

# The Analysis of Health Infrastructure in the Public Health System in Romania

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**Abstract:** Public health infrastructure plays a crucial role in the health of a population. The delivery of population health capabilities, such as allocating resources based on a community health plan, analyzing data on preventive services use, and engaging community stakeholders in health improvement planning, is associated with increased public health system strength. Population health approaches, which aim to enhance the health of whole populations, have been successful in improving health outcomes and reducing health inequalities. An effective public health infrastructure is developed through several important factors. Strong institutional capacity, including public health laws that are responsive to contemporary public health issues, a skilled and empowered workforce, and an infrastructure capable of continuous monitoring, are among these important factors. A strong public health infrastructure and the implementation of population health strategies are essential for improving the health of a population. The main objective of this study is to analyze the health infrastructure in Romania's public health systems using a spatial distribution of the number of doctors, hospitals, and hospital beds. The data were collected at the county level using the National Institute of Statistics - Tempo online database for the period 2014-2021. The results reveal disparities in the availability and quality of health infrastructure in different regions. These challenges highlight the need for integrated systems to improve the management strategies or plans for healthcare service allocation, they must ensure fair access and overcome spatial inequities.

**Key words:** Health Infrastructure, Public Healthcare, Healthcare System, Health Planning.  
**JEL:** I18, I15, I10

## 1. Introduction

The population's health should be improved as a health system's main goal. Instead of focusing on healthcare services, which mostly treat the symptoms of illnesses that have already appeared, governments must prioritize disease prevention and health promotion in order to achieve this aim (Brouwer et al., 2006). To put it another way, a successful health system must be focused on promoting public health in order to eradicate disease's fundamental causes and prevent avoidable morbidity and expenses. The common objective of promoting health is advanced when public health and health care are both prioritized and resources are distributed in accordance (Shi, 1995).

Access to healthcare is a fundamental human right that should be enjoyed by every individual at the highest attainable standard (CESCR, 2000). Health is a complex term and can be defined in various ways; the World Health Organization (WHO) defines it as a state of physical, mental, and social well-being (Sherif, 2007). A healthy society can support social and economic development by promoting good mental and physical ability and high social well-being among individuals, leading to their increased productivity and effectiveness.

Economic growth and healthcare have a close association. Governments offer fair and balanced healthcare that satisfies the requirements of all members of society when the rate of economic expansion grows. Economic growth, however, may not always facilitate the provision of equitable healthcare for a variety of reasons, including a lack of available health resources and insufficient preparation and implementation of short- and long-term plans for allocating healthcare services across areas with varying population densities (Drissy, 2015).

Achieving spatial equality in healthcare access requires an understanding of spatial planning and its role in offering an effective and fair healthcare system (Mokgalaka, 2014). Nonetheless, spatial planning refers to a set of techniques employed to deal with the arrangement of individuals and activities in diverse locations and timeframes (Dallhammer et al., 2016).

To be more exact, it is a series of purposeful acts that may be carried out at one or more geographical scales (national, regional, or local) within a defined timeframe. Spatial planning makes use of a variety of techniques and approaches to maximize the long-term utilization of existing natural and human resources. The spatial planning of the healthcare system involves detailed policies for providing healthcare services to individuals, such as programs and projects aimed at achieving optimal health levels for both individuals and society within a specific time period. These policies aim to make optimal use of available materials and human resources (Sherif, 2007).

The healthcare system encompasses organizations, institutions, and resources focused primarily on enhancing public health. Such a system should offer services that meet current and future demands and are equally accessible to all individuals. However, healthcare systems in both developing and developed countries face several issues. The most crucial problem is inadequate utilization and access to healthcare services among certain population groups due to the failure of healthcare service planning to consider the principle of equality. Improving the spatial performance of the healthcare services system in general can be achieved through standards-based spatial planning to address the inequality in the spatial distribution of healthcare services (Sherif, 2007).

## 2. Literature review

One of the service industries where the primary focus is on providing high-quality services is the medical industry. However, sustaining excellence in the new medical contexts is a challenging problem. In the present market context, medical advancements and high-quality treatment are essential, which fuels fierce competition amongst service providers (Moshood et al., 2020).

One of the most complex systems each of us faces in society is the healthcare system (Orr and Sankaran, 2007). Healthcare is a multidisciplinary environment in which physicians, specialists, pathologists, nurses, radiologic technologists, laboratory technicians, social workers, respiratory therapists, psychologists, counselors, pharmacists, and other healthcare professionals make decisions (Schubert et al., 2012).

Hospitals, clinics, clinic administrators, financial managers, pharmaceutical firms, human resources, ministries of health, health insurance companies, activist groups, educational organizations, and research communities comprise the healthcare sector. The increase in chronic diseases is the main driver of healthcare costs.

Monitoring and defending the public's health depend greatly on the health infrastructure. It is made up of reliable information and communication technology (ICT), skilled employees, and efficient organizations (Budillon et al., 2021). Building learning health systems, which include informational, governmental, and cultural infrastructures, is crucial for enhancing health outcomes (Vinson, 2021). Public health and infrastructure policy are intertwined, and making health and well-being the primary considerations when making infrastructure decisions can aid in achieving sustainable development objectives (Harris et al., 2021). The COVID-19 pandemic has brought attention to the necessity for robust and ready health systems that are equipped to identify, monitor, and react to health catastrophes (Dixon and Grannis, 2020). Overall, maintaining the health of all people and communities depends on a robust and resilient health infrastructure.

Infrastructure refers to the internal framework of a system or organization, the "substructure" that supports the "superstructure", and the overall foundation that supports the entire structure. This establishes the system's competence and ability to carry out its fundamental responsibilities and fulfill its core mandates, as well as the commensurate level of care and ease of access to healthcare in society (Okafor, 2020). The World Health Organization (WHO) has advised that the infrastructure for healthcare be "formal and enduring," necessitating a defined strategic emphasis that is sustained throughout time. This is necessary to ensure the delivery of high-quality services. It is expected that formal and long-lasting infrastructure would be sustained and maintained by the government on a regular basis, rather than on an as-needed or fragmented basis.

Both qualitatively and quantitatively, the word "health infrastructure" refers to the level of accessibility and care provided inside a country. It is assessed based on the quality of the physical, technological, and human resources that are accessible at a certain time. Within the healthcare surroundings, physical structure refers to the buildings and other permanent structures like pipe-borne water, excellent access roads, power, and so on, whereas technology refers to the equipment designed expressly for hospital usage, including procedures (Erinosho, 2006). This also includes technological equipment and supplies, whereas human resources are formed up

of healthcare personnel including physicians, pharmacists, nurses, midwives, laboratory techs, administrators, accountants, and other varying staff members. When all of these factors are considered, they provide the framework for healthcare delivery in any society and the factors that determine its infrastructure.

According to Adebayo and Oladeji (2006), the idea of the health system as its entirety includes the health policy, financial allocation, implementation, and monitoring. In terms of diagnosis, treatment, and compliance, this is more comprehensive and larger in concept than a combination of facilities and medical consultation. Additionally, it involves the recipients of healthcare as well as other elements or adjuncts to healthcare delivery.

In addition, according to these all-encompassing requirements, health infrastructure involves individuals, groups, and the legal system working together in a structured manner to mobilize and distribute resources expressly for disease management, sickness prevention, and injury treatment. On the one hand, it can be deduced that the organization of healthcare delivery is closely linked to the caliber of medical staff, effective administration, successful finance, and effective communication.

Because of advances in medical technology and population aging, global healthcare spending as a proportion of gross domestic product (GDP) is often increasing more quickly than total economic growth (Chernew and Newhouse, 2011). The hospital system is a significant factor in rising healthcare expenses and accounts for the majority of health spending in many nations in order to reduce costs and improve the value of health spending, reforms have focused on hospitals (Docteur and Oxley, 2003).

The demographics, medical knowledge, and budgetary restraints all continue to change, forcing public hospital systems to adapt. In general, during the past 20 years, hospitals have grown more effective and cost-conscious, and their role in the wider healthcare system has shrunk. The number of hospitals and hospital beds are on the decline (OECD, 2012).

Hospitals continue to consume a significant percentage of healthcare spending in middle- and low-income nations. Health expenditure has changed, nevertheless, as a result of access to cutting-edge or expensive technology, modifications to institutional structures for the delivery of healthcare, changes in clinical recommendations, and the prevalence of certain diseases. Recent patterns in high-income nations show that inpatient care expenditure - which is mostly supplied in hospitals - represented a lesser proportion of the rise in health spending than in OECD countries with lower incomes. This shows a shift in health spending in wealthy nations from hospitals to other services like long-term care.

### **3. Research methodology**

The purpose of this study is to analyze the health infrastructure in the public health systems in Romania using a spatial distribution of the number of hospitals, number of doctors and the number of hospital beds. The data used are at the county level using the National Institute of Statistics - Tempo online database and several spatial analysis tools were applied to measure the optimal distribution of the number of hospital beds in relation to the Romanian population.

#### **Study area**

The study area is represented by the 42 counties of the 8 development regions of Romania (as shown in Figure 1).

Figure 1: Study area - Romania



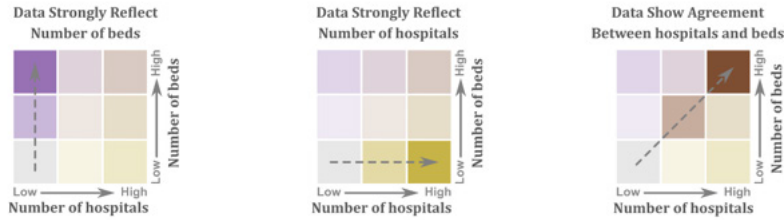
Source: Data provided by <https://www.naturalearthdata.com/>

### Spatial analysis

The data used were distributed over the 42 counties of Romania and a conventional spatial analysis was performed on them. A database was created containing the number of doctors, the number of hospitals, the number of hospital beds and the population at the county level. The spatial analysis was performed on the data sets for the period 2014-2021 as follows: specific intervals were created for each type of data studied and a group of 8 different maps was developed for each type of data, although in the content of the article there are only 3 representative maps: the year 2014 (the first year of the analysis) and the last 2 years - 2020 and 2021 (beginning and period of the pandemic crisis).

The graphical representation method used is called a bivariate choropleth and types of sets have been made. In the first set, the first variable is represented by the number of hospital beds, vertically oriented in the legend (see Figure 2) with values from low to high (up@down), and the second variable is represented by the number of hospitals, horizontally oriented in the legend with values from low to high (left@right). In the second set, the first variable is the number of hospitals, oriented vertically in the legend (see Figure 3) with values from low to high (up@down), and the second variable is the number of doctors, oriented horizontally in the legend with values from low to high (left@right). In the third set, the first variable is the number of hospital beds, oriented vertically in the legend (see Figure 4) with values from low to high (up@down), and the second variable is the number of population, oriented horizontally in the legend with values from low to high (left@right). The aggregation of the variables can be seen in the Data Show Agreement. The color of the map is given by the number of classes resulting from the aggregation of the variables. QGIS (spatial analysis) and Inkscape (vector graphics) were used for the maps.

Figure 2: Bivariate Choropleth map legend for correlating the number of hospitals and the number of beds



Source: Authors' own research contribution

Figure 3: Bivariate Choropleth map legend for correlating the number of hospitals and the number of doctors



Source: Authors' own research contribution

Figure 3: Bivariate Choropleth map legend for correlating the number of hospitals and the number of doctors



Source: Authors' own research contribution

#### 4. Results and discussions

The right to health, as the right to health care, is the most expensive social right in Europe and has a significant financial impact on the budgets of all Member States, whether they have universal health care systems or insurance-based health care systems.

The correlation between the number of hospital beds at the county level and the spatial distribution of hospitals depicts the state of healthcare in Romania (Figure 5). In 2014, Bucharest had the highest number of registered hospitals (50), followed by Cluj and Iași counties, each having



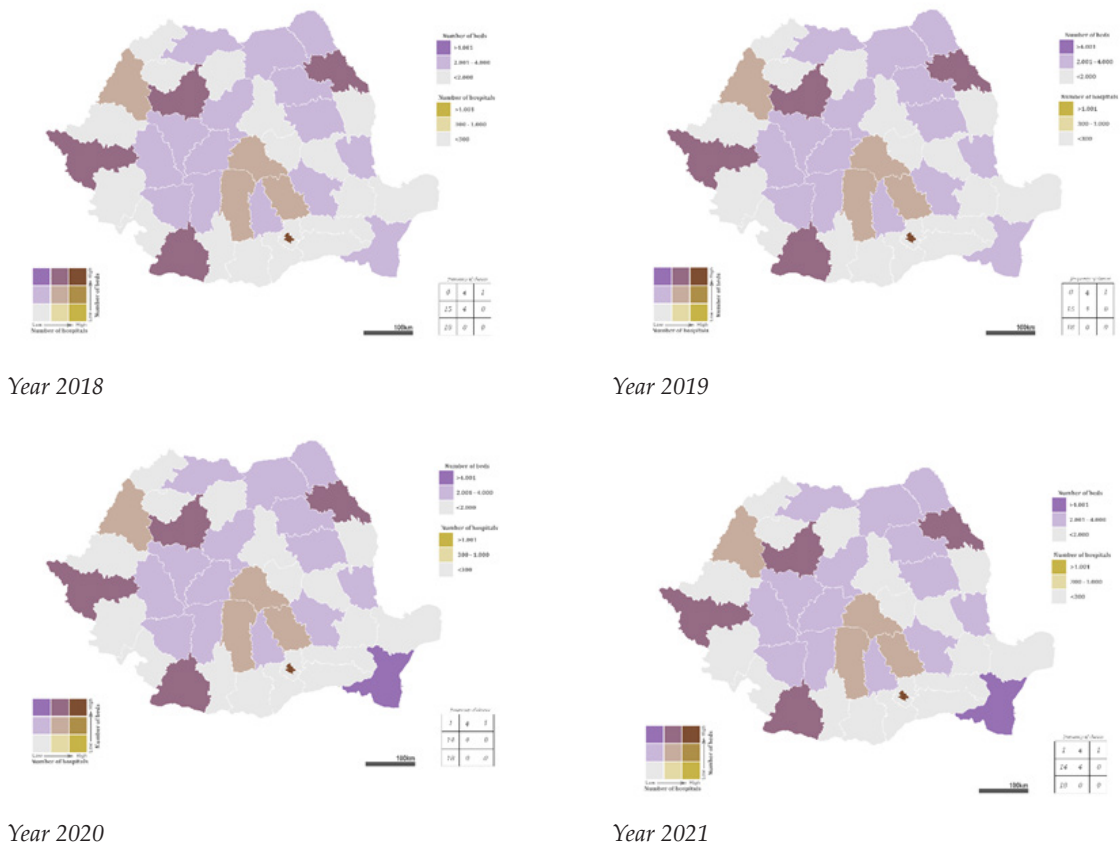
19 hospitals. Prahova County had 16 hospitals, and Arges County had 15 hospitals. As of the end of the analysis period, the situation remained the same. Bucharest has 50 hospitals, while Iasi County, Cluj County, Prahova County, and Arges County each have 19 or 15 hospitals.

In 2014, Bucharest registered the highest number of hospital beds with 19,862, followed by Iasi County with 6,715, Cluj County with 6,392, Timis County with 5,238, and Dolj County with 4,488. In 2021, Bucharest recorded the highest number of hospital beds at 20,447, followed by Iasi County with 6,903 hospital beds, Cluj County with 6,361 hospital beds, Timis County with 5,305 hospital beds, and Dolj County with 4,493 hospital beds. These same counties consistently reported the highest number of hospital beds throughout the analyzed period.

The correlation between the number of hospitals and beds reflects the significant spatial regions and the changes in the indicators over time.

Figure 5: Spatial distribution of the number of hospitals and the number of beds per county in Romania for the period 2014-2021



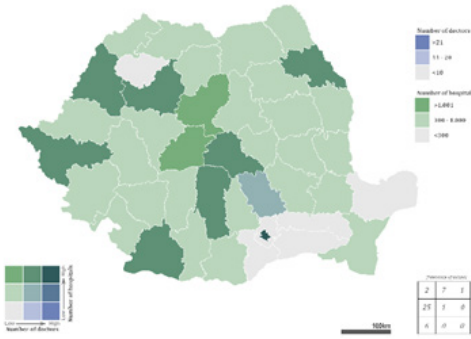


Source: Data provided by the National Institute of Statistics (INS)

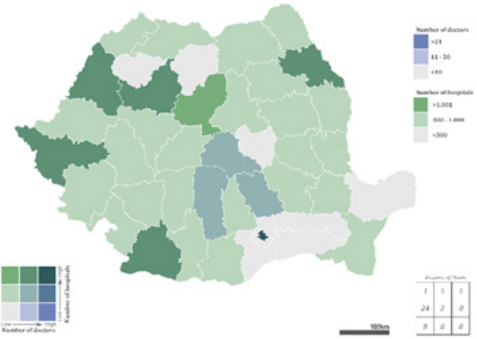
The distribution of doctors throughout the country is noteworthy (Figure 6). In the initial year of analysis, it was found that the regions with the most doctors are as follows when viewed spatially: In 2021, Bucharest has 11,034 doctors followed by Cluj County with 3,674 doctors, Iasi County with 3,688 doctors, Timiș County with 3,324 doctors, and Mures County with 2,330 doctors. Previously, Bucharest had 7,076 doctors and Cluj County had 2,891 doctors, while Iasi County, Timiș County, and Dolj County had 2,779, 2,304, and 2,143 doctors, respectively.

There are remarkable spatial patterns as well as temporal shifts in the correlation between the number of hospitals and the number of doctors.

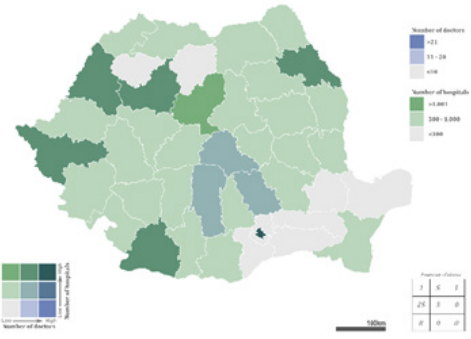




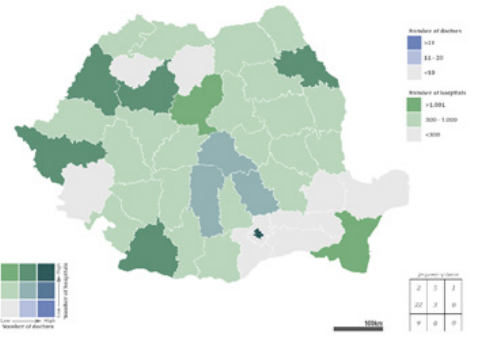
Year 2014



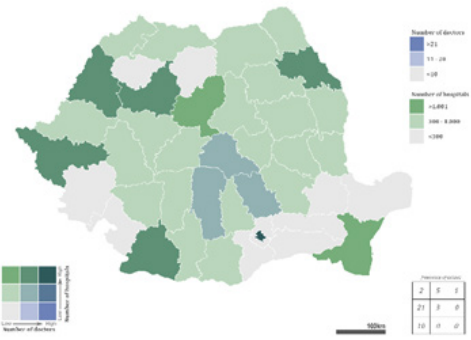
Year 2015



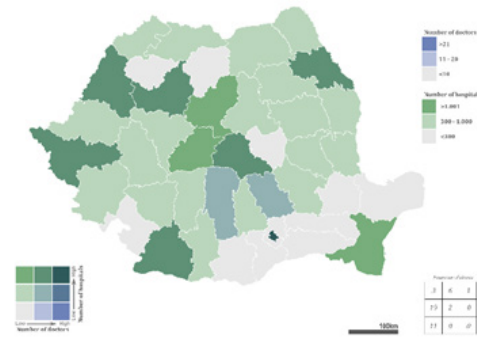
Year 2016



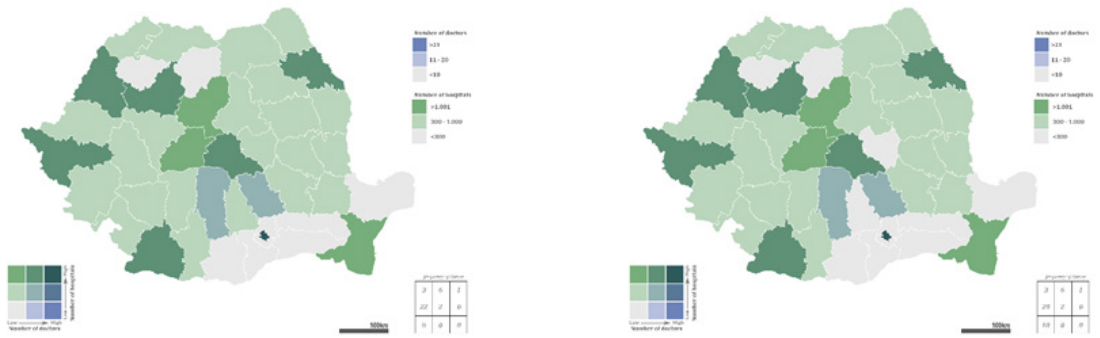
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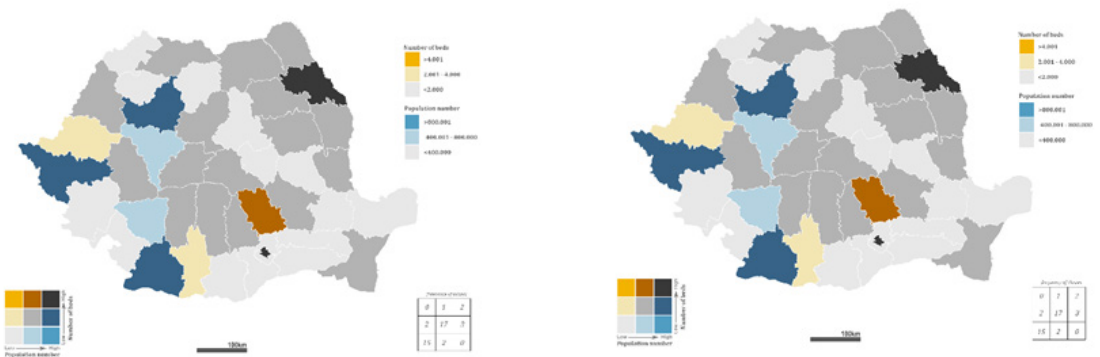
Year 2021

Source: Data provided by the National Institute of Statistics (INS)

Correlating the spatial distribution of hospital beds with the national population presents a controversial situation (Figure 7).

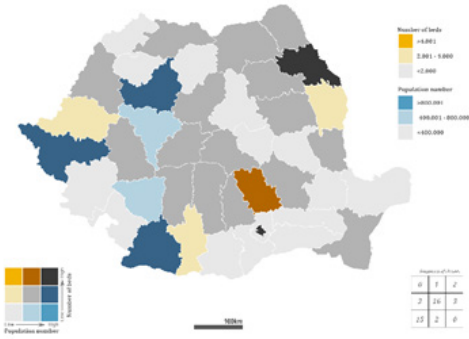
There are regions with inadequate hospital bed coverage, causing issues within the health-care system. Significant bed numbers are located within Bucharest Municipality, Iasi County, Cluj County, Timis County, and Dolj County in both 2014 and 2021. The most populated areas, including Bucharest Municipality, Iasi County, Prahova County, Suceava County, and Constanta County, also have large agglomerations.

Figure 7: Spatial distribution of the number of beds and population number per county in Romania

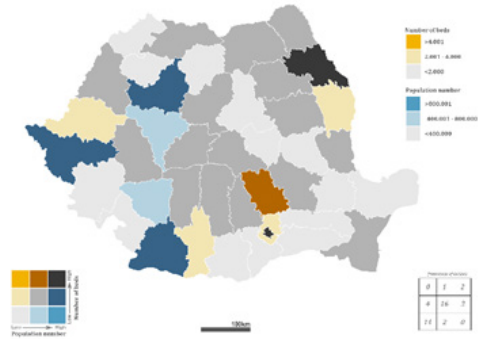


Year 2014

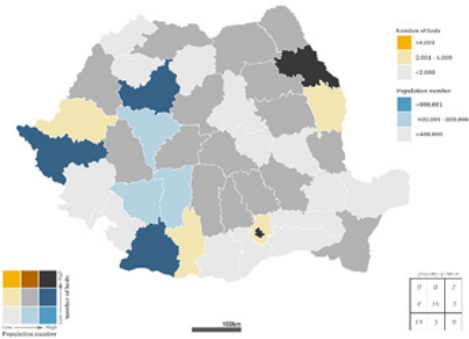
Year 2015



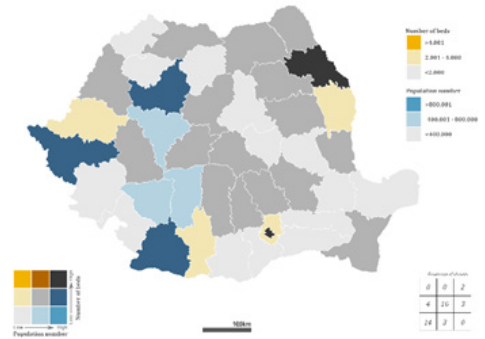
Year 2016



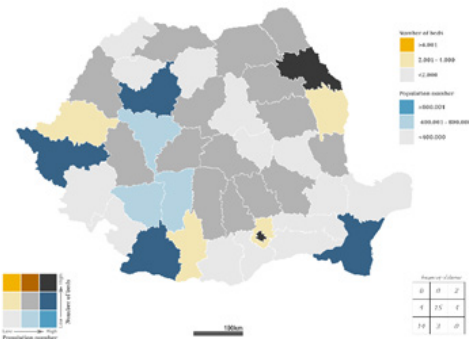
Year 2017



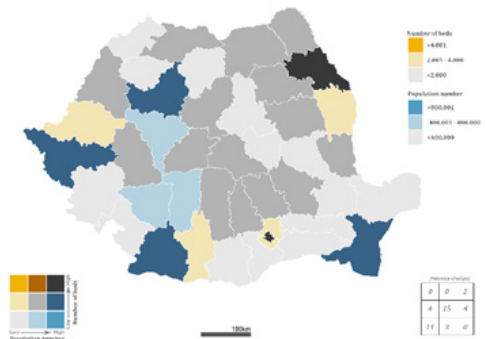
Year 2018



Year 2019



Year 2020



Year 2021

Source: Data provided by the National Institute of Statistics (INS)

To make health infrastructure more equitable and accessible, there is a need to focus on interactions across urban and rural areas, addressing trade-offs and synergies, decision-making, institutional arrangements, and effective co-production of knowledge (Pearsall et al., 2021). The decentralization mechanism should be implemented to synergize healthcare across states and ensure equal distribution of physical health infrastructure and public health resources (Rymbai and Thangkhiew, 2022). A multidimensional and complex public health infrastructure is required to achieve health equity, which should be responsive to current and emerging priorities and capable of providing the foundation for health initiatives (Dean et al., 2016). Infrastructure should integrate hospitals into the broader healthcare system, promoting accessibility and societal buy-in, and supporting effective health promotion, prevention, and self-care for the whole population (Luxon, 2015).

Hospitals face the challenge of reducing their expenses while the demand for healthcare services continues to rise. To maintain a high quality of care, entities are consistently searching for chances to decrease their costs and enhance their operational efficiency (Rais and Viana, 2011; Yanamandra, 2018). Hospitals receive and handle a wide range of goods that are directly related to patient care, such as pharmaceutical products, medical consumables, sterile items, blood, laboratory samples, food, and linen (Landry and Beaulieu, 2013; Volland et al., 2017).

## 5. Conclusions

The healthcare system is made up of different components, such as infrastructure, medicines, medical products, financing, and human resources for health. According to general consensus, effective leadership and governance are critical and relevant to address these factors, including the interaction between different components.

Health infrastructure plays a crucial role in improving health system performance and child health outcomes. Studies have shown that different types of infrastructure, such as transport, electricity, and ICT, have a significant positive impact on population health outcomes, including reducing under-five mortality and improving maternal and infant health (Osakede, 2022; Gillani, 2022). However, there are disparities in the availability and quality of health infrastructure across different regions. The COVID-19 pandemic has further highlighted the weaknesses in public health infrastructure, emphasizing the need for targeted implementation of high-value population health capabilities to strengthen the public health system and improve health outcomes (Hogg-Graham, 2022).

Improving health infrastructure in developing countries faces several key challenges. Limited health care facilities and high population densities contribute to healthcare access issues, exacerbated by manual processes and affordability concerns. The COVID pandemic has further overwhelmed already scarce health systems, particularly impacting the poor and vulnerable members of society. However, the pandemic also presents an opportunity to utilize information technology to enhance access to healthcare services, considering the high penetration of mobile technology in developing countries. Additionally, the quality of health services in many developing countries is poor, with weak incentives for public sector health workers. Reforms that

strengthen incentives show promise, but institutional details are crucial. The number of hospitals and doctors are the main indicators of accessibility. Traditionally, the number of hospitals and beds have been the main capacity indicators for healthcare organizations.

Life expectancy is increasing, technology is developing, and the availability of treatments is growing quite quickly. Health should be seen as an investment in both society and the economy, a driver of growth for circular prosperity between technology suppliers (companies), the use of technical devices during an emergency and routine care (hospitals and medical professionals), and the benefit of those (the patients).

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