Spatial Characteristics of Healthcare Provision in the Fergana Region

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Abstract

This study examines the territorial distribution of healthcare resources in the Fergana Region of Uzbekistan. Statistical and comparative analyses assess population distribution, age composition, healthcare facilities, physicians, and hospital beds. The findings indicate uneven resource distribution across cities and districts, with substantial concentration in major urban centres. Recommendations emphasise strengthening primary care and aligning workforce allocation with population needs. Resource availability is distinguished from access to care, as patient flows, travel times, costs, and service quality were not measured. The findings offer a preliminary basis for regional healthcare planning, subject to verification of measurement units and alignment of reporting periods.

Keywords

Fergana, healthcare, population, accessibility, physicians, hospitals, disparities, distribution, equity, infrastructure.

Introduction. The rational spatial organization of healthcare services is of considerable importance for safeguarding population health. The location of healthcare facilities, the availability of qualified medical personnel, and transport accessibility largely determine the population's ability to obtain timely medical care. Therefore, examining the spatial distribution of healthcare services and urban–rural disparities in the Fergana Region is particularly relevant for promoting more equitable access to healthcare services.

Review of the Research Problem. Adapting the scientific and methodological

approaches developed in international studies to the assessment of the spatial characteristics of healthcare provision in the Fergana Region is of particular importance. Studies by Hashtarkhani et al. [1], Wood et al. [2], and Pu [3] place particular emphasis on evaluating the spatial availability of healthcare services, the adequacy of healthcare resources, and the equity of their distribution.

These approaches can be applied across the districts and cities of the Fergana Region by calculating the number of physicians, mid-level healthcare personnel, hospital beds, and healthcare facilities per 10,000 inhabitants and identifying disparities among different territories. Such indicators provide a quantitative basis for assessing differences in healthcare provision and determining areas that are comparatively underserved.

The comparative approach to assessing spatial inequality employed by Giraudy and Pribble [4] can also be adapted to the Fergana Region. In particular, it provides a methodological basis for comparing the level of healthcare provision in the cities of Fergana, Kokand, Margilan, and Kuvasay with that of the rural districts of the region, thereby enabling the identification of urban–rural disparities in access to healthcare resources and services.

The methods used by He et al. [5] and Raeesi et al. [6] to assess the spatial accessibility and equity of healthcare services can be adapted to examine the population's access to healthcare facilities in the Fergana Region based on distance and travel time. In particular, assessing access to healthcare services for settlements located far from major urban centres can help reveal spatial disparities in healthcare accessibility. Drawing on the approach proposed by Hierink et al. [7], the effects of distance to healthcare facilities and travel time on timely access to medical care can also be evaluated.

The principles developed by Pan et al. [8] and Wang et al. [9] for the rational location of healthcare facilities and the spatial optimisation of healthcare resources can provide an important methodological basis for assessing the existing spatial structure of

healthcare infrastructure in the Fergana Region. This approach makes it possible to identify districts with relatively large populations but comparatively low levels of provision with physicians or hospital beds and to classify them as priority areas for healthcare development. Furthermore, the integrated approach proposed by Chen et al. [10] can be used to assess the interrelationships among population distribution, healthcare resources, and transport infrastructure. Based on the results, the districts and cities of the Fergana Region can be classified into areas with high, medium, and low levels of healthcare provision.

In Uzbekistan, Ahmedov et al. (2007) analysed the national healthcare system and identified disparities in healthcare financing across regions, shortages of medical personnel in rural healthcare facilities, and financial barriers to accessing healthcare services. Their findings provide an important theoretical and methodological basis for examining the spatial distribution of healthcare facilities, the availability of medical personnel, and urban–rural disparities in the Fergana Region.

Materials and Methods. The study is expected to use data from the National Statistics Committee of the Republic of Uzbekistan, the Fergana Regional Department of Statistics, and regional healthcare authorities. The spatial scope of the study covers the districts and cities of the Fergana Region, while the initial and final years of the study period will be determined according to data availability. The principal indicators include the number of healthcare facilities and the provision of physicians, mid-level healthcare personnel, and hospital beds per 10,000 inhabitants.

Comparative geographical and statistical methods will be employed to identify disparities among districts and cities, while dynamic analysis will be used to assess changes in the selected indicators over time. Districts and cities will be compared by calculating the ratio of their healthcare provision indicators to the regional average. The results will reflect the spatial distribution of healthcare resources and territorial

accessibility. Conclusions regarding the quality of healthcare services or the actual level of healthcare utilisation by the population will be drawn only where supported by additional empirical evidence.

Research Results. The demand for healthcare services is closely associated with the demographic structure and spatial distribution of the population. Population size, density, and age composition determine both the scale and structure of demand for healthcare services. As of 1 January 2026, the population of the Fergana Region was 4,223,044. Based on this population figure and the region's area of 6.76 thousand km² as of the beginning of 2025, the estimated population density was approximately 624.7 persons per km².

Considerable spatial disparities were observed across the region. The estimated population density in the Tashlak and Uchkuprik districts was 942.4 and 933.8 persons per km², respectively, whereas in the Besharik District it was substantially lower, at 326.4 persons per km².

In terms of age structure, 34.9% of the population was under 18 years of age, while 10.6% was aged 60 years and older. This demographic profile highlights the need to ensure adequate provision of paediatric and preventive healthcare services, as well as services tailored to the needs of older adults. At the same time, in densely populated areas, the capacity of healthcare facilities should be aligned with population size to ensure that healthcare infrastructure adequately responds to local demand.

Spatial and Demographic Indicators of the Fergana Region

Territory	**Area, km²**	**Population, persons**	**Population density, persons/km²**	**Age 0–17, %**	**Age 18–59, %**	**Age 60+, %**
Fergana Region	6,760	4,223,044	624.7	34.9	54.5	10.6
Fergana city	110	335,087	3,046.2	29.7	58.9	11.4

Kokand city	60	319,611	5,326.9	34.1	54.6	11.2
Kuvasay city	260	104,832	403.2	32.8	55.2	12.0
Margilan city	50	261,948	5,239.0	35.0	54.5	10.5
Altiarik District	630	237,263	376.6	34.3	55.5	10.2
Kushtepa District	370	217,765	588.6	36.1	54.5	9.4
Bagdad District	340	243,006	714.7	35.9	52.8	11.2
Buvayda District	280	258,244	922.3	36.8	53.4	9.8
Besharik District	770	251,311	326.4	35.8	54.3	9.8
Kuva District	440	285,386	648.6	34.1	56.0	9.9
Uchkuprik District	270	252,138	933.8	36.8	52.7	10.5
Rishtan District	310	225,158	726.3	34.7	55.0	10.3
Sokh District	220	88,652	403.0	36.5	54.8	8.7
Tashlak District	240	226,175	942.4	35.3	54.0	10.6
Uzbekistan District	670	244,968	365.6	35.3	53.0	11.6
Fergana District	590	230,196	390.2	35.4	53.7	10.9
Dangara District	430	184,682	429.5	36.9	51.5	11.6
Furkat District	310	132,231	426.6	35.0	53.0	12.0
Yazyavan District	410	124,391	303.4	35.8	55.6	8.6

Of the 245 hospitals in the Fergana Region, 69 were located in the city of Fergana and 26 in Kokand. Together, these two urban centres accounted for 38.8% of all hospitals in the region. They also accounted for 40.6% of the total number of hospital beds reported in the available dataset, indicating a concentration of inpatient healthcare resources in major urban centres. However, since hospitals may also serve patients from surrounding districts and other areas, their spatial distribution should be assessed in conjunction with patient flows and service catchment areas. In addition, the apparent inconsistency between the unit of measurement indicated as “thousand” in the hospital-bed dataset and

the values reported as whole numbers should be clarified before these figures are interpreted as absolute numbers.

Access to healthcare services among urban and rural populations in the Fergana Region is influenced by the spatial distribution of healthcare facilities, transport accessibility, the availability of medical personnel, and the socioeconomic conditions of the population. In urban areas, the closer proximity of healthcare facilities may facilitate both access to services and the ability to choose among providers; however, waiting times and healthcare-related costs may still restrict utilisation. In rural areas, greater travel distances, irregular transport services, and shortages of healthcare personnel may create additional barriers to obtaining timely medical care.

Therefore, the spatial accessibility of healthcare services should be assessed not only in terms of the physical availability of healthcare facilities but also by considering whether the population can reach these facilities in a timely manner, afford the associated costs, and obtain care appropriate to their healthcare needs. These dimensions represent key criteria for evaluating territorial accessibility and identifying urban–rural disparities in healthcare provision.

In 2025, the number of physicians in the Fergana Region reached 9,856, representing an increase of 44.0% compared with 2011 and 5.5% compared with 2024. However, medical personnel were unevenly distributed across the region. The city of Fergana had 3,259 physicians, followed by Kokand with 1,064, Margilan with 499, and Kuvasay with 184. Although these four administratively separate cities accounted for approximately 24.2% of the region’s total population, they accommodated 50.8% of all physicians. Based on the population as of the beginning of 2026, there were 97.3 physicians per 10,000 inhabitants in the city of Fergana and 33.3 in Kokand, compared with the regional average of 23.3 physicians per 10,000 inhabitants. These figures indicate a marked concentration of medical personnel in major urban centres. However, this pattern should

be interpreted with caution, as healthcare facilities located in these centres may also serve patients from surrounding districts and other parts of the region.

Overall, 43.3% of the Fergana Region's population resides in rural areas. The proportion of the rural population reaches 80.7% in Uchkuprik, 77.9% in Dangara, and 76.3% in Tashlak. These districts have 15.0, 16.9, and 12.9 physicians per 10,000 inhabitants, respectively, all of which are below the regional average. Physician availability is even lower in Kuva and Kushtepa, at 11.7 and 12.7 physicians per 10,000 inhabitants, respectively. These findings indicate that in predominantly rural districts, the availability of medical personnel should be assessed in conjunction with the population's spatial accessibility to healthcare services.

The spatial distribution of public and private healthcare facilities in the Fergana Region should also be evaluated in relation to population density, the urban–rural composition of the population, and demand for healthcare services. In major cities such as Fergana, Kokand, and Margilan, population concentration and relatively well-developed infrastructure may create favourable conditions for the expansion of private healthcare services. In contrast, in districts with a high proportion of rural residents, such as Uchkuprik, Dangara, and Tashlak, the spatial coverage of public healthcare facilities and their proximity to the population are particularly important for ensuring access to essential medical care.

For the preliminary classification of the districts and cities of the Fergana Region according to physician availability, the number of physicians per 10,000 inhabitants was used as the principal indicator. Relative to the regional average of 23.3 physicians per 10,000 inhabitants, values below 75% of the regional average were classified as "relatively low," values ranging from 75% to 125% as "medium," and values exceeding 125% as "relatively high." These thresholds represent operational criteria established specifically for the purposes of this study.

Level of Physician Availability	Physicians per 10,000 Population	Territories
Relatively high	More than 29.2	Cities of Fergana and Kokand
Medium	17.5–29.2	Cities of Margilan and Kuvasay; Fergana and Furkat districts
Relatively low	Less than 17.5	Altiarik, Bagdad, Besharik, Buvayda, Dangara, Kuva, Kushtepa, Rishtan, Sokh, Tashlak, Uzbekistan, Uchkuprik, and Yazyavan districts

This classification reflects the level of physician availability. However, a comprehensive assessment of healthcare provision should also take into account the availability of hospital beds, the capacity of outpatient facilities, and the spatial accessibility of healthcare services. The calculations were performed by interpreting the 2025 physician data as absolute numbers of physicians and relating these figures to the population as of the beginning of 2026.

Conclusion and Recommendations. The principal geographical characteristic of healthcare provision in the Fergana Region is the relatively extensive distribution of outpatient facilities across the districts, accompanied by the concentration of physicians and inpatient healthcare resources in several major urban centres. Population-adjusted indicators reveal substantial spatial disparities; however, they do not directly reflect the quality of healthcare services or the actual level of healthcare utilisation by the population. Therefore, the classification based on physician availability should be regarded as a preliminary assessment rather than a comprehensive measure of overall healthcare provision.

Identifying the factors underlying the relatively low level of physician availability in the Kuva, Kushtepa, and Tashlak districts should be considered a priority. This requires an assessment of existing staffing levels, vacant positions, physicians' workloads, and patterns of healthcare utilisation outside residents' districts of residence. Once settlements with limited transport accessibility have been identified, appropriate interventions should be selected according to local conditions. These may include the provision of mobile healthcare services, improvements in transport connectivity, or the expansion of the capacity of nearby healthcare facilities.

The demand for healthcare personnel should be determined on the basis of population size, age structure, morbidity patterns, and the actual catchment areas of healthcare facilities. In reallocating healthcare resources, particular attention should be paid to strengthening primary healthcare services in the districts while maintaining the interdistrict and regional service functions of major urban healthcare centres. Measures aimed at attracting and retaining healthcare professionals should be based on a systematic assessment of staff vacancies and working conditions.

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