

CARDIOVASCULAR DISEASE DYNAMICS AND STRUCTURAL CAPACITY OF CARDIOLOGY SERVICES IN THE ALMATY REGION: IMPLICATIONS FOR RURAL HEALTH POLICY

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Abstract

Relevance. Cardiovascular diseases remain a major public health challenge. In predominantly rural regions, the geographical distribution of healthcare resources may limit access to specialist care.

Objective. To assess trends in registered cardiovascular morbidity and cardiology service capacity in the Almaty Region and estimate cardiologist workforce requirements for 2026.

Materials and methods. A retrospective population-based analytical study used aggregated administrative data. Regional morbidity was assessed for 2019–2024; territorial morbidity, workforce, and bed capacity for 10 territorial units during 2022–2024; and urban and rural hospitalizations for 2022–2025. Surgical and high-technology care indicators were assessed for the available periods. Analyses included descriptive statistics, coefficients of variation, and Pearson correlations. Workforce requirements were estimated using the 2024 dispensary-registered patient population, annual growth, and a planning assumption of one cardiologist per 2,000 patients.

Results. Regional registered cardiovascular morbidity increased from 2,319.7 to 2,497.3 per 100,000 population (+7.7%), with the largest increase observed for ischemic heart disease. In 2024, the mean rate across the 10 territories was 5,101.4 per 100,000, with a coefficient of variation of 65.3%. Rural hospitalizations increased from 1,756 to 2,325 (+32.4%). None of the three correlations reached statistical significance ($p > 0.05$). The projected requirement for 2026 was 84 cardiologists compared with 71 reported in 2024, yielding a net model-based gap of 13.

Conclusions. Registered cardiovascular morbidity increased, and substantial territorial variability was observed. Correlations remain exploratory. The workforce projection is a planning estimate rather than a confirmed future shortage. Further assessment of workforce distribution, referral pathways, and access to specialist care is warranted.

Keywords: Cardiovascular Diseases; Rural Health Services; Health Workforce; Health Resources; Hospitalization; Kazakhstan.

Introduction

Cardiovascular diseases (hereinafter – CVD) remain the leading cause of death globally. An estimated 19.8 million people died from CVD in 2022, representing approximately 32% of all global deaths, and more than three quarters of CVD

deaths occurred in low- and middle-income countries [1; 2]. These figures underline the importance of health-system capacity, early detection, timely treatment, and continuity of cardiovascular care, particularly in settings with geographically dispersed populations.

In Kazakhstan, CVD remains a major public health challenge [3; 4]. Mortality from diseases of the circulatory system decreased from 178.9 per 100,000 population in 2016 to 163.1 per 100,000 in 2019, but increased during the COVID-19 pandemic to 193.8 in 2020 and 226.9 in 2021 [4]. These changes highlight the sensitivity of cardiovascular health outcomes and service delivery to system-level disruptions.

Geographic variation in healthcare provision is an important consideration in cardiovascular care. Rural populations may experience longer travel distances to specialized facilities, fewer specialist services, and differences in the availability of diagnostic, treatment, and rehabilitation resources [2; 5; 6]. Such structural differences may influence the delivery and detection of cardiovascular care. However, differences in registered morbidity should not be interpreted as differences in underlying disease burden alone, because observed rates may also be affected by case detection, registration practices, referral patterns, and local healthcare capacity.

Evidence from Kazakhstan demonstrates substantial variation in cardiovascular indicators between urban and rural populations. Analysis of official health statistics for 2006-2020 identified differences in the incidence of arterial hypertension, ischemic heart disease, acute myocardial infarction, and cerebrovascular disease between urban and rural populations, as well as marked regional variation [7]. A subsequent analysis of outpatient registry data from the northern regions of Kazakhstan reported increasing numbers of patients with chronic CVD in both urban and rural areas during 2015-2020 [8]. These findings indicate that geographic context is relevant to cardiovascular epidemiology and to the organization of outpatient care.

The broader Central Asian region also continues to experience a substantial cardiovascular burden, with differences in epidemiological patterns and health-system conditions across countries [9]. In Kazakhstan, successive national health programmes have emphasized population health improvement, primary healthcare development, prevention of noncommunicable diseases, and access to medical services, including the *Salamatty Kazakhstan* programme for 2011-2015, the *Densaulyk* programme for 2016-2019, and the National Project *Quality and Accessible Healthcare for Every Citizen* “*Healthy Nation*” for 2021-2025 [10-12]. These policy measures provide an important context for assessing

changes in cardiovascular morbidity and the organization of specialized services at the regional level.

Approximately 37.8% of Kazakhstan’s population lived in rural areas at the beginning of 2024 [13]. This demographic structure makes the territorial organization of specialized cardiovascular care particularly relevant in regions where settlements are widely dispersed. In such settings, the distribution of cardiologists, inpatient capacity, referral pathways, and advanced cardiovascular procedures may differ substantially between territorial units. Previous studies in Kazakhstan have examined cardiovascular epidemiology, urban-rural differences, and selected components of cardiovascular care [3; 7; 8], but integrated regional assessments combining morbidity, specialist workforce, inpatient capacity, hospital utilization, and cardiovascular procedures remain limited.

Therefore, this study aimed to assess registered cardiovascular morbidity dynamics in the Almaty Region during 2019-2024; characterize inter-district variability in cardiovascular morbidity, cardiology workforce, and inpatient capacity during 2022-2024; describe cardiovascular hospitalizations by urban and rural residence during 2022-2025; characterize regional cardiovascular procedures and cardiac surgical hospitalizations among rural residents using the corresponding available administrative periods; and estimate cardiologist workforce requirements to 2026 using a scenario-based planning approach.

Materials and Methods

Study design

This retrospective population-based analytical study assessed registered cardiovascular disease morbidity and the structural capacity and utilization of cardiology services in the Almaty Region, Kazakhstan. The analysis integrated epidemiological indicators with information on specialist workforce, inpatient bed capacity, cardiovascular hospitalizations, cardiac surgical hospitalizations, interventional procedures, and high-technology cardiovascular care.

Different indicators were analyzed over the periods for which comparable administrative data were available. Regional CVD morbidity was assessed for 2019-2024. Inter-district CVD morbidity, cardiologist workforce, and inpatient bed indicators were analyzed for 2022-2024. Cardiovascular hospitalizations by urban and rural residence were analyzed for 2022-2025. Regional interventional cardiovascular

procedures were assessed for 2023-2025, while cardiac surgical hospitalizations and high-technology cardiovascular procedures among rural residents were assessed for the corresponding periods available in the administrative records. Workforce projection used 2024 as the baseline year and estimated cardiologist requirements for 2026. Analyses based on territorial units were ecological; no individual-level clinical outcomes were evaluated.

Study setting and population

The study focused on cardiovascular morbidity and cardiology service capacity in the predominantly rural Almaty Region of Kazakhstan, with particular attention to rural residents and territorial differences in access to and provision of cardiology care. According to official administrative and population statistics, the Almaty Region had a population of 1,531,167 as of January 1, 2024. Rural residents accounted for 83.8% of the population (1,283,648), while 16.2% (247,519) lived in urban settlements. The region covers approximately 105,090 km², corresponding to an average population density of approximately 14.6 persons per km². The region includes geographically dispersed settlements, including mountainous and remote areas.

For the inter-district analysis, the study population comprised 10 territorial units: nine administrative districts and Konaev city. These units were selected because comparable district-level data on CVD morbidity, cardiologist workforce, and hospital-bed capacity were available for the 2022-2024 analytical period. Other urban administrative units were not included in the district-level models because they did not form part of the comparable territorial dataset used for these analyses.

The epidemiological population denominator was the corresponding population of each territorial unit and study year. Regional morbidity rates were calculated using the population of the Almaty Region for the respective year. District-level morbidity rates were based on the number of registered CVD cases in the corresponding territorial unit divided by the respective population and expressed per 100,000 population.

Hospitalization analyses were stratified according to the recorded residence of patients as urban or rural. Procedural analyses of high-technology cardiovascular care specifically concerned rural residents referred to tertiary centers, whereas regional interventional procedure statistics represented the

corresponding administrative service volume and were not restricted to rural residents.

Data sources and data extraction

Data were obtained from official aggregated administrative and statistical records provided by the Almaty Regional Health Department and participating healthcare organizations. The analysis used annual healthcare statistical reporting and administrative records relevant to morbidity, hospital activity, medical workforce, healthcare organization, and cardiovascular procedures.

The principal sources included:

- Form 15 – annual report on diseases registered among the population served by healthcare organizations and on patients under dispensary observation;
- Form 16 – annual report on patients discharged from inpatient care, including hospitalization-related indicators;
- Form 17 – annual report on medical and pharmaceutical personnel, used to identify the number and territorial distribution of cardiologists;
- Form 19 – annual report on healthcare organizations and their activities;
- Form 26 – annual report on the network and activities of healthcare organizations;
- regional administrative records on cardiovascular morbidity and dispensary registration;
- district-level workforce records;
- hospital-bed capacity records, including cardiology beds;
- administrative records on cardiovascular hospitalizations;
- records of interventional cardiology, cardiac surgery, and high-technology cardiovascular procedures.

Forms 15, 16, 17, 19, and 26 were used for the corresponding reporting years covered by the study indicators (2019-2025). Regional and district administrative records were obtained for the same reporting periods as specified for each indicator. Data extraction was performed in January 2026 from the administrative datasets available at the Almaty Regional Health Department and participating healthcare organizations. All data were analyzed in aggregated form. No names, personal identification numbers, medical record numbers, or other individual-level identifiers were accessed.

Study variables and operational definitions

The study variables were grouped into epidemiological, healthcare capacity, service-utilization, and derived analytical indicators.

Epidemiological indicators included:

- total registered CVD morbidity rate per 100,000 population;
- registered hypertension morbidity rate per 100,000 population;
- registered ischemic heart disease morbidity rate per 100,000 population;
- acute myocardial infarction incidence per 100,000 population;
- cerebrovascular disease morbidity rate per 100,000 population;
- district-level registered CVD morbidity rates per 100,000 population.

The term registered morbidity was used throughout the analysis to distinguish administrative case-registration indicators from the underlying population prevalence or incidence of disease. The recorded rate may be influenced by case detection, registration practices, referral patterns, and health-care utilization.

Because the analytical file contained aggregated reporting indicators rather than individual diagnosis records, diagnostic groupings were analyzed as reported in the source administrative forms. Total CVD morbidity and diagnosis-specific indicators were not treated as mutually additive, and category-specific rates were not summed to reconstruct the total CVD rate. The aggregate dataset did not permit patient-level deduplication across coexisting diagnoses, and no patient-level ICD-10 recoding was performed.

Healthcare capacity indicators included:

- number of practicing cardiologists by territorial unit;
- cardiologist density per population;
- number of registered CVD patients under dispensary observation;
- number of registered dispensary patients per cardiologist;
- total inpatient bed capacity per 10,000 population;
- cardiology bed capacity, both in absolute numbers and per 10,000 population;
- proportion of cardiology beds among total inpatient beds;

Service-utilization indicators included:

- total cardiovascular hospitalizations;
- planned and emergency cardiovascular hospitalizations;
- bed-days;
- mean length of hospital stay;

- cardiac surgical hospitalizations;
- coronary stenting;
- percutaneous transluminal coronary angioplasty (PTCA);
- coronary angiography;
- coronary artery bypass grafting (CABG);
- valve surgery, including aortic valve replacement/transcatheter aortic valve implantation where specified in the administrative records;
- device implantation;
- radiofrequency ablation;
- other recorded cardiovascular procedures.

For Table 7, cardiovascular hospitalizations represent all recorded cardiovascular inpatient episodes classified by urban or rural residence. For Table 8, cardiac surgery refers only to inpatient episodes recorded as cardiac surgical care among rural residents at regional and metropolitan referral institutions. The two tables therefore represent different service categories and were not treated as components of a single arithmetically additive total.

For Tables 9 and 10, procedural counts were treated as procedure episodes recorded in administrative statistics. They were not interpreted as unique patients unless explicitly specified by the source data.

Derived indicators included the standard deviation (hereinafter – SD), coefficient of variation (hereinafter – CV), Pearson correlation coefficient (r) and projected cardiologist workforce requirements.

The coefficient of variation was calculated as:

$$CV(\%) = \frac{SD}{Mean} \times 100$$

For descriptive interpretation, CV values below 20% were considered low, 20–40% moderate, and >40% high variability.

Data quality and comparability assessment

Before statistical analysis, the administrative datasets were reviewed for comparability across study years and territorial units. The assessment included verification of:

1. consistency of territorial boundaries and territorial-unit names across years;
2. consistency of indicator definitions and measurement units;
3. consistency of population denominators used for rate calculations;
4. correspondence between absolute numbers and population-standardized rates;

5. consistency between regional and territorial totals where both were available;

6. continuity of reporting for workforce, hospital-bed, hospitalization, and procedural indicators;

7. identification of unusually large year-to-year changes requiring cautious interpretation.

Large changes in recorded morbidity or service activity were not automatically interpreted as epidemiological changes. Where substantial fluctuations were observed, possible contributions from differences in case detection, registration, referral patterns, reporting completeness, or administrative coding were considered.

The analysis therefore distinguished observed changes in registered administrative indicators from changes that could be interpreted as changes in the underlying population disease burden.

District-level comparisons were restricted to the same 10 territorial units for 2022-2024. The longer 2019-2024 regional series was analyzed at the aggregate regional level; possible effects of administrative-territorial reorganization on year-to-year comparability were therefore treated as a limitation and were not interpreted as epidemiological change.

Statistical analysis

Descriptive statistics were used to summarize annual morbidity trends, inter-district variation, healthcare capacity, hospitalization activity, and cardiovascular procedures. Rates were expressed per 100,000 population for morbidity indicators and per 10,000 population for hospital-bed availability, as appropriate. Absolute numbers were retained for hospitalizations, cardiologist workforce, and cardiovascular procedures.

Inter-district variability was assessed using the mean, standard deviation, and coefficient of variation. The CV was used to characterize the relative degree of dispersion across the 10 territorial units.

Pearson correlation analysis was specified for three territorial-level relationships:

1. cardiologist density and recorded district-level CVD morbidity;

2. population density and cardiologist density;

3. population density and hospital-bed availability.

For each correlation, the Pearson correlation coefficient (r), two-sided p -value, and 95% confidence interval (95% CI) were calculated. Correlation coefficients were interpreted descriptively as weak (<0.30), moderate ($0.30-0.70$), or strong (>0.70). Given the small number of territorial units ($n=10$)

and the substantial dispersion of several indicators, correlation findings were interpreted cautiously. Associations with p -values >0.05 were not considered statistically confirmed and were described only as observed directional patterns.

Given the small number of territorial observations ($n=10$), multivariable regression was not retained in the final analysis because stable adjusted estimates could not be supported reliably. Inferential territorial analysis was therefore limited to the pre-specified Pearson correlations described above.

All statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Microsoft Excel was used for data organization, calculation of descriptive indicators, rates, percentage changes, and workforce projections. A two-sided p -value <0.05 was considered statistically significant.

Workforce demand forecasting

The workforce projection was developed as a short-term planning scenario rather than as a formal prediction of future staffing requirements.

The baseline population for the projection was the number of CVD patients registered under dispensary observation in 2024. The annual growth rate of 2.3% was calculated from the observed change in the number of registered CVD patients between 2022 and 2024.

The projected number of registered CVD patients in year t was calculated using:

$$P_t = P_o(1 + g)^t$$

where P_o represents the number of registered CVD patients in 2024, g is the observed annual growth rate of 2.3%, and t is the projection period in years.

For the workforce scenario, a planning threshold of one cardiologist per 2,000 registered dispensary CVD patients was applied. This value was selected as a rounded planning benchmark close to the median territorial workload observed in 2024 (1,769.6 registered CVD patients per cardiologist). It was used to provide a transparent and reproducible scenario for workforce estimation and does not represent a statutory national staffing standard. To assess the robustness of the workforce projection, sensitivity analyses were performed using alternative annual growth rates of 1.5% and 3.0% around the observed base rate of 2.3%.

The projected number of cardiologists required for 2026 was calculated separately for each

territorial unit by dividing the projected number of registered CVD patients by 2,000 and rounding the resulting requirement upward to the nearest whole number. The territorial-level requirements were then summed to obtain the regional workforce requirement.

The difference between the projected workforce requirement and the number of cardiologists available in 2024 was used to estimate the model-based workforce gap. A positive value indicated a model-based deficit, whereas a negative value indicated a model-based surplus.

The analysis used the reported headcount of practicing cardiologists in the administrative workforce dataset; no conversion to full-time equivalents was performed.

The resulting estimate was interpreted as a scenario-based planning estimate conditional on the observed patient-growth rate and the 1:2,000 planning assumption and was not considered a confirmed future workforce shortage.

Ethical considerations and data protection

The study was based on secondary administrative and statistical data obtained in aggregated and anonymized form. No individual-level patient records, personal identifiers, biological materials, or identifiable clinical information were accessed. The study protocol was reviewed and approved by the Local Ethics Committee of Kazakhstan Medical

University (Protocol #IRB-193-2024 No. 8, dated 06 May 2024). As the analysis used aggregated and anonymized administrative data, individual informed consent was not required. All data were handled in accordance with applicable national requirements for the use and protection of medical information in analytical and statistical research.

Results

Cardiovascular morbidity dynamics in the Almaty Region (2019-2024)

Between 2019 and 2024, the registered cardiovascular disease morbidity rate in the Almaty Region showed a non-linear pattern, with an overall increase from 2,319.7 to 2,497.3 per 100,000 population (+7.7%). The lowest regional rate was recorded in 2021 (2,152.9 per 100,000), followed by an increase in 2022-2024.

Ischemic heart disease showed the most pronounced increase, rising from 457.3 per 100,000 population in 2019 to 1,020.8 per 100,000 in 2024. Hypertension had the highest recorded rate among the morbidity categories presented throughout the study period, although its rate fluctuated substantially, from 1,077.1 per 100,000 in 2020 to 2,222.0 in 2023 and 1,604.0 in 2024. Acute myocardial infarction rates also fluctuated, reaching 149.2 per 100,000 in 2022 before decreasing to 92.1 in 2024. Cerebrovascular disease rates ranged from 212.2 to 396.1 per 100,000 over the study period (Table 1).

Table 1. Registered cardiovascular morbidity rates in the Almaty Region (per 100,000 population), 2019-2024

Year	Total CVD	Hypertension	Ischemic heart disease	Acute myocardial infarction	Cerebrovascular diseases
2019	2,319.7	1,259.5	457.3	78.9	291.8
2020	2,362.9	1,077.1	441.4	93.6	254.6
2021	2,152.9	1,672.1	423.0	123.7	212.2
2022	2,267.6	1,763.3	693.6	149.2	241.0
2023	2,495.0	2,222.0	936.1	91.0	396.1
2024	2,497.3	1,604.0	1,020.8	92.1	346.1

The rate of ischemic heart disease increased by approximately 123% between 2019 and 2024, corresponding to a compound annual growth rate

(hereinafter – CAGR) of 17.4%. The annual dynamics of the main CVD categories are presented in Figure 1.

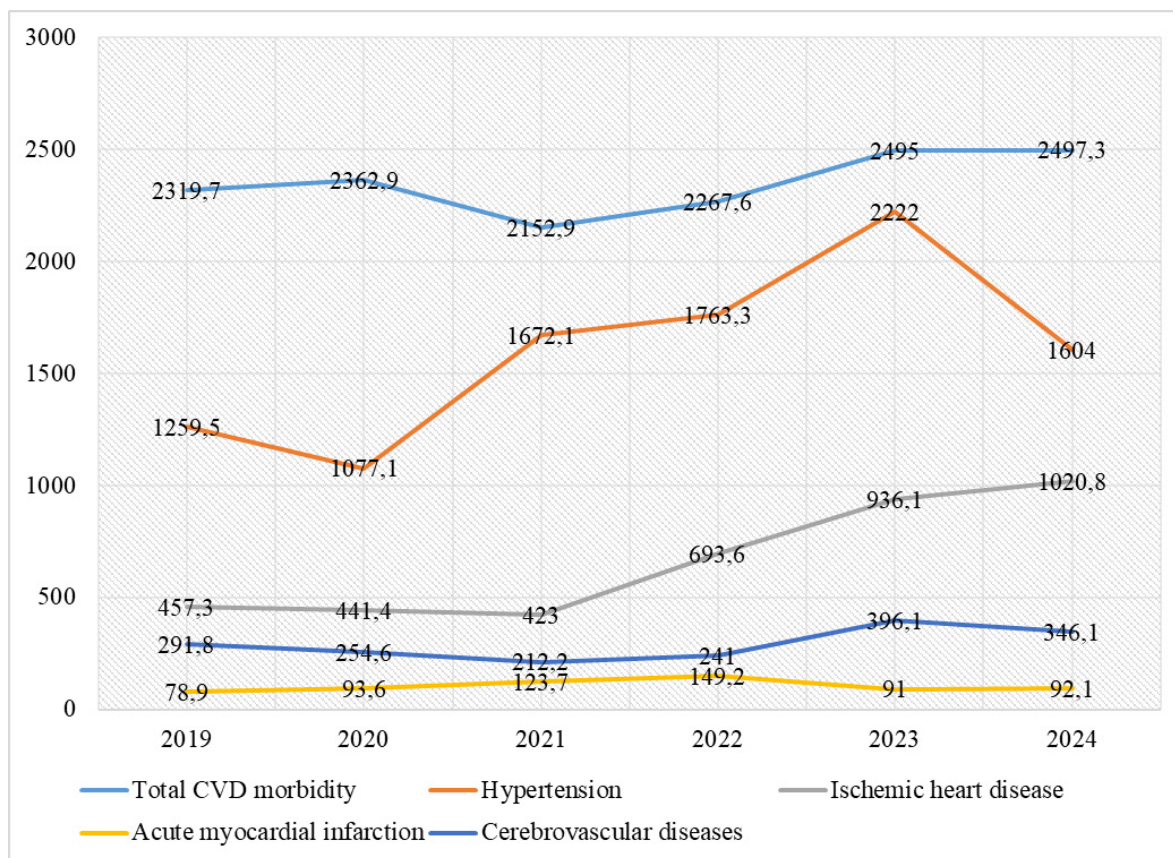


Figure 1. Trends in registered cardiovascular morbidity in the Almaty Region, 2019-2024

Source: compiled by the authors

Inter-district variability in registered CVD morbidity and cardiology workforce, 2022-2024

Substantial inter-district variation was observed in registered CVD morbidity across the 10 territorial units included in the analysis. In 2024, the arithmetic mean of the district-level CVD morbidity rates was 5,101.4 per 100,000 population (SD = 3,329.1; coefficient of variation [CV] = 65.3%). This unweighted territorial mean was higher than the regional CVD morbidity rate because it

was calculated as the arithmetic mean of the 10 territorial rates, whereas the regional rate was based on the population-weighted number of registered cases for the entire Almaty Region.

In 2024, the highest registered CVD morbidity rates were observed in Rayymbek (9,212.7 per 100,000), Talgar (8,944.4), and Zhambyl (8,501.9), whereas the lowest rates were recorded in Kegen (395.7), Uyghur (816.9), and Karasay (2,221.9) (Table 2).

Table 2. District-level registered CVD morbidity rates, dispensary-registered CVD patients, and cardiologists in the Almaty Region, 2022-2024

District	CVD per 100,000			Dispensary patients (2024)	Cardiologists (2024)
	2022	2023	2024		
Balkhash	13,901.8	4,124.3	4,286.0	1,989	1
Enbekshikazakh	6,109.7	5,584.0	5,035.5	27,719	10
Zhambyl	2,387.2	14,526.3	8,501.9	20,424	6
Ile	2,490.4	3,553.5	7,542.7	20,025	17
Karasay	2,653.3	4,949.1	2,221.9	23,253	15
Kegen	3,696.7	7,273.3	395.7	2,157	2

Table continued

District	CVD per 100,000			Dispensary patients (2024)	Cardiologists (2024)
	2022	2023	2024		
Rayymbek	2,462.4	3,610.4	9,212.7	17,946	2
Talgar	4,429.3	5,921.3	8,944.4	6,401	12
Uyghur	2,679.6	12,743.4	816.9	23,537	1
Konaev city	1,238.5	1,907.9	4,056.3	4,422	5

Source: compiled by the authors

Between 2022 and 2024, the direction and magnitude of changes differed markedly between territorial units. The largest increases in registered CVD morbidity were observed in Rayymbek (+274.1%), Zhambyl (+256.2%), and Ile (+202.9%). These changes represent variation in registered morbidity and should not be interpreted as direct evidence of changes in underlying disease burden. Differences in case detection, registration practices, referral patterns, reporting completeness, or administrative coding may have contributed to the observed fluctuations.

The distribution of the cardiology workforce also varied substantially between territorial units. In 2024, the number of cardiologists ranged from 1 in Balkhash and Uyghur to 17 in Ile and 15 in Karasay, while the number of registered dispensary CVD patients ranged from 1,989 in Balkhash to 27,719 in Enbekshikazakh. The corresponding number of registered dispensary CVD patients per cardiologist ranged from 533 in Talgar to 23,537 in Uyghur (Table 3).

Across territories, positive deficits sum to 31 cardiologists and model-based surpluses to 18, yielding the net regional balance of +13 shown in the total row.

Table 3. Cardiologist workload and model-based workforce requirement in the Almaty Region, 2024-2026

District	Patients (2024)	Cardiologists (2024)	Patients per cardiologist	Projected patients (2026)*	Projected cardiologists required*	Deficit/Surplus **
Balkhash	1,989	1	1,989	2,082	2	+1
Enbekshikazakh	27,719	10	2,772	29,009	15	+5
Zhambyl	20,424	6	3,404	21,374	11	+5
Ile	20,025	17	1,178	20,957	11	-6
Karasay	23,253	15	1,550	24,335	13	-2
Talgar	6,401	12	533	6,699	4	-8
Rayymbek	17,946	2	8,973	18,781	10	+8
Kegen	2,157	2	1,079	2,257	2	0
Uyghur	23,537	1	23,537	24,632	13	+12
Konaev city	4,422	5	884	4,628	3	-2
Total	147,873	71	-	154,754	84	+13

* Projected workforce requirement based on the planning assumption of one cardiologist per 2,000 registered dispensary CVD patients; this ratio was used as an analytical planning assumption and does not represent a statutory national staffing standard. Projected patient numbers were calculated using the formula: $N_{2026} = N_{2024} \times (1 + 0.023)^2$

**Deficit/Surplus: positive values indicate a model-based deficit; negative values indicate a model-based surplus.

Source: compiled by the authors

Sensitivity analysis using alternative annual growth scenarios of 1.5%, 2.3%, and 3.0% resulted in projected workforce requirements of 83, 84, and 84 cardiologists, respectively. The corresponding net model-based workforce gaps were 12, 13, and 13 cardiologists relative to the reported count of 71 cardiologists in 2024, indicating that the overall workforce estimate remained relatively stable across the tested growth assumptions.

Using the 2024 number of registered dispensary CVD patients as the baseline, the projected number of patients in 2026 was 154,754, compared with 147,873 in 2024. Under the predefined planning assumption of one cardiologist per 2,000 registered dispensary CVD patients, the estimated workforce requirement increased from the reported

71 cardiologists in 2024 to 84 in 2026. The resulting net model-based workforce gap was 13 cardiologists. At the territorial level, positive deficits summed to 31 cardiologists, while negative values represented 18 cardiologists of model-based surplus; the net regional balance was therefore +13. The largest projected deficits were observed in Uyghur (+12), Rayymbek (+8), Enbekshikazakh (+5), and Zhambyl (+5), whereas the largest model-based surpluses were observed in Talgar (-8) and Ile (-6).

Hospital bed capacity (2022-2024)

Total inpatient bed availability in medical organizations of the region declined from 42.2 to 33.4 beds per 10,000 population between 2022 and 2024, corresponding to a 20.8% decrease (Table 4).

Table 4. Inpatient hospital bed availability in the Almaty region (per 10,000 population), 2022-2024

District	2022	2023	2024
Region total	42.2	38.5	33.4
Balkhash	73.0	59.0	46.0
Enbekshikazakh	23.5	23.1	25.1
Zhambyl	21.3	21.0	22.0
Ile	43.5	41.9	44.2
Karasay	19.9	17.7	18.4
Kegen	48.8	50.6	42.4
Rayymbek	40.6	42.1	42.8
Talgar	110.4	91.3	56.7
Uyghur	26.2	32.7	31.3
Konaev	34.2	36.3	32.8

Source: compiled by the authors

Marked differences in inpatient bed availability were observed across territorial units. In 2024, bed availability ranged from 18.4 beds per 10,000 population in Karasay to 56.7 in Talgar, while the regional value was 33.4 beds per 10,000 population. Several territories showed values above the regional level, whereas others remained substantially below it. These differences indicate considerable territorial variation in general inpatient capacity; however, bed availability alone does not directly measure access to cardiology care.

Exploratory ecological analysis of cardiology service resources, 2024

To characterize territorial differences in cardiology service resources, 10 territorial units were

included in the exploratory ecological analysis. The analysis considered recorded CVD morbidity, cardiologist density, population density, and inpatient bed availability. Because dedicated cardiology departments were not established in all district-level healthcare organizations, total inpatient bed availability was used as an indicator of general inpatient capacity.

In 2024, the mean recorded CVD morbidity rate across the 10 territorial units was 5,101.4 per 100,000 population (SD = 3,329.1; CV = 65.3%), indicating substantial inter-territorial variation. Registered dispensary workload per cardiologist showed even greater dispersion (mean 4,589.9 patients; median 1,769.6; range 533-23,537; CV

= 154.6%). Total inpatient bed availability ranged from 18.4 to 56.7 beds per 10,000 population, with a mean of 36.2 per 10,000 (CV = 33.7%) (Table 5).

Pearson correlation analysis showed a moderate positive relationship between cardiologist density and recorded CVD morbidity ($r = 0.55$; 95% CI: -0.12 to 0.88; $p = 0.10$).

A moderate positive relationship was also observed between population density and cardiologist density ($r = 0.61$; 95% CI: -0.03 to 0.90; $p = 0.06$). The relationship between population density and total inpatient bed availability was weaker ($r = 0.38$; 95% CI: -0.33 to 0.81; $p = 0.28$) (Table 6).

Table 5. Descriptive statistics of selected morbidity, cardiologist workload, and inpatient capacity indicators across territorial units of the Almaty Region, 2024

Indicator	Mean	Median	Min	Max	SD	CV, %
Registered CVD morbidity (per 100,000 population)	5,101.4	4,660.8	395.7	9,212.7	3,329.1	65.3
Workload per cardiologist (patients)	4,589.9	1,769.6	533	23,537	7,095.2	154.6
Total inpatient beds (per 10,000 population)	36.2	37.6	18.4	56.7	12.2	33.7
State inpatient beds (per 10,000 population)	34.4	36.6	17.6	48.9	11.1	32.4
Day-hospital beds (per 10,000 population)	12.2	8.6	6.1	43.4	11.3	92.3

**Note: CVD, cardiovascular disease; SD, standard deviation; CV, coefficient of variation. Descriptive statistics are based on the 10 territorial units included in the ecological analysis. Workload statistics were recalculated from the absolute 2024 dispensary-patient and cardiologist counts reported in Table 3.*

Source: compiled by the authors

Table 6. Pearson correlations between selected territorial cardiology service indicators, 2024

Relationship	Pearson r	95% CI	p-value
Cardiologist density and recorded CVD morbidity	0.55	-0.12 to 0.88	0.10
Population density and cardiologist density	0.61	-0.03 to 0.90	0.06
Population density and total inpatient bed availability	0.38	-0.33 to 0.81	0.28

**Note: CVD, cardiovascular disease; CI, confidence interval. Two-sided Pearson correlations were calculated for 10 territorial units. Correlations with $p > 0.05$ were not interpreted as statistically confirmed associations.*

Source: compiled by the authors

None of the three Pearson correlations reached statistical significance. The observed coefficients were therefore interpreted as directional territorial patterns. The positive correlation between cardiologist density and recorded CVD morbidity may reflect, at least in part, differences in case detection and registration across territories. The positive relationship between population density and cardiologist density suggests a tendency toward greater concentration of specialist resources in more densely populated territories. The correlation between population density and inpatient bed availability was weaker.

Given the limited number of territorial observations ($n=10$), multivariable regression estimates

were not retained in the final analysis. The ecological analysis was therefore interpreted on the basis of descriptive statistics and the three bivariate Pearson correlations reported in Table 6.

Cardiovascular hospitalizations among urban and rural populations, 2022-2025

Between 2022 and 2025, the number of recorded cardiovascular hospitalizations increased in both urban and rural populations. Among rural residents, hospitalizations increased from 1,756 in 2022 to 2,325 in 2025, representing a 32.4% increase. Among urban residents, the corresponding increase was from 6,757 to 8,250 hospitalizations (22.1%) (table 7).

Table 7. Cardiovascular hospitalizations among urban and rural populations, 2022-2025

Year	Population group	Total cases	Planned	Emergency	Emergency (%)	Bed-days	Mean length of stay
2022	Urban	6,757	6,163	594	8.8%	57,977	8.6
2022	Rural	1,756	1,585	171	9.7%	15,579	8.9
2023	Urban	7,294	6,609	685	9.4%	68,110	9.3
2023	Rural	1,941	1,768	173	8.9%	18,580	9.6
2024	Urban	7,885	6,622	1,263	16.0%	63,048	8.0
2024	Rural	2,002	1,763	239	11.9%	15,827	7.9
2025	Urban	8,250	6,803	1,447	17.5%	67,430	8.2
2025	Rural	2,325	1,851	474	20.4%	15,954	6.9

**Note: Values represent recorded cardiovascular inpatient episodes. Urban and rural groups were analyzed separately according to the population classification used in the administrative records. Mean length of stay was calculated as total bed-days divided by the corresponding number of hospitalizations. This table summarizes all recorded cardiovascular inpatient episodes and is not a subtotal of the cardiac-surgery table.*

Source: compiled by the authors

The proportion of emergency hospitalizations increased over the study period in both population groups. Among urban residents, the proportion increased from 8.8% in 2022 to 17.5% in 2025, while among rural residents it increased from 9.7% to 20.4%. The increase in recorded emergency hospitalizations was particularly pronounced in the rural population between 2024 and 2025. These changes

describe hospital utilization recorded in the administrative data and should not be interpreted independently as evidence of a change in underlying disease incidence. Mean length of stay ranged from 6.9 to 9.6 days across the study period. In 2025, mean length of stay was 6.9 days among rural residents and 8.2 days among urban residents (figure 2,3).

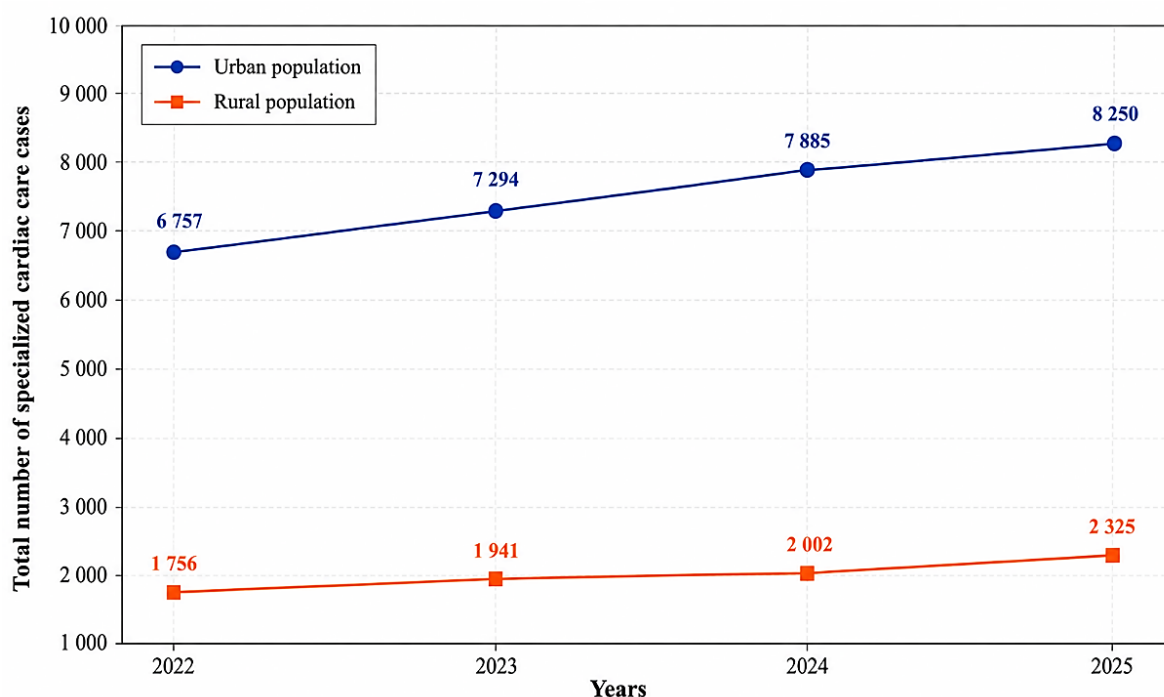


Figure 2. Total cardiovascular hospitalizations among urban and rural populations

Source: compiled by the authors

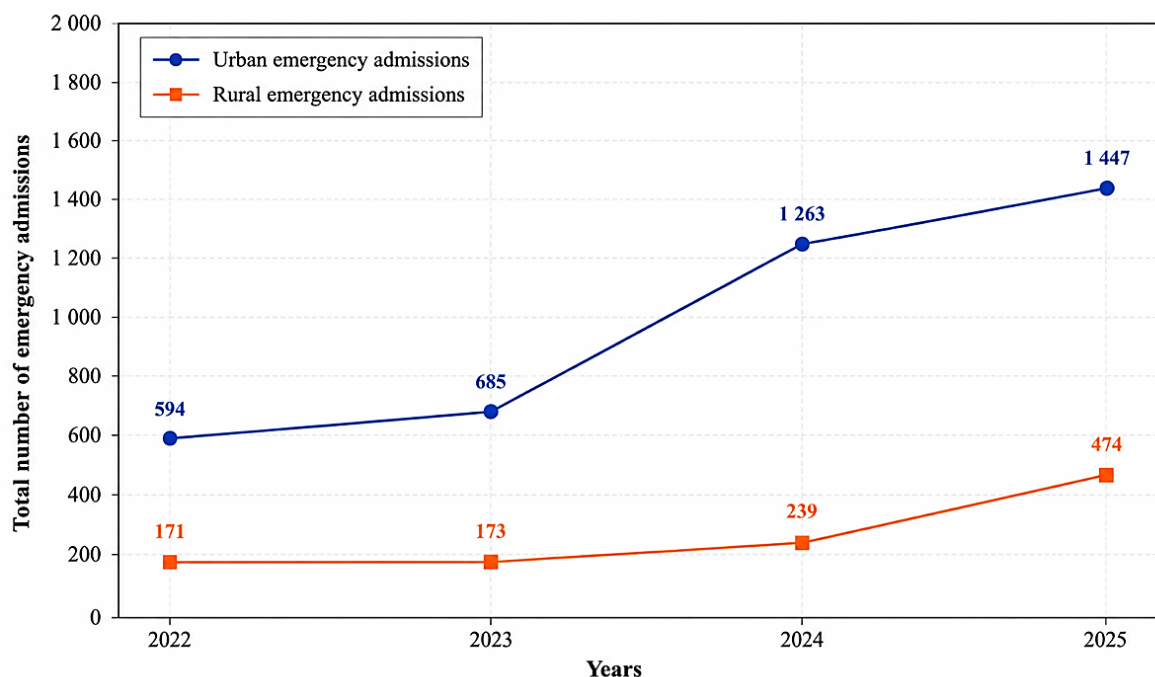


Figure 3. Emergency cardiovascular hospitalizations among urban and rural populations (2022-2025)

Source: compiled by the authors

Cardiac surgical hospitalizations among rural residents, 2025

In 2025, rural residents received cardiac surgical care both within the Almaty Region and through referral to tertiary institutions in Almaty city. Within the region, 511 recorded cardiac surgical hospitalizations were reported, including 139 planned and 372 emergency episodes. Emergency hospitalizations accounted for 72.8% of the regional total.

At the two regional institutions shown in Table 8, emergency episodes predominated. The Almaty Regional Multidisciplinary Hospital recorded 62 hospitalizations, of which 39 (62.9%)

were emergency, while the Karasay Interdistrict Hospital recorded 449 hospitalizations, including 333 (74.2%) emergency episodes.

Among rural residents treated in Almaty city, 1,814 cardiac surgical hospitalizations were recorded. Planned hospitalizations predominated, accounting for 1,618 episodes (89.2%), compared with 196 emergency episodes (10.8%). Thus, the distribution of recorded cardiac surgical care differed by treatment location, with a greater proportion of emergency episodes among cases treated within the region and a greater proportion of planned episodes among rural residents referred to metropolitan tertiary institutions.

Table 8. Cardiac surgical hospitalizations among rural residents by medical institution, 2025

Medical institution	Total	Planned	Emergency	Emergency, %	Bed-days	Mean LOS, days
Almaty Regional Multidisciplinary Hospital	62	23	39	62.9	841	13.6
Karasay Interdistrict Hospital	449	116	333	74.2	3,021	6.7
Almaty Region total	511	139	372	72.8	3,862	7.6
Cardiology & Internal Diseases Research Institute	588	588	0	0	4,147	7.1
National Scientific Surgery Center	329	329	0	0	4,244	12.9

Table continued

Medical institution	Total	Planned	Emer- gency	Emer- gency, %	Bed- days	Mean LOS, days
City Cardiology Center	310	120	190	61.3	2,703	8.7
City Clinical Hospital No. 7	151	151	0	0	863	5.7
Other institutions (combined)	436	430	6	1.4	3,997	9.2
Almaty city total	1,814	1,618	196	10.8	15,954	8.8

**Note: Data represent recorded cardiac surgical inpatient episodes among rural residents in 2025 and do not necessarily correspond to unique patients. The Almaty Region total refers to care delivered within the region, whereas the Almaty city total refers to rural residents referred to tertiary institutions in Almaty city. These cardiac-surgery episodes constitute a distinct service category and were not used to calculate the totals in Table 7.*

Source: compiled by the authors

These findings describe the recorded distribution of inpatient cardiac surgical care and referral activity. They do not, by themselves, establish differences in clinical need, treatment quality, or accessibility between territories.

Interventional and high-technology cardiovascular procedures, 2022-2025

Administrative records also demonstrated changes in the volume and composition of recorded cardiovascular procedures. Regional procedural volumes for 2023–2025 are presented separately from high-technology interventions performed among rural residents in tertiary institutions in Almaty city during 2022-2025 (table 9).

Table 9. Recorded interventional cardiovascular procedures in the Almaty Region, 2023-2025

Procedure	2023	2024	2025	Total	Absolute change, 2023-2025	Relative change, %
Coronary stenting	48	88	297	433	+249	+518.8
PTCA	6	3	73	82	+67	+1,116.7
Coronary angiography	48	55	156	259	+108	+225.0
CABG	42	43	45	130	+3	+7.1
Valve surgery	7	5	10	22	+3	+42.9
Device implantation	3	4	9	16	+6	+200.0
Other procedures	60	54	21	135	-39	-65.0

**Note: Values represent recorded procedure episodes in the regional administrative data and are not necessarily counts of unique patients. PTCA, percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass grafting.*

Source: compiled by the authors

The largest absolute increases between 2023 and 2025 were observed for coronary stenting (+249 episodes), coronary angiography (+108), and PTCA (+67). CABG volume remained relatively stable, increasing from 42 to 45 recorded procedures. The

observed changes represent administrative procedure volumes and may reflect changes in service availability, referral pathways, case detection, or reporting in addition to changes in clinical demand (table 10).

Table 10. High-technology cardiovascular interventions among rural residents treated in tertiary centers of Almaty city, 2022-2025

Procedure	2022	2023	2024	2025	Change, %
Coronary stenting	398	296	349	412	+3.5
PTCA	21	28	54	189	+800.0
CABG	218	214	197	338	+55.0
Aortic valve replacement, including TAVI	40	47	27	94	+135.0
Valve annuloplasty	18	35	29	61	+238.9
ICD implantation	81	108	101	128	+58.0
Radiofrequency ablation	266	268	326	214	-19.5

**Note: Values represent recorded high-technology cardiovascular procedure episodes among rural residents treated in tertiary institutions in Almaty city. PTCA, percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass grafting; TAVI, transcatheter aortic valve implantation; ICD, implantable cardioverter-defibrillator.*

Source: compiled by the authors

Among rural residents referred to tertiary centers in Almaty city, the largest recorded procedural volumes in 2025 were coronary stenting (412), CABG (338), and radiofrequency ablation (214). Compared with 2022, the largest relative increases were observed for PTCA (+800.0%), valve annuloplasty (+238.9%), and aortic valve replacement including TAVI (+135.0%). Radiofrequency ablation decreased by 19.5% over the same period.

Taken together, the administrative data demonstrate an increase in several recorded cardiovascular intervention volumes and a broad range of high-technology procedures available through metropolitan referral centers. The findings indicate the role of referral pathways in providing advanced cardiovascular care to rural residents, but the available data do not permit direct assessment of unmet need, appropriateness of referral, or accessibility at the individual patient level.

Discussion

Temporal changes in registered cardiovascular morbidity

Registered cardiovascular morbidity in the Almaty Region increased between 2019 and 2024, with the largest increase observed for ischemic heart disease. These data represent registered cases rather than population incidence or prevalence. Changes in registration may reflect diagnostic activity, dispensary follow-up, referral, coding, and reporting practices, as well as changes in disease burden. The observed increase should therefore not be interpreted

as evidence of a corresponding increase in underlying incidence.

The findings are consistent with the substantial cardiovascular burden reported for Kazakhstan, Central Asia, and Asia more broadly [7; 14; 15]. Previous studies in Kazakhstan have also identified differences in cardiovascular indicators between urban and rural populations [7; 8]. Territorial variation in registered morbidity may therefore be relevant to cardiovascular service planning, but should be considered alongside health-system indicators.

Territorial variation in cardiovascular morbidity and service resources

Marked differences in recorded CVD morbidity were observed across the 10 territorial units. The territorial arithmetic mean is not directly comparable with the regional population-weighted rate because the two measures use different denominators. The coefficient of variation therefore describes territorial dispersion rather than inequality in health-care access.

Access to cardiovascular care may be influenced by specialist availability, geographic distance, transportation, referral pathways, waiting time, and continuity of care [16,17]. These dimensions were not measured in the present study. Differences in recorded morbidity may also reflect variation in detection, registration, and referral. A lower recorded rate should therefore not be interpreted as evidence of a lower underlying disease burden.

The correlation analysis was ecological and based on only 10 territorial observations. The

observed associations should consequently be regarded as exploratory directional patterns that require further evaluation rather than as evidence of causal effects.

Cardiologist workload and workforce planning

Cardiologist workload varied substantially between territories. The projected requirement of 84 cardiologists in 2026 compared with the reported count of 71 cardiologists in 2024 represents a model-based planning estimate and should not be interpreted as evidence of a confirmed regional shortage. The ratio of one cardiologist per 2,000 registered cardiovascular patients was an analytical assumption rather than a statutory staffing standard.

Rural workforce planning may require consideration of geographical distribution, recruitment, retention, professional development, and working conditions [18; 19]. Workforce decisions could therefore incorporate territorial workload and referral demand rather than rely on a single staffing ratio.

Service organization and telecardiology

The distribution of specialists and advanced cardiovascular services suggests a potential role for closer coordination between district facilities and tertiary centers rather than duplication of high-technology services at the district level.

Telemedicine may improve access to rural specialty care where local specialists are unavailable, although its implementation depends on local infrastructure and integration with existing services [25]. A hub-and-spoke cardiology model provides an example of using predominantly virtual specialist care to address geographic gaps in cardiology provision [26].

Referral organization remains an important component of this model. The potential contribution of telecardiology is also dependent on appropriate transfer pathways, particularly when patients require urgent assessment or invasive treatment [27]. In rural Kazakhstan, recent evidence supports the feasibility of remote hypertension consultations integrated with the national electronic health record, providing a locally relevant example of specialist support through telemedicine [28].

Telecardiology should therefore be considered as a complement to direct clinical assessment, emergency care, and referral to tertiary services. Its potential value may include reducing unnecessary travel, supporting local clinicians, and facilitating specialist input where remote assessment is clinically appropriate.

Cardiovascular hospitalizations and concentration of advanced care

Cardiovascular hospitalizations increased in both rural and urban populations. This pattern may reflect changes in service utilization, referral, case detection, treatment availability, or admission practices; the available data cannot distinguish between these mechanisms.

Advanced cardiac care remained concentrated in tertiary institutions in Almaty city, while regional institutions provided a larger share of emergency surgical care. This distribution is compatible with a referral-based model for complex cardiovascular services. Similar organizational approaches have been described in rural cardiovascular systems, where smaller hospitals are connected with tertiary centers through referral networks while selected services remain available locally [29]. Evidence from other rural and geographically dispersed settings also indicates that referral pathways may be affected by the centralization of specialized cardiovascular services, communication between facilities, transportation, and the availability of trained personnel [30].

These findings do not, by themselves, demonstrate differences in quality or accessibility. Well-coordinated referral systems may be particularly important between rural district and regional facilities where specialist capacity is limited. Future assessment should therefore consider referral completion, transfer time, waiting time, and appropriateness rather than procedure volumes alone.

Continuity of cardiovascular care

Continuity after hospital discharge is relevant when cardiovascular care is distributed across primary, district, and tertiary services. Structured discharge planning, scheduled specialist follow-up, coordination with primary care, and remote specialist support may help maintain continuity of care.

The present dataset does not contain information on adherence, rehabilitation, readmission, or patient-reported access. These outcomes should therefore be incorporated into subsequent evaluations of cardiovascular service organization. Connected health technologies may complement conventional follow-up when geographic barriers limit access to specialist services [22; 24].

Strengths and limitations

The main strength of the study is the combined analysis of cardiovascular morbidity and health-system indicators within the same territorial

framework. Morbidity, cardiology workforce, inpatient capacity, hospitalization, cardiac surgical care, and cardiovascular procedures were considered together, allowing differences in recorded morbidity to be examined alongside differences in service organization.

Several limitations should be considered. First, the study relied on administrative data, which may differ between territories and years in registration completeness, diagnostic activity, coding, reporting, and referral practices. Recorded morbidity therefore cannot be equated with underlying incidence or prevalence.

Second, the interdistrict analysis included only 10 territorial units. Correlation analyses should consequently be considered exploratory, and the small sample limits statistical power. The ecological design also prevents individual-level inference.

Third, total inpatient bed availability was used as a measure of general inpatient capacity because dedicated cardiology beds were not uniformly available across all territorial organizations. This indicator should not be interpreted as a measure of cardiology-specific capacity or direct accessibility to specialist care.

Fourth, the study did not include individual clinical characteristics, mortality, treatment outcomes, travel distance, waiting time, transportation, household expenditure, treatment adherence, or patient-reported access. Territorial differences in the available indicators therefore cannot be translated directly into differences in quality or accessibility of cardiovascular care.

Finally, hospitalization and procedure counts represent recorded episodes rather than necessarily unique patients. The workforce projection is also scenario-dependent because it is based on an analytical staffing ratio rather than an established national requirement. Changes in healthcare organization during the study period may additionally have influenced registration, referral, hospitalization, and procedural activity. The study describes temporal and territorial patterns but does not establish the causal effect of a specific healthcare intervention.

Policy implications

The findings have several organizational implications.

First, territorial cardiovascular surveillance should use stable case definitions, consistent denominators, and comparable reporting procedures. Large changes in recorded morbidity should be

reviewed together with diagnostic activity, registration, referral, coding, and reporting completeness.

Second, workforce planning should account for territorial workload rather than relying solely on regional averages. Territories with persistently high numbers of registered cardiovascular patients per cardiologist may require targeted recruitment and retention measures or additional specialist-support mechanisms [18; 19].

Third, referral pathways between district facilities and tertiary cardiovascular centers should be standardized. The concentration of planned cardiac surgical care in Almaty city makes coordination of referral, transfer, preoperative assessment, and post-discharge follow-up particularly important.

Fourth, telecardiology can be considered for specialist consultation and follow-up in territories with limited cardiology resources. Implementation should include appropriate infrastructure, staff training, clinical protocols, and monitoring of utilization and outcomes [20; 21; 23].

Finally, continuity of care should remain part of cardiovascular service planning as hospitalization and procedural activity increases. The organizational priorities identified here represent implications of the observed patterns rather than effects demonstrated by the present study. Future research should evaluate whether changes in workforce distribution, referral organization, and digital support are associated with measurable improvements in waiting time, referral completion, avoidable transfers, continuity of care, and cardiovascular outcomes.

Conclusion

Recorded cardiovascular morbidity in the Almaty Region increased overall between 2019 and 2024, with the most pronounced growth observed for ischemic heart disease. The interpretation of these trends requires consideration of diagnostic activity, registration, referral, and reporting practices because administrative morbidity indicators do not measure underlying incidence directly.

Substantial territorial variation was observed in recorded CVD morbidity, cardiologist workload, and inpatient capacity. Correlation analysis showed several positive directional relationships, but statistical significance was not reached. Cardiovascular hospitalizations increased among both rural and urban populations between 2022 and 2025. Advanced cardiac surgical care remained concentrated in tertiary institutions in Almaty city, while regional hospitals accounted for a larger proportion of

emergency cardiac surgical episodes. The pattern points to the importance of coordinated referral and transfer between district and tertiary levels of care.

Cardiologist workload varied markedly between territories. The net projected difference of 13 cardiologists represents a model-based workforce planning estimate under the selected analytical assumption and should not be interpreted as a confirmed national staffing deficit.

These findings support further assessment of territorial workforce distribution, referral pathways, specialist support for rural facilities, and telecardiology. Future research should incorporate patient-level clinical outcomes and direct measures of accessibility, including travel time, waiting time, referral completion, rehabilitation participation, and patient-reported access to cardiovascular services.

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АЛМАТЫ ОБЛЫСЫНДАҒЫ ЖҮРЕК-ҚАН ТАМЫРЛАРЫ АУРУЛАРЫНЫҢ ДИНАМИКАСЫ ЖӘНЕ КАРДИОЛОГИЯЛЫҚ ҚЫЗМЕТТЕРДІҢ ҚҰРЫЛЫМДЫҚ МҮМКІНДІКТЕРІ: АУЫЛДЫҚ ДЕНСАУЛЫҚ САҚТАУ САЯСАТЫНА ӘСЕРІ

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Андатпа

Өзектілігі. Жүрек-қан тамыр аурулары қоғамдық денсаулық сақтаудың маңызды мәселесі болып қала береді. Халқы негізінен ауылдық жерлерде тұратын өңірлерде медициналық ресурстардың аумақтық бөлінуі мамандандырылған көмектің қолжетімділігін шектеуі мүмкін.

Мақсаты. Алматы облысындағы жүрек-қан тамыр ауруларының тіркелген аурушандық динамикасын және кардиологиялық қызметтің әлеуетін бағалау, сондай-ақ 2026 жылға кардиологтарға есептік қажеттілікті анықтау.

Материалдар мен әдістер. Жинақталған әкімшілік деректер негізінде ретроспективті популяциялық аналитикалық зерттеу жүргізілді. Өңірлік аурушандық 2019–2024 жылдарға; 10 аумақтық бірліктің аурушандығы, кадрлық қамтамасыз етілуі және төсек қоры 2022–2024 жылдарға; қалалық және ауылдық тұрғындардың госпитализациялары 2022–2025 жылдарға талданды. Хирургиялық және жоғары технологиялық көмек көрсеткіштері қолжетімді кезеңдер бойынша бағаланды. Сипаттамалық статистика, вариация коэффициенті және Пирсон корреляциясы қолданылды. Кардиологтарға қажеттілік 2024 жылғы диспансерлік есептегі пациенттер саны, жылдық өсім және 2 000 пациентке бір кардиолог деген жоспарлық арақатынас негізінде есептелді.

Нәтижелері. Өңірлік тіркелген аурушандық 100 000 тұрғынға шаққанда 2 319,7-ден 2 497,3-ке дейін өсті (+7,7%); ең жоғары өсім жүректің ишемиялық ауруы бойынша байқалды. 2024 жылы 10 аумақ бойынша орташа көрсеткіш 100 000 тұрғынға шаққанда 5 101,4, вариация коэффициенті 65,3% болды. Ауыл тұрғындарының госпитализациялары 1 756-дан 2 325-ке дейін өсті (+32,4%). Үш корреляцияның ешқайсысы статистикалық мәнділікке жеткен жоқ ($p > 0,05$). 2026 жылға есептік қажеттілік 84 кардиологты құрады; 2024 жылы 71 маман тіркелген. Таза есептік айырма 13 маман.

Қорытынды. Тіркелген аурушандықтың өсуі және көрсеткіштердің айтарлықтай аумақтық өзгергіштігі анықталды. Корреляциялар зерттеушілік сипатқа ие. Кадрлық болжам болашақтағы расталған тапшылықты емес, жоспарлық бағалауды білдіреді. Кадрлардың бөлінуін, пациенттерді бағыттау жолдарын және мамандандырылған көмектің қолжетімділігін одан әрі бағалау қажет.

Түйін сөздер: жүрек-қан тамыр аурулары; ауылдық жерлердегі медициналық көмек; денсаулық сақтаудың кадрлық ресурстары; денсаулық сақтау ресурстары; ауруханаға жатқызу; Қазақстан.

ДИНАМИКА СЕРДЕЧНО-СОСУДИСТЫХ ЗАБОЛЕВАНИЙ И СТРУКТУРНЫЙ ПОТЕНЦИАЛ КАРДИОЛОГИЧЕСКИХ СЛУЖБ В АЛМАТИНСКОЙ ОБЛАСТИ: ПОСЛЕДСТВИЯ ДЛЯ ПОЛИТИКИ ЗДРАВООХРАНЕНИЯ В СЕЛЬСКОЙ МЕСТНОСТИ

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Аннотация

Актуальность. Сердечно-сосудистые заболевания остаются значимой проблемой общественного здравоохранения. В преимущественно сельских регионах территориальное распределение ресурсов может ограничивать доступность специализированной помощи.

Цель. Оценить динамику зарегистрированной заболеваемости сердечно-сосудистыми заболеваниями и структурный потенциал кардиологической службы Алматинской области, а также расчётную потребность во врачах-кардиологах на 2026 год.

Материалы и методы. Проведено ретроспективное популяционное аналитическое исследование агрегированных административных данных. Региональная заболеваемость анализировалась за 2019-2024 гг.; межрайонные показатели заболеваемости, кадрового обеспечения и коечного фонда – для 10 территориальных единиц за 2022-2024 гг.; госпитализации городских и сельских жителей – за 2022-2025 гг. Показатели хирургической и высокотехнологичной помощи оценивались за доступные периоды. Использовались описательная статистика, коэффициент вариации и корреляция Пирсона. Потребность в кардиологах рассчитывалась на основе числа диспансерных пациентов в 2024 году, ежегодного прироста и планового соотношения одного кардиолога на 2 000 пациентов.

Результаты. Региональная зарегистрированная заболеваемость увеличилась с 2 319,7 до 2 497,3 на 100 000 населения (+7,7%); наибольший рост отмечен по ишемической болезни сердца. В 2024 году средний показатель по 10 территориям составил 5 101,4 на 100 000 населения, коэффициент вариации – 65,3%. Госпитализации сельских жителей увеличились с 1 756 до 2 325 (+32,4%). Ни одна из трёх корреляций не достигла статистической значимости ($p > 0,05$). Расчётная потребность на 2026 год составила 84 кардиолога при 71 специалисте в 2024 году; чистая расчётная разница – 13 специалистов.

Выводы. Выявлены рост зарегистрированной заболеваемости и значительная территориальная вариабельность показателей. Корреляции имеют исследовательский характер. Кадровый прогноз представляет плановую оценку, а не подтверждённый будущий дефицит. Необходима дальнейшая оценка распределения кадров, маршрутизации и доступности специализированной помощи.

Ключевые слова: сердечно-сосудистые заболевания; медицинская помощь в сельской местности; кадровые ресурсы здравоохранения; ресурсы здравоохранения; госпитализация; Казахстан.

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The datasets used in this study are not publicly available because they are derived from administrative health records subject to institutional access restrictions. Data access may be considered upon reasonable request to the corresponding author and subject to approval by the relevant data-owning institutions.

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