figure 5. Number and structure of doctors by specialty.

Kyustendil district stands out positively from the rest of the country as another indicator. The proportion of people with health insurance in the district's total population is very high, 94.9%. The data shows that the value of this indicator has increased steadily and gradually over the years. It is difficult to determine a clear explanation for this finding. We attributed this to the ethnic structure of the population. The 2021 census showed that 93.9% of the district's population is Bulgarian. 5.1% are the next largest ethnic communities that do not seek health insurance.

3.3. Emergency medical care

A serious problem of the system is the territorial unevenness of the location of medical facilities not only in the analysed area, but also in the country (National Health Strategy 2021–2030 (Council of Ministers of Republic of Bulgaria 2024)). The territorial distribution of the objects of the healthcare system in the territory of the district is relatively unfavourable. This is also true for emergency medical care (Fig. 4). The importance of medical facilities in the town of Dupnitsa for healthcare in the five neighboring municipalities is high. Of the nine municipalities in the district, there is one center for emergency medical assistance in Kyustendil and five other branches; that is not every municipality has a local branch providing this vital service to its citizens (Fig. 6). Two of the branches serve the population of two other municipalities as well as the emergency center in the city of Kyustendil (it serves the municipality of the same name as well as the municipality of Treklyno). Part of the area served by this center includes very remote and hard-to-reach small villages with few inhabitants. This makes the provision of care very difficult the services less efficient and makes it more difficult for these citizens to access healthcare in the event of urgent needs.

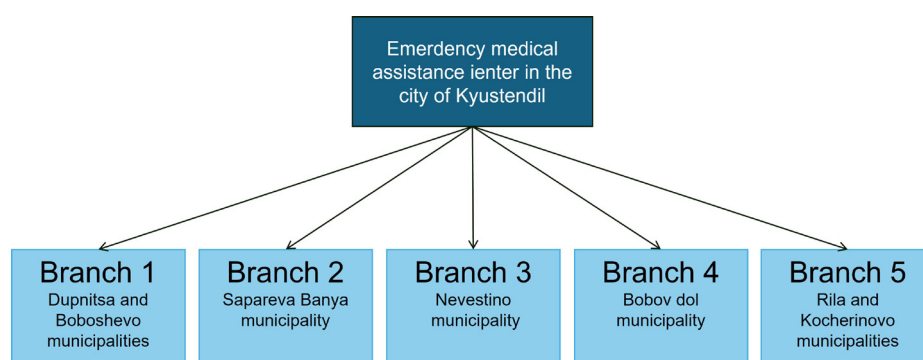


Figure 6. Regional systems for emergency medical assistance in 2021.

The total number of emergency responders in the district is 211 people. Of these, 33 are doctors, 50 paramedics, 21 nurses and 4 midwives. The branches have a total of 28 means of transport. The provision of mobile first-aid teams (doctors/paramedics) is not sufficient. One team has to care for a population of around 15,000 to 16,000 people. The medical staff in the Kyustendil region is highly qualified. All general practitioners have completed or are in the process of completing specialist training in general medicine.

According to the Concept for the Development of Emergency Medical Care in the Republic of Bulgaria 2014–2020 and National Development Program “Bulgaria 2030” (Ministry of Transport and Communications 2020) the accessibility of healthcare facilities, particularly the branch for emergency medical care in the town of Dupnitsa, is within 20 minutes for the territory of the municipality of Dupnitsa (Fig. 7). The geographical conditions for this are both the valley relief and the proximity of the villages to the town for which medical assistance is provided, as well as the condition of the road infrastructure. In this context, the local healthcare system covers the community standards for quickly reaching the scene of the accident and providing first medical aid (Fig. 7).

The accessibility of health facilities in the town of Kyustendil has deteriorated for a large part of the villages and their population, because they are far away from the regional center. The topography of part of the area is mountainous, the villages are mainly located in the low mountain range, and the roads have sections with poor pavement and many curves, which increases the time to reach these settlements and provide first aid.

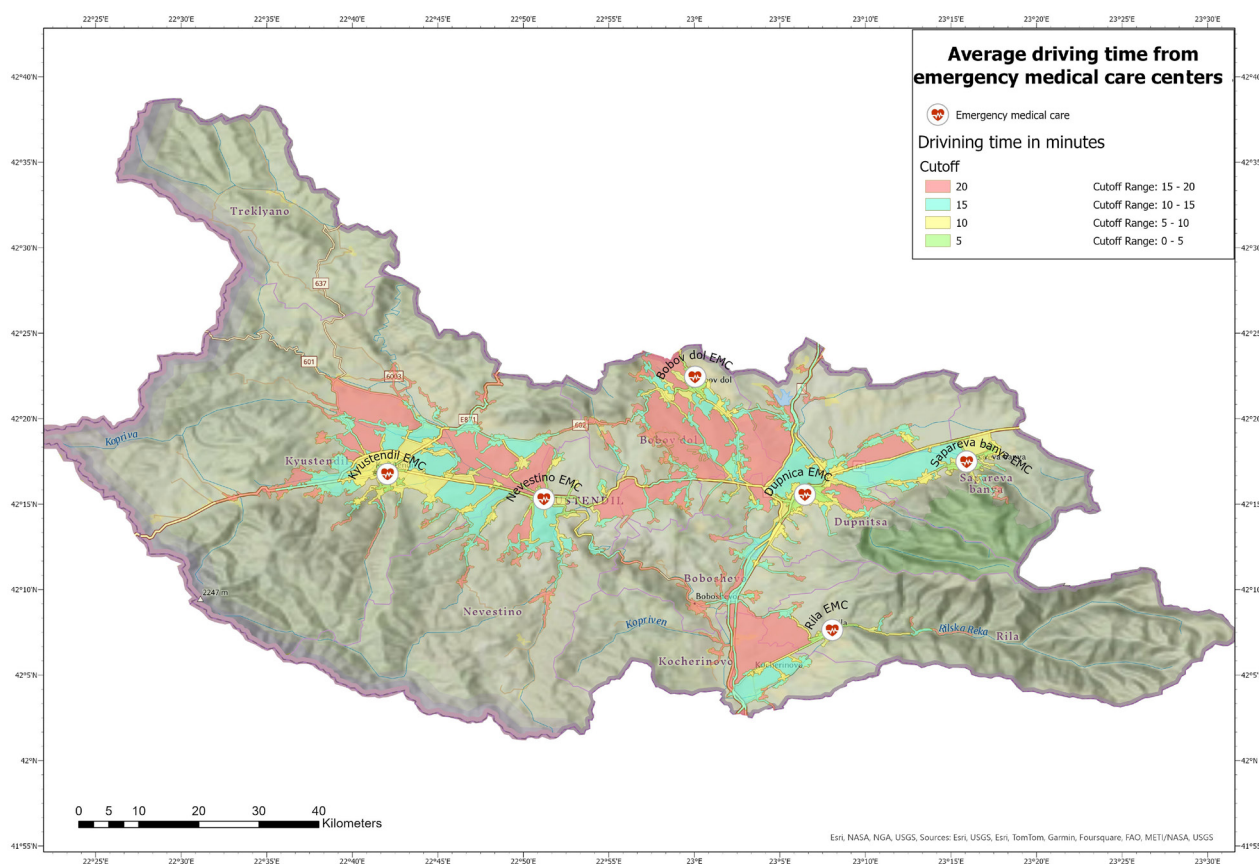


Figure 7. Areas with transport accessibility to emergency centers, up to 20 minutes.

Our analysis shows that in peripheral, mountainous and rural areas transport connectivity mostly determined by geographical distances, topography and transport network (road classes and condition).

3.4. Medical professionals

Healthcare for the population is provided through the provision of outpatient and inpatient medical care. Outpatient and dental care is provided almost exclusively by practising or specialized doctors. At the end of 2021, 409 doctors with a simple employment contract were practicing in medical and healthcare facilities in the Kyustendil region. There are 112 dentists. Health services to the population are also provided by healthcare specialists (Table 3). The distribution of medical workers by types of healthcare facilities is shown in Table 4.

Table 3. Healthcare specialists in Kyustendil region in 2021.

Nº	Medical staff	Total number
1.	Doctors	409
2.	Dentists	112
3.	Nurses	407
4.	Medical laboratory assistants	47
5.	Paramedics	54
6.	Midwives	43

Table 4. Medical Personnel in Kyustendil district (only with a basic employment contract).

Nº	Medical staff	Total	Hospital care facilities	Outpatient care facilities	Other medical and health care facilities
1.	Doctors	409	209	157	43
2.	Dentists	112	-	112	-
3.	Healthcare professionals	551	347	45	237

The supply of specialist doctors in the Kyustendil region at the end of 2021 is 35.0 per 10,000 inhabitants, compared to 42.6 per 10,000 inhabitants in the country as a whole, more than 7 points lower. The concentration of specialized hospitals in the country's major cities therefore has a negative impact on the provision of such specialists to the district's population, as Kyustendil is a relatively small regional center in terms of population size. When consultations or examinations are required, the population of the district travels to the health facilities in the capital.

The situation is almost identical when it comes to the provision of dental specialists. The supply of dentists in the district is 9.6 per 10,000 inhabitants, compared to 10.6 per 10,000 inhabitants in the country as a whole. The gap is even greater here and poses a threat to the dental health of the district's inhabitants.

The situation regarding the supply of general practitioners to the population is much more favourable. In Kyustendil district, the supply of general practitioners is 7.43 per 10,000 inhabitants compared to 5.9 per 10,000 inhabitants in the country as a whole, i.e. the trend here is favourable for the local population. The municipality of Dupnitsa has the best provision of general practitioners of

all the municipalities in the district. The indicator is 8.01 practicing doctors per 10,000 inhabitants in the municipality, with an average value for the district of 7.43 (RHI for 2021). The reasons for this high coverage were examined and presented in section 3.2. The distribution of general practitioners in the municipality is as follows: 28 of the doctors work in individual practices and 32—in group practices. The concentration of individual practices, 80%, is also in the town of Dupnitsa. Only three of them are in the villages of the municipality. An even higher concentration of dentists is observed in the city, 97.5%, and only one out of a total of 40 dentists works in the village of Yahinovo, Dupnitsa municipality.

Regarding the protection of the health and life of the population, it is important to comment on the following fact. At the hospitals of the towns of Dupnitsa and Kyustendil and the medical centres operating there, emergency service offices have been established for the patients of general practitioners from the respective towns and neighbouring municipalities.

The good care of the population or the quality of health services depends largely on certain demographic characteristics of doctors. It is a well-known fact that due to the shortage of doctors in the country, medical facilities and individual practices are massively staffed by doctors who are over the working age. In the surveyed area, the age structure of doctors is favourable. Almost 74% (73.8%) of them are in the age range of 45–64 years, but the relative proportion of young practicing doctors under 35 years is only 3%, so the aging of doctors will be more pronounced in the coming years. In terms of gender distribution, the ratio is in favor of women—46:54 (NSI 2021).

3.5. Other units of the healthcare system

3.5.1. Child and school healthcare

Children's health is and should be the main priority of Bulgarian health policy. The deteriorating demographic situation in the country is another argument in favor of this priority. Therefore, the "return" of health services to schools and childcare facilities about ten years ago was an important step in the implementation of this policy. Providing medical care for children and young people in full-day nurseries and schools in the event of an accident is vital for the protection of their health and for the peace of mind of parents and teachers. The area under investigation is no exception. Child and school healthcare in the district is provided by open and functioning health offices staffed by nurses. There are a total of 25 health professionals, five of whom work in two offices due to the small number of children in the respective children's and/or educational institutions.

3.5.2. Pharmacy network

For 2021, a total of 55 pharmacies are registered and operating in Kyustendil district, 26 of them in the town of Kyustendil, 20 pharmacies in the town of Dupnitsa, two pharmacies each in the towns of Bobov dol, Rila and Sapareva Banya, and one in each Boboshevo, Kocherinovo and Nevestino. Pharmacies are in the municipal centers (Fig. 8). Territorial distribution of pharmacies in the district is proportional to the size of the settlements and is a function of the

administrative-territorial structure. There is at least one pharmacy in almost all municipalities of the district, which proves that the population is relatively well provided with this service. The only exception is the municipality of Treklyno, whose population receives the service from the pharmacies in the town of Kyustendil.

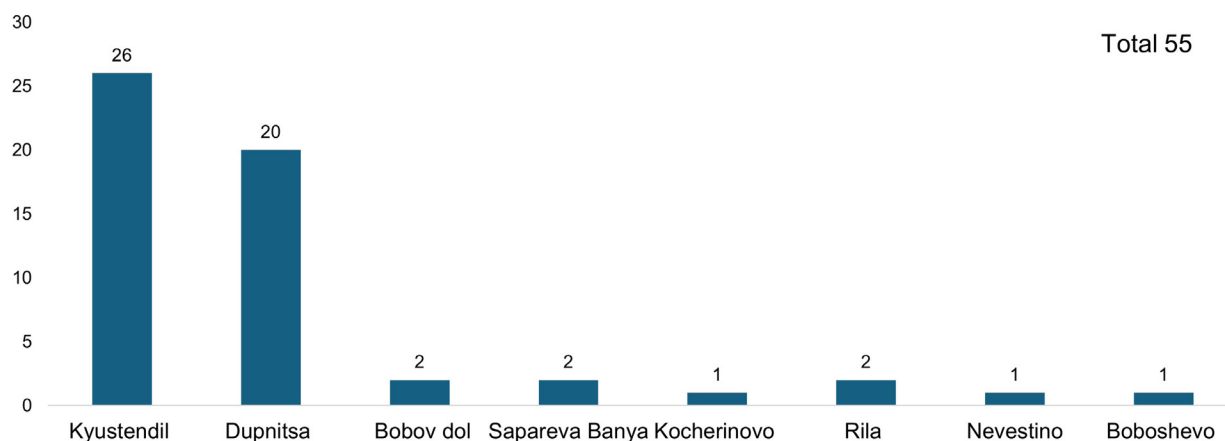


Figure 8. Territorial distribution of pharmacies in the Kyustendil district, 2021 (NHIF 2022).

3.5.3. Nurseries and diary kitchens

Nurseries are independent organizational structures in which medical and other specialists provide care, education and training for children aged three months to three years. At the end of the study period (2021), there were 15 independent nurseries and nurseries groups as part of kindergartens in the Kyustendil region with a total of 480 places. In towns there are 12 nurseries with 398 places and in the villages—3 with 82 places. In the municipality of Kyustendil there are seven nurseries with a total capacity of 190 places. There are no functioning nurseries in the municipalities of Boboshevo, Rila, Nevestino and Treklyno.

As of 31st of December 2021, the availability of nursery places in Kyustendil district is 20.0% compared to 19.5%—the national average. The highest level of the indicator is recorded in the municipality of Kocherinovo (26.9%), the lowest availability of places in the municipality of Bobov dol, 14.5%.

The distribution of children growing up in nurseries by age shows that the group of children aged 2 years is the most numerous—87.5%, followed by children aged 1 year—11.9%. At a national level, the trend is the same—two-year-olds also have the highest relative share—81.5% of the total number of children attending these childcare facilities.

The number of children growing up in daycare centers in the Kyustendil district is 14.4%, which is below the national average of 17.9%. The highest value of the indicator is in the municipality of Kocherinovo (16.4%), the lowest in the municipality of Bobov dol—8.1% (2021). Nursery care services are unevenly distributed across the district. The largest discrepancy is between the urban centers and villages in the municipalities.

This healthcare structure employs 84 medical and other professionals who raise, educate and train the children. 60.7% of them work in the municipality of Dupnitsa. There are 47 medical professionals, 45 of whom are nurses. The non-medical staff that takes care of the children consists of 37 people.

Children's kitchens are separate structures that exist independently or to nurseries. They employ medical professionals and nutritionists. The children's kitchens operate on the area of the district and provide meals for children up to the age of three in the municipalities of Dupnitsa and Kyustendil. The service is offered all year round and is used by an average of around 200 families per year. It aims to support motherhood and raise healthy children.

The services provided to the population of the district, directly or indirectly related to health, are complemented by the activities of a large non-governmental organization—Bulgarian Red Cross (BRC). In Kyustendil district, it has a regional structure that develops various activities. The main target groups it supports are very old people with serious chronic diseases, pensioners living alone, disadvantaged children, unemployed people, disabled children, large families, extremely poor groups and people with various types of addictions.

4. Discussion

The study of the health system in Kyustendil region showed that there are significant differences in the geographical location of the health infrastructure of the studied territory (Fig. 4). It is characteristic of all components of the health care system—multidisciplinary and specialized hospitals for treatment, pre-hospital care, emergency centers and affiliates, etc. The population in the villages, peripheral and mountainous areas of the region face difficulties in accessing the healthcare facilities and services they provide. This endangers the health and lives of these people. This raises two questions for discussion. Is equal access to healthcare services truly guaranteed to the population of the region (NUTS 3), regardless of where they live? Is the network of emergency centers and affiliates established in the country sufficient to meet the standard of rapid access?

The research conducted in one Bulgarian administrative region (NUTS 3) can be considered as a model, i.e. it can be applied to any other territorial unit of the same level because people living in hundreds or even thousands of villages in Bulgaria may face the same problems. The indexes are a high overall mortality rate and premature mortality rate, and the main fatal diseases are cardiovascular and cerebrovascular diseases, as well as trauma-related deaths. For example, in 2020, 92.2% all of deaths were caused by one of the following five diseases: circulatory system diseases (60.6%), neoplasms (14.9%), COVID-19 (6.9%), injuries and poisoning (5%), respiratory diseases (4.8%) (NSI 2021).

4.1. Hospital care

Hospital care in the studied area is represented by the operation of five hospitals. The total capacity of the hospitals shows a high degree of provision of the population with this type of highly specialized services. The high territorial concentration, only two settlements Dupnitsa and Kyustendil, is logical and linked to the provision of services with highly qualified medical specialists.

4.2. Pre-hospital

Pre-hospital care in the studied territory is at a good level. Kyustendil district occupies one of the leading places in the country in the assessment of the health system according to several indicators. For example, it is in second place in terms of the number of patients per general practitioner—1,429 people (2021). The district is also distinguished by a very high share of health-insured persons from the total population of the district—94.9%. And with pre-hospital care, there is also a high territorial concentration in the two largest cities in the district—Kyustendil and Dupnitsa. Therefore, the size and hierarchy of settlements is decisive in the localization of the main part of the elements of the health system. This is consistent with the services that these health facilities offer to the population. Urban areas increase their population density and attractiveness also through the health services provided (Alhazzani et al. 2021).

4.3. Emergency medical care

Emergency medical care has a relatively less favorable territorial distribution on the territory of the district (Fig. 4). On the one hand, emergency medical care has a more dispersed territorial structure (one center and five branches). On the other hand, not every municipality has an emergency medical assistance branch. Out of a total of nine municipalities in the district, there is one emergency medical care center in Kyustendil and another five branches, i.e. not every municipality has a localized branch offering this vital service to citizens (Fig. 6). The question of equal access of the population to this often life-saving service remains a debatable issue. The number of centers and affiliates for emergency medical care must be consistent not only with the number of the population they serve. It must also be taken into account the number of settlements, their distance from the centers and branches, the transport connectivity between them, the classes of the road network and features of the geographical environment, the age characteristics of the population, etc.

The problem of transport connectivity is manifested not only in the studied territory but also in the periphery throughout the country—border and internal, as well as in other European countries (Patarchanov 2009; Stiglitz 2016; Am-laev et al. 2022; Borisova 2022).

Todorov and Todorova (2023) prove that to improve transport connectivity and accessibility to hospital facilities in urbanized territories, it is necessary to apply measures based on infrastructure and location, as well as individual indicators as dominant to study the interrelationships between the different components. In peripheral, mountainous and rural areas, transport connectivity is mainly/largely determined by geographical distances, topography and the transport network (road classes and condition).

4.4. Medical specialists in the studied territory have the main role for the functioning of the health system

Specialist physician coverage at the end of 2021 more than 7 points lower than national values. The situation with the provision of the population with general practitioners is much more favorable. The provision of general practitioners is

7.43 per 10,000 people of the population, with 5.9 per 10,000 people in total for the country, i.e. the trend here is favorable for the local population.

We recommend conducting research similar to ours at the regional and local level, because they reveal features, strengths and weaknesses of the system that can be used in strategic planning of health care policies, and which are not found at the national and higher levels. Furthermore, the involvement of all stakeholders, the population, the state, health professionals and non-governmental organizations in health planning is key to promoting equity in access to health care (Kumar and Vinati 2024). This is how social justice in health care is guaranteed. "Bringing stakeholders into the health policy-making process makes decisions more accountable and clear and shows that policymakers care about open communication between them and the people" (Kumar and Vinati 2024).

The conducted research, as well as providing it with statistical information, revealed another problem—the various institutions in the health system operate with certain information and are not interested in other related information. The connection between the various elements of the system is too episodic or completely absent. Securing the research with data required multiple visits to different institutions that operate with some of the data. Establishing informational connectivity of databases would facilitate research and policy planning within the system.

5. Conclusion

The health system consists of several components, and it is very difficult to achieve the same level of development for each of them. This makes its management even more complicated and is accepted by many authors as part of the country's national and social security (Marinov 2013; Todorova 2022; Shopov 2023). Therefore, such studies are needed that identify specific characteristics related to geographical factors, demographic and settlement characteristics, and others that can determine the right aspects in developing the specific component of the system. This is because the need for health services and health infrastructure is one thing in rural areas with a highly pronounced process of population aging and quite another in rural areas affected by urbanization processes or in areas with pronounced ruralization processes.

The policy for the development of the health system must be uniform in order to guarantee equal access to medical centers and hospital facilities for all citizens. Therefore, the territorial inequality of hospitals and urgent care centers, and therefore the possibility of accessing the services they offer, takes shape as the main problem of health care in the area under study.

The district has a very well-developed healthcare infrastructure and healthcare services, placing it in one of the leading positions in the country. At the same time, very large differences in the territorial organization of the system and in the population's access to the services offered were identified at a local level. There is a disproportion between the two large cities of the district—Kyustendil and Dupnitsa, where most of the medical facilities, offices, pharmacies, etc. are located, and the other settlements of the district. The second disparity manifests itself at the level of municipalities. The municipalities in the central and eastern parts of the district (Fig. 4) have a much more optimal network of

emergency medical care centers than the municipalities in the western and especially the northwestern part.

Although the district has qualified medical staff and beds, there is a problem with the lack of a hospital in the municipality of Bobov Dol, which includes 17 villages with a predominantly elderly population. Healthcare for the population of the municipality is available about 30 km away in the town of Kyustendil. The situation is similar for the population of the municipalities of Treklyno and Nevestino.

Territorial disproportions can also be observed in the spatial location of dental practices and pharmacies, which are located exclusively in the cities of the area studied. There is also an uneven distribution of the children's kitchen service, which is only located in two municipalities where the two largest towns in the district are located, so the number of potential users of the service is the largest, young children. The service is of great importance and helps young families as it provides children with healthy food that meets healthy eating requirements.

The high level of health insurance of the population does not guarantee quick and safe access to emergency centers, hospitals, laboratories, pharmacies, etc. It turns out that more important for receiving health care and services is the level of transport connectivity of the settlements with the centers where all the elements of the health system are located. That is why those parts of the territory that are further away from the health centers, the peripheral rural areas have the highest premature and total mortality. Their aging population has limited access to health services. The policy of disease prevention among the population is also less developed in these territories.

The health system, health services and other related services must be developed so that their organization and capacity are tailored to the needs and characteristics of the population in each area and to the environment in which they live. Increasing attention should be paid to people's needs in the development and planning of health services in order to provide targeted health care.

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Additional information

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.