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Anatolii V. Ivaniuk, Ph.D., Doctoral Candidate, Department of Public Health, https://orcid.org/0000-0001-8539-6048
Bogomolets National Medical University, Kyiv, Ukraine

Analysis of the Network, Staffing, and Activity of the Healthcare System and Cardiology Service of Kyiv Oblast

Abstract. Providing high-quality cardiac care for the population is impossible without a thorough analysis of the number of healthcare facilities that can provide such services, the distribution of cardiologists and cardiovascular surgeons per appropriate number of the population, and proper monitoring of specialized examinations required for patients seeking such care.

The aim. Getting inside the scope of the network, staffing, and activities of the healthcare system and cardiology service of Kyiv oblast.

Materials and methods. Data on mortality, morbidity of the population, the structure of healthcare institutions, and the performance of the network of healthcare facilities of Kyiv oblast were the material of the study. The general scientific approach, i.e. synthesis, generalization, interpretation, system analysis, and medical statistics, was used to attain the aim.

Results. The absence of cardiologists was noted in some territorial units of Kyiv oblast, either entirely or at certain time intervals. At the same time, the supply of cardiovascular surgeons was also inadequate. The dynamics of the number of beds in the region showed negative trends from 2018 to 2021. The increase in the workload of cardiac surgeons had a steady upward trend during 2018-2021, along with a peak number of operations and a statistically significant correlation with an increase in patient mortality. The number of specialized cardiology examinations carried out for the population in the region is also insufficient.

Conclusions. The network, staffing and activities of the cardiology service of Kyiv oblast do not meet the needs of the population and require a systematic approach to provide reforms at the level of the regional leadership to solve the issue of optimizing cardiac care for the population, taking into account the formation of local communities.

Keywords*: cardiac care, cardiologists, cardiovascular surgeons, efficacy assessment, demography.*

Background. The population can't receive high-quality cardiology care without an appropriate network of healthcare facilities with a targeted cardiology profile. During the previous decade, an administrative-territorial reform was introduced, which started with the publication of the Decree of the Cabinet of Ministers of Ukraine of November 10, 2010 No. 2081-p "On the approval of the plan of measures to establish and change the boundaries of administrative-territorial units, the names of settlements and assigning them to certain categories" [1]. The reform of local self-government and territorial organization of power in Ukraine, which continued in 2014, had the primary goal of creating conditions for forming an effective and responsible local government capable of providing a comfortable and safe environment for people to live throughout Ukraine. The above required the introduction of an effective mechanism for providing services in the health care, taking into account the population's needs for high-quality cardiology care.

The aim. To analyze the network, staffing, and activities of the healthcare system and cardiology service in Kyiv oblast.

Materials and methods. The work used methods of a general scientific approach: synthesis, generalization, interpretation, and system analysis; methods of medical statistics, including the use of Shapiro-Wilk test (optimal linear immovability grades dispersion to its usual grades through the method of maximum probabilities); Wilcoxon W-test, D'Agostino-Pearson ($n > 30$)/W Shapiro-Wilk ($n \leq 30$) test, Student's t-test. The materials for the study were selected based on open data of the Communal nonprofit enterprise of Kyiv oblast Regional Council, Kyiv Regional Public Health Center for 2018, 2019, 2020 and 2021 (open data unified by districts of the region), State Institution "Center for Medical Statistics of the Ministry of Health of Ukraine"; data of state and industry statistical reports of healthcare institutions of the Ministry of Health of Ukraine and data of the State Statistics Service of Ukraine. For the purpose of a comprehensive analysis of the network of in-

Table 1

Provision of a network of health centers in Kyiv oblast with cardiologists and cardiovascular surgeons (2018-2021)

No.	Districts of Kyiv oblast	The number of positions of cardiologists per 10,000 adult population by district of Kyiv oblast (by year)							
		2018				2019			
		Number of positions				Number of positions			
		Total staff	Of them in inpatient units	Employed total	Of them in inpatient units	Total staff	Of them in inpatient units	Employed total	
1	Baryshivskyi	0.174	0.000	0.174	0.000	0.000	0.000	0.000	
2	Bilotserkivskyi	0.243	0.000	0.243	0.000	0.245	0.000	0.245	
3	Bohuslavskyi	0.703	0.352	0.615	0.352	0.712	0.356	0.623	
4	Boryspilskyi	0.570	0.299	0.516	0.299	0.678	0.298	0.515	
5	Borodianskyi	0.219	0.000	0.110	0.000	0.220	0.000	0.110	
6	Brovarskyi	0.474	0.328	0.474	0.328	0.542	0.397	0.542	
7	Vasylkivskyi	0.429	0.198	0.363	0.198	0.432	0.199	0.365	
8	Volodarsky	0.357	0.000	0.357	0.000	0.545	0.182	0.363	
9	Vyshgorodskyi	0.379	0.169	0.379	0.169	0.419	0.209	0.335	
10	Zgurivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
11	Ivankivskyi	0.411	0.000	0.000	0.000	0.415	0.000	0.000	
12	Kaharlytskyi	0.179	0.000	0.000	0.000	0.181	0.000	0.000	
13	Kyiv-Sviatoshynskyi	0.308	0.068	0.171	0.034	0.293	0.065	0.098	
14	Makarivskyi	0.510	0.340	0.510	0.340	0.517	0.345	0.517	
15	Myronivskyi	0.358	0.000	0.358	0.000	0.361	0.000	0.361	
16	Obukhivskyi	0.455	0.364	0.409	0.318	0.457	0.366	0.411	
17	Pereyaslav-Khmelnytskyi	0.666	0.444	0.666	0.444	0.675	0.450	0.675	
18	Poliskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
19	Rokytnianskyi	0.473	0.000	0.473	0.000	0.481	0.000	0.481	
20	Skvirsky	0.328	0.000	0.082	0.000	0.333	0.000	0.083	
21	Stavishchenskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
22	Tarashchanskyi	0.223	0.000	0.000	0.000	0.226	0.000	0.000	
23	Tetiivskyi	0.758	0.000	0.569	0.000	0.764	0.000	0.573	
24	Fastivskyi	0.532	0.164	0.532	0.164	0.536	0.165	0.536	
25	Yahotynskyi	0.378	0.189	0.378	0.189	0.384	0.192	0.384	
26	Bila Tserkva	0.794	0.588	0.794	0.588	0.797	0.591	0.797	
27	Irpin	0.684	0.376	0.684	0.376	0.656	0.361	0.623	
28	Berezan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
29	Rzhyshchiv	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
30	Bucha	0.373	0.000	0.373	0.000	0.363	0.000	0.363	
31	Slavutych	0.239	0.000	0.000	0.000	0.000	0.000	0.000	
Kyiv region	Kyiv Regional Clinical Hospital	0.028	0.028	0.012	0.012	0.028	0.028	0.011	
	Kyiv Regional Hospital (Regional Hospital No. 2)	0.053	0.035	0.053	0.035	0.053	0.035	0.051	
	Kyiv Regional Cardiology Dispensary	0.140	0.108	0.140	0.108	0.139	0.108	0.139	
	Kyiv Regional Oncology Dispensary	0.007	0.007	0.007	0.007	0.007	0.007	0.007	
	Kyiv Regional Center of Rehabilitation and Sports Medicine	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	Medical and social center of war veterans (Tsibli)	0.055	0.055	0.041	0.041	0.000	0.000	0.000	
	General indicator for the region	0.743	0.453	0.658	0.418	0.697	0.407	0.605	

The number of positions of cardiovascular surgeons per 10,000 adult population by district of the Kyiv region (by year)									
Kyiv region		Total staff (2018)	Of them in inpatient units (2018)	Employed total (2018)	Of them in inpatient units (2018)	Total staff (2019)	Of them in inpatient units (2019)	Total employed (2019)	
	Bila Tserkva	0.030	0.030	0.030	0.030	0.030	0.030	0.030	
	Kyiv Regional Clinical Hospital	0.101	0.090	0.097	0.090	0.101	0.090	0.097	
	Kyiv Regional Hospital (Regional Hospital No. 2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	General indicator for the region	0.104	0.093	0.101	0.093	0.104	0.093	0.101	

		2020				2021			
		Number of positions				Number of positions			
	Of them in inpatient units	Total staff	Of them in inpatient units	Employed total	Of them in inpatient units	Total staff	Of them in inpatient units	Employed total	Of them in inpatient units
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.248	0.000	0.248	0.000	0.377	0.000	0.251	0.000
	0.356	0.723	0.362	0.362	0.362	0.734	0.367	0.367	0.367
	0.298	0.675	0.297	0.486	0.270	0.458	0.243	0.378	0.216
	0.000	0.222	0.000	0.167	0.000	0.224	0.000	0.112	0.000
	0.397	0.538	0.395	0.538	0.395	0.538	0.395	0.466	0.395
	0.199	0.434	0.200	0.334	0.134	0.439	0.202	0.337	0.135
	0.000	0.559	0.186	0.373	0.000	0.571	0.190	0.380	0.000
	0.168	0.373	0.207	0.332	0.207	0.369	0.164	0.328	0.164
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.211	0.000	0.000	0.000
	0.000	0.184	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.016	0.311	0.093	0.093	0.000	0.270	0.060	0.105	0.000
	0.345	0.519	0.519	0.519	0.519	0.531	0.354	0.531	0.354
	0.000	0.367	0.000	0.367	0.000	0.372	0.000	0.372	0.000
	0.320	0.458	0.366	0.412	0.321	0.460	0.368	0.414	0.322
	0.450	0.685	0.457	0.685	0.457	0.697	0.465	0.349	0.116
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.489	0.000	0.489	0.000	0.499	0.000	0.499	0.000
	0.000	0.339	0.000	0.085	0.000	0.345	0.000	0.086	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.232	0.000	0.000	0.000	0.472	0.000	0.472	0.000
	0.000	0.387	0.000	0.097	0.000	0.392	0.000	0.098	0.000
	0.165	0.376	0.167	0.376	0.167	0.382	0.170	0.382	0.170
	0.192	0.391	0.196	0.196	0.000	0.398	0.199	0.199	0.000
	0.591	0.857	0.591	0.828	0.591	0.860	0.593	0.771	0.534
	0.328	0.755	0.472	0.692	0.440	0.704	0.459	0.551	0.306
	0.000	0.000	0.000	0.000	0.000	0.376	0.000	0.188	0.000
	0.000	0.000	0.000	0.000	0.000	1,238	0.000	1,238	0.000
	0.000	0.356	0.000	0.356	0.000	0.357	0.000	0.357	0.000
	0.000	0.120	0.000	0.120	0.000	0.121	0.000	0.121	0.000
	0.011	0.026	0.026	0.026	0.026	0.040	0.040	0.040	0.040
	0.035	0.053	0.032	0.053	0.032	0.055	0.033	0.051	0.033
	0.108	0.139	0.107	0.139	0.107	0.153	0.118	0.137	0.102
	0.007	0.007	0.007	0.007	0.007	0.007	0.000	0.007	0.000
	0.000	0.011	0.000	0.007	0.000	0.009	0.000	0.007	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.377	0.700	0.415	0.612	0.390	0.725	0.422	0.598	0.361

	Of them in inpatient units (2019)	Total staff (2020)	Of them in inpatient units (2020)	Total employed (2020)	Of them in inpatient units (2020)	Full-time employees (2021)	Of them in inpatient units (2021)	Total employed (2021)	Of them in inpatient units (2021)
	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
	0.090	0.111	0.111	0.105	0.105	0.097	0.097	0.097	0.097
	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002
	0.093	0.114	0.114	0.109	0.109	0.106	0.106	0.102	**0.102**

Table 2

Providing the adult population in Kyiv oblast with cardiology inpatient medical care in 2018-2021 in the scope of the region districts

		2018							
	Districts of Kyiv oblast	**1***	**2***	**3***	**4***	**5***	**1**	**2**	
No.	**All cardiology beds, incl**	**709,000**	**5,020**	**167,754**	**0.017**	**356,013**	**510,000**	**3,597**	
1	Baryshivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2	Bilotserkivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
3	Bohuslavskyi	20,000	7,033	209,923	0.010	297,800	20,000	7,124	
4	Boryspilskyi	45,000	4,885	168,049	0.014	353,867	45,000	4,881	
5	Borodianskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
6	Brovarskyi	60,000	4,375	178,208	0.007	372,117	60,000	4,335	
7	Vasylkivskyi	30,000	3,956	127,522	0.032	331,567	30,000	3,984	
8	Volodarskyi	5,000	3,566	161,164	0.035	408,000	22,000	15,990	
9	Vyshgorodskyi	20,000	3,371	130,439	0.050	277,700	22,000	3,686	
10	Zgurivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
11	Ivankivskyi	15,000	6,170	204,014	0.044	314,333	15,000	6,223	
12	Kaharlytskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
13	Kyiv-Sviatoshynskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
14	Makarivskyi	15,000	5,098	216,143	0.042	345,600	15,000	5,170	
15	Myronivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
16	Obukhivskyi	20,000	3,640	209,645	0.010	515,250	20,000	3,657	
17	Pereyaslav-Khmelnytskyi	30,000	6,661	247,119	0.028	310,167	30,000	6,751	
18	Poliskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
19	Rokytnianskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
20	Skvirskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
21	Stavishchenskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
22	Tarashchanskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
23	Tetiivskyi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
24	Fastivskyi	20,000	3,271	166,678	0.020	448,850	20,000	3,297	
25	Yahotynskyi	10,000	3,780	134,956	0.017	318,800	10,000	3,838	
26	Bila Tserkva	70,000	4,119	149,164	0.023	340,557	70,000	4,134	
27	Irpin	40,000	5,474	230,591	0.039	363,175	40,000	5,246	
28	Berezan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
29	Rzhyshchiv	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
30	Slavutych	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Kyiv region	Kyiv Regional Clinical Hospital	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	Kyiv Regional Hospital (Regional Hospital No. 2)	48,000	0.340	15,923	0.002	495,917	48,000	0.339	
	Kyiv Regional Cardiology Dispensary	60,000	0.425	20,051	0.010	364,733	60,000	0.423	
	Kyiv Regional Oncology Dispensary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	Kyiv Regional Center of Rehabilitation and Sports Medicine	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	Medical and social war veterans center (Tsibli)	201,000	1,423	21,693	0.000	323,070	0.000	0.000	
	Cardiosurgical beds of all, including	**12,000**	**0.085**	**3,866**	**0.004**	**276,833**	**12,000**	**0.085**	
Kyiv region	Kyiv Regional Clinical Hospital (Regional Hospital No. 1)	12,000	0.085	3,866	0.004	276,833	12,000	0.085	

Note: * - 1, average annual number of beds; 2, availability of beds (per 10,000 inhabitants); 3, level of hospitalization (per 10,000 population); 4, mortality rate among hospitalized patients; 5, use of bed stock.

2019			2020					2021				
3	4	5	1	2	3	4	5	1	2	3	4	5
143,759	**0.018**	**360,292**	**464,000**	**3,263**	**81,548**	**0.031**	**210,543**	**335,000**	**2,358**	**74,155**	**0.028**	**253,824**
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
218,359	0.011	319,900	19,000	6,869	174,627	0.021	267,789	10,000	3,668	110,410	0.010	288,800
153,496	0.012	350,200	35,000	3,780	102,072	0.057	303,429	20,000	2,157	90,711	0.015	467,500
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
182,430	0.009	360,500	60,000	4,308	118,964	0.017	225,517	45,000	3,229	108,130	0.034	269,667
126,693	0.028	309,733	30,000	4,009	82,060	0.039	154,900	20,000	2,699	75,976	0.060	213,100
465,150	0.045	255,409	5,000	3,726	114,017	0.046	290,600	8,000	6,086	158,223	0.019	248,750
107,233	0.045	255,409	22,000	3,651	64,890	0.066	125,682	12,000	1,970	53,680	0.046	220,500
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
201,618	0.031	301,600	15,000	6,269	104,476	0.032	150,533	15,000	6,343	125,587	0.027	165,933
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
186,826	0.041	281,867	8,000	2,770	81,717	0.097	207,500	3,000	1,062	29,382	0.036	185,667
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
200,029	0.007	523,200	20,000	3,663	121,612	0.027	314,000	16,000	2,947	123,023	0.018	339,250
240,779	0.031	321,933	8,000	1,827	75,834	0.033	357,000	-	-	-	-	-
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
177,229	0.011	437,500	20,000	3,344	92,133	0.015	237,250	17,000	2,889	80,224	0.025	231,118
150,846	0.010	347,400	7,000	2,738	66,093	0.018	204,714	3,000	1,194	32,248	0.062	187,000
146,330	0.025	336,286	70,000	4,139	91,716	0.018	192,429	61,000	3,618	111,027	0.036	241,721
242,245	0.038	346,100	40,000	5,033	119,292	0.091	168,975	0.000	0.000	17,759	0.159	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15,533	0.000	481,854	45,000	0.316	7,356	0.003	203,000	45,000	0.317	9,016	0.005	257,178
19,560	0.013	351,650	60,000	0.422	11,294	0.016	183,200	60,000	0.422	13,302	0.020	187,400
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17,804	**0.001**	**291,833**	**23,000**	**0.162**	**6,800**	**0.026**	**191,696**	**30,000**	**0.211**	**10,184**	**0.037**	**210,333**
17,804	0.001	291,833	23,000	0.162	6,800	0.026	191,696	30,000	0.211	10,184	0.037	210,333

stitutions, data acquisition and comparison of indicators was carried out regarding the compliance of the existing healthcare facilities with cardiology doctors, the medical and diagnostic, medical and preventive services provided, and population health indicators.

Results and discussion. Staffing of the network of healthcare facilities during 2018-2021 had characteristic signs of uneven distribution of personnel by district (before the formation of the relevant local communities). The relevant indicators are shown in Table 1. The absence of cardiologists in Baryshivskyi, Ivankivskyi, Poliskyi, Stavyschenskyi districts and in the cities of Berezan, Rzhyshchiv, and Slavutych was noted, either completely or at certain time intervals. At the same time, the supply of cardiovascular surgeons was also inadequate; for example, during 2018-2020, there was no single doctor of this specialization in the Communal Non-Profit Enterprise of Kyiv Regional Council "Kyiv Regional Hospital" (Regional Hospital No. 2).

The dynamics of the number of beds in the region continued to show negative trends during 2018-2021, with a 52.8% decrease from 2018 to 2021 (Table 2), which also correlated with a reduction in the provision of beds per 10,000 population. A drop in the level of hospitalizations was established, although the stable increase in the incidence of circulatory system diseases was mentioned above. Indicators of bed stock utilization in the region also fluctuated with a trend towards efficiency decrease.

At the same time, the level of hospitalizations in the adult population in 2018-2021 tended to decrease, which did not correspond to the real state of the population's needs, taking into account the stable incidence rate of circulatory system diseases (Table 3).

At the same time, the workload on cardiac surgeons had a steady upward trend during 2018-2021; the peak number of operations performed by these doctors in adults was found in 2021 (909) (Table 4). Such pressure on doctors revealed a statistically reliable correlation with an increase in patient mortality, which is an additional factor contributing to burnout syndrome among cardiac surgeons.

The provision of up-to-date, high-quality medical care according to cardiac patients' needs is impossible without providing healthcare facilities with adequate diagnostic equipment and recruiting specialists with the appropriate level of practical skills to work with such equipment.

Retrospectively, out of 29 districts of Kyiv oblast, 10 districts in 2014-2018 were provided with minimal diagnostic equipment for diagnosing cardiac pathology (only electrocardiographs). Echocardiographs were missing in 14 districts, and cycle ergometers were not working or were missing in 16 districts. Of the 8 districts with cycle ergometers, 3 had this equipment manufactured in 1982-1985. Daily monitoring of patients' electrocardiography (ECG) and blood pressure was carried out only in 3 districts of the region, in Kyiv Regional Hospital No. 2 and Kyiv Regional Cardiology Dispensary. Fifteen districts (half) did not have the opportunity to conduct blood tests for lipids. Holter ECG and blood pressure monitoring of patients was carried out only in 4 districts of the region, Kyiv Regional Hospital No. 2 and Kyiv Regional Cardiology Dispensary.

The dynamics of indicators of the provision of cardiac diagnostic equipment over the past five years show the absence of positive changes (including the reduction of veloergometry and transesophageal echocardiography. This trend continued in 2018-2021 (Table 5). At the same time, the same trend was comparable to the decrease in the number of such specialized studies as angiography, echocardiography, etc. (Table 6).

Table 3

The level of hospitalization of patients (adults) with pathology of the cardiovascular system

	Diseases of the circulatory system (I00-I99)**			
	2018	**2019**	**2020**	**2021**
2019	0.906			
2020	<0.001*	**<0.001***		
2021	<0.001*	<0.001*	**0.03***	
2022	0.002*	**0.007***	0.124	0.003*
	(I10-I13)			
2019	0.584			
2020	0.034*	0.092		
2021	0.026*	0.079	0.84	
2022	0.789	0.794	0.049*	0.056
	(I20-I25)			
2019	0.913			
2020	**<0.001*****	**<0.001*****		
2021	**<0.001*****	**<0.001*****	**0.02*****	
2022	**<0.001*****	**<0.001*****	0.866	0.079
	(I20)			
2019	0.824			
2020	**0.012***	**0.006***		
2021	**0.002***	**<0.001***	0.225	
2022	0.299	0.209	0.149	**0.048***
	(I21-I22)			
2019	0.713			
2020	**<0.001*****	**<0.001*****		
2021	**<0.001*****	**<0.001*****	**<0.001*****	
2022	**0.049*****	0.052	0.992	**0.039*****

Note: * – Comparison of central tendencies for two independent samples. Wilcoxon W-test, two-sided critical region, central tendencies differ at the level of significance; ** – Nosology in accordance with the international classification of diseases (ICD-10/11); *** – Comparison of the means of two independent samples. Student's test, two-sided critical region, central tendencies differ at a significance level of p less than or equal to the corresponding one.

Table 4

Surgical activity of cardiovascular surgeons of Kyiv oblast in 2018-2022

	Hospitalized patients with cardiovascular diseases (selection)	Deaths	Number of performed operations	Lethality	Surgical activity	Total hospitalizations (by region)
2018	**13760**	1	**283**	0.353	0.021	**72371**
2019	**13253**	2	**292**	0.685	0.022	**65518**
2020	**8582**	24	**670**	3.582	0.078	**40727**
2021	**9280**	37	**909**	4.070	0.098	**37380**
2022	**7157**	44	**854**	5.152	0.119	**40149**

Note: Sample size: N=5. The linear correlation coefficient R=0.995, the number of degrees of freedom k=3. There is a linear correlation R>0 at the level of significance p<0.001. Coefficient of determination = 0.991; (lethality = 47.51; surgical activity - 0.4429).

Table 5

Providing the population of Kyiv oblast with electrocardiographic examination in 2018-2021 in the scope of the region districts

No.	Districts of Kyiv oblast region	2018	2019	2020	2021
1	Baryshivskyi	3179.7	2723.1	1660.8	1792.7
2	Bilotserkivskyi	4921.8	4960.1	4061.5	3846.0
3	Bohuslavskyi	3323.6	4213.7	2876.8	2372.9
4	Boryspilskyi	3545.7	3273.9	2825.4	3282.9
5	Borodianskyi	3847.1	3822.6	2454.5	2457.9
6	Brovarskyi	4278.3	4518.3	3406.6	3272.3
7	Vasylkivskyi	2953.8	4695.8	3119.9	3110.4
8	Volodarsky	6168.4	6253.4	4156.8	3666.5
9	Vyshgorodskyi	4353.2	3571.7	2078.1	1719.2
10	Zgurivskyi	5217.4	5005.3	3536.0	2286.3
11	Ivankivskyi	2187.4	2426.1	728.0	2076.6
12	Kaharlytskyi	7162.0	9205.1	4914.3	3735.2
13	Kyiv-Sviatoshynskyi	4552.6	3924.3	3177.4	2277.9
14	Makarivskyi	5990.1	6235.9	5098.7	5018.2
15	Myronivskyi	8261.7	8317.1	6846.3	7174.2
16	Obukhivskyi	4970.2	4974.6	13892.7	4386.3
17	Pereyaslav-Khmelnytskyi	4181.9	5076.8	4484.9	5345.1
18	Poliskyi	4020.4	3468.7	3243.1	3873.1
19	Rokytnianskyi	7915.8	7750.6	5840.8	5156.6
20	Skvirsky	3424.5	3211.4	1286.0	1726.9
21	Stavishchenskyi	7082.3	6985.0	5290.6	4544.6
22	Tarashchanskyi	2786.3	2255.2	1895.5	2090.5
23	Tetiivskyi	4902.2	4360.4	3543.7	3234.8
24	Fastivskyi	6624.1	5888.9	4043.0	4494.3
25	Yahotynskyi	4297.1	5279.2	4400.5	4206.5
26	Bila Tserkva	4997.1	4936.4	3675.6	3902.7
27	Irpin	4273.5	3371.9	2794.3	3468.5
28	Berezan	4686.7	3976.9	4385.4	2334.9
29	Rzhyshchiv	8814.2	4865.7	3430.6	2045.6
30	Bucha	3076.7	3672.8	3098.6	3598.7
31	Slavutych	8541.1	5376.2	3880.8	4599.3

Continuation of Table 5

No.	Districts of Kyiv oblast region	2018	2019	2020	2021
Kyiv region	Kyiv Regional Clinical Hospital	150.5	145.8	107.4	122.0
	Kyiv Regional Hospital (Regional Hospital No. 2)	152.9	141.4	61.1	74.5
	Kyiv Regional Oncology Dispensary	50.1	87.3	61.3	26.2
	Kyiv Regional Cardiology Dispensary	70.9	130.8	81.1	82.4
	Medical and social center of war veterans (Tsibli)	93.7	-	-	-
General indicator for the region		5170.1	5080.0	4099.7	3687.1

Table 6

Provision of the population of Kyiv oblast with specialized cardiology examination in 2018-2021 in the scope of the region districts

		The number of specialized cardiology examinations per 10,000 people							
		2018		2019		2020		2021	
No.	District/institution	Echocardio-graphy	Angiography	Echocardio-graphy	Angiography	Echocardio-graphy	Angiography	Echocardio-graphy	Angiography
1	Baryshivskyi	293.94	0.00	182.41	0.00	76.29	0.00	106.17	0.00
2	Bilotserkivskyi	0.00	0.00	-	0.00	-	0.00	-	0.00
3	Bohuslavskyi	547.14	0.00	397.53	0.00	413.61	0.00	408.26	0.00
4	Boryspilskyi	1164.51	0.00	880.08	0.00	791.08	0.00	960.18	0.00
5	Borodianskyi	-	0.00	-	0.00	11.54	0.00	6.71	0.00
6	Brovarskyi	765.04	0.00	631.46	0.00	525.18	0.00	426.13	0.00
7	Vasylkivskyi	144.80	0.00	106.37	0.00	79.52	0.00	103.24	0.00
8	Volodarskyi	205.38	0.00	178.79	0.00	86.44	0.00	31.19	0.00
9	Vyshgorodskyi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
10	Zgurivskyi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Ivankivskyi	78.15	0.00	62.23	0.00	0.00	0.00	60.04	0.00
12	Kaharlytskyi	0.00	0.00	11.25	0.00	0.00	0.00	0.00	0.00
13	Kyiv-Sviatoshynskyi	43.78	0.00	8.08	0.00	31.23	0.00	40.10	0.00
14	Makarivskyi	0.00	0.00	0.00	0.00	30.47	0.00	14.87	0.00
15	Myronivskyi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Obukhivskyi	372.34	0.00	272.25	0.00	251.28	0.00	281.96	0.00
17	Pereyaslav-Khmelnytskyi	1988.28	0.00	914.74	0.00	131.34	0.00	0.00	0.00
18	Poliskyi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Rokytnianskyi	0.00	0.00	84.11	0.00	58.14	0.00	31.93	0.00
20	Skvirskyi	6.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Stavishchenskyi	153.21	0.00	159.07	0.00	149.20	0.00	164.31	0.00
22	Tarashchanskyi	50.31	0.00	22.65	0.00	2.32	0.00	0.00	0.00
23	Tetiivskyi	3.79	0.00	73.36	0.00	19.34	0.00	35.67	0.00
24	Fastivskyi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Yahotynskyi	0.00	0.00	0.00	0.00	0.00	0.00	10.35	0.00
26	Bila Tserkva	255.20	0.00	130.86	0.00	117.38	0.00	202.36	0.00
27	Irpin	256.46	0.00	99.55	0.00	45.17	0.00	31.35	0.00
28	Berezan	259.03	0.00	341.64	0.00	320.88	0.00	565.12	0.00
29	Rzhyshchiv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	Bucha	0.00	0.00	170.78	0.00	65.22	0.00	112.69	0.00

Continuation of Table 6

No.	District/institution	The number of specialized cardiology examinations per 10,000 people							
		2018		2019		2020		2021	
		Echocardiography	Angiography	Echocardiography	Angiography	Echocardiography	Angiography	Echocardiography	Angiography
31	Slavutych	558.93	0.00	470.26	0.00	366.51	0.00	726.13	0.00
Kyiv region	Kyiv Regional Clinical Hospital	2.14	5.77	2.66	4.97	6.08	12.69	16.63	10.06
	Kyiv Regional Hospital (Regional Hospital No. 2)	28.72	0.00	23.45	0.00	11.07	0.00	14.81	0.00
	Kyiv Regional Oncology Dispensary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Kyiv Regional Cardiology Dispensary	28.32	0.00	39.01	0.00	46.05	0.00	41.18	0.00
	Medical and social center of war veterans (Tsibli)	3.00	0.00	-	0.00	-	0.00	-	0.00
General indicator for the region		380.67	5.77	283.65	4.97	228.10	12.69	256.80	10.07

The key differences when considering the above-mentioned features of the network, staffing, and activities of the healthcare system and cardiology service of Kyiv oblast compared to various models of healthcare systems of the countries of the world were as follows.

Japan (as a country with a high level of income) with its model succeeded in its fight against stroke and cardiovascular diseases and showed positive trend towards healthcare reform in accordance with national data. Since enacting the Stroke and Cardiovascular Disease Control Act, the national government and related scientific societies have collaborated to promote countermeasures based on five core principles: development of medical systems, promotion of registration projects, development of human resources, public awareness, and promotion of research. At the same time, the Japanese government is intensively promoting health data reform to compensate for the delay in digital medicine that became evident during the coronavirus pandemic [2].

In the United States, in addition to reforming the medical care system, including cardiology, the broader use of medications is also being discussed [3].

Studies conducted in Kazakhstan (a country of post-Soviet influence) have shown that avoidable deaths from cardiovascular diseases have decreased in recent years, which may be due to policies to strengthen primary care for early diagnosis and detection of cardiovascular diseases, vascular diseases and their risk factors. However, primary healthcare institutions got recommendations to improve activities related to the population's health literacy (adherence to medications, familiarization with risk factors), including prevention of cardiovascular diseases [4].

Considering the comparison of cardiological care in Ukraine and developing and developed countries, it should be noted that there is a lack of specialists in cardiology care. According to the actual data from the European Society of Cardiology, the number of Ukrainian cardiologists (44.59 per million people [pmp]) is just bigger than that in Malta, Uzbekistan, Tunisia, Turkey, the United Kingdom, and Ireland [5]. Meanwhile, countries with less burden of cardiovascular diseases [6] have more cardiologists, like France (107.14 pmp), Spain (84.1 pmp), Norway (80.78 pmp) etc.

However, the number of cardiac surgeons (15.39 pmp) in Ukraine is within the top 10 of the specified list of countries [7], which again does not correspond to needs in cardiovascular healthcare, considering our country is number 1 in the chart of deaths due to cardiovascular diseases for males (1379.5 per 100000, age-adjusted) and number 6 for females (925.8 per 100000, age-adjusted) [8, 9].

In Ukraine, the lack of a structural approach in the organization was also shown in the example of providing dental care; it was noted that medical dental services also lack a solid structure, process quality, and result quality. The quality of the organization of medical services is extremely important and must be maintained high at all levels of management and treatment processes, in relation to the conditions of the treatment process and the resources of medical organizations. Medical care should be patient-centered. To solve the problem in Ukraine, a whole state quality management system is needed [10].

Taking into account the consequences of cardiovascular diseases, in addition to mortality, a rehabilitation system is also necessary for such patients [11], which creates an additional economic burden both for individual households and for the state as a whole.

Conclusions. In the course of the research, it was established:

1. Gaps in sustainable cardiovascular healthcare for Kyiv oblast population were revealed. These were characterized by the definite signs of uneven distribution of cardiology profile personnel (cardiologists and cardiovascular surgeons) in separate territorial units; the discrepancy between the number of hospitalizations and the incidence of cardiovascular diseases may indicate that it is difficult for the population to receive cardiac care. The dynamics of the use of specialized cardiology studies have negative trends.
2. The workload of cardiac surgeons had a steady upward trend with a statistically significant correlation with increased patient mortality.
3. The above requires a systematic approach at the level of at least the regional leadership to resolve the issue of optimizing the provision of cardiac care to the population, taking into account the formation of local communities.

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Аналіз мережі, кадрового забезпечення й діяльності системи охорони здоров'я та кардіологічної служби Київської області

Іванюк А. В., канд. мед. наук, докторант кафедри громадського здоров'я

Національний медичний університет імені О. О. Богомольця, м. Київ, Україна

Резюме. Якісна медична допомога кардіологічного профілю для населення є обов'язковою передумовою правильної стратегії організації охорони здоров'я і є неможливою без ретельного аналізу кількості закладів охорони здоров'я, які можуть надавати такі послуги, розподілу лікарів-кардіологів та лікарів-хірургів серцево-судинних на визначену кількість населення, відповідного моніторингу спеціалізованих обстежень, які потрібні для пацієнтів, що звертаються по таку допомогу.

Мета – проведення аналізу мережі, кадрового забезпечення й діяльності системи охорони здоров'я та кардіологічної служби Київської області.

Матеріали та методи. Матеріали дослідження – дані щодо смертності, захворюваності населення, структури закладів охорони здоров'я, результатів діяльності мережі закладів охорони здоров'я Київської області. Для досягнення поставленої мети були використані методи загальнонаукового підходу: синтезу, узагальнення, інтерпретування, системного аналізу та методи медичної статистики.

Результати. Була відзначена повна, або в певні часові інтервали, відсутність лікарів-кардіологів у деяких територіальних одиницях Київської області. Водночас забезпеченість лікарями-хірургами серцево-судинними також не була задовільною. Динаміка кількості ліжкового фонду області продовжувала мати негативні тренди протягом 2018–2021 років. Зростання навантаження на лікарів-хірургів кардіологічного профілю мало стійку тенденцію до збільшення протягом 2018–2021 років пікової кількості операцій, статистично достовірної кореляції з підвищенням смертності пацієнтів. Також не є достатньою кількість спеціалізованих кардіологічних обстежень, проведених для населення області.

Висновки. Мережа, кадрове забезпечення та діяльність кардіологічної служби Київської області не відповідають потребам населення і вимагають системного підходу щодо реформування на рівні не менше керівництва області для вирішення питання щодо оптимізації надання кардіологічної допомоги населенню з урахуванням формування територіальних громад.

Ключові слова: *кардіологічна допомога, лікарі-кардіологи, лікарі-хірурги серцево-судинні, оцінювання ефективності, демографічні показники.*

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