ORIGINAL ARTICLE

THE TRENDS OF THE DENSITY OF SURGEONS IN SOME EUROPEAN COUNTRIES AND 16 OECD COUNTRIES DURING 2005-2018

DOI: 10.36740/WLek202205120

Tatiana A. Vezhnovets, Valentin D. Paryi, Vitalyi G. Gurianov, Oleksandr V. Korotkyi
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE

ABSTRACT

The aim: To establish that there are differences in the density trends of surgeons in some European countries and 16 OECD countries and to compare the trends of the density of surgeons in some European countries and 16 OECD member countries, 2005 – 2018.

Materials and methods: The study is based on data of the Centre for Medical Statistics of the Ministry of Health of Ukraine obtained during 2005-2020 and OECD data obtained during 2005-2018. The Difference-in-Differences method has been used to determine the density trends differences, the regression analysis method – to predict the number of surgeons in 2020.

Results: In 2020, there were 28,559 surgeons (0.687 per 1,000) in Ukraine, which is by 17.7% less than in 2005. From 2005 to 2018, the density of surgeons per 1000 in Ukraine and the United States decreased (-7.45% and -2.5%). In Korea (+ 78.38%), Greece (+ 65.52%), Lithuania (+ 58.57%), Slovenia (+ 45.65%) and other 11 countries the surgeon's density increased. In 2030, Ukraine is predicted to significantly reduce the number of surgeons, general surgeons, ophthalmologists and urologists; as well as to increase the number of cardiovascular surgeons. The number of proctologists, oncologists-surgeons, neurosurgeons, thoracic surgeons, orthopaedists-traumatologists and anaesthesiologists will not change significantly.

Conclusions: It is possible to state the availability of **s**urgical care according to the density of surgeons in Ukraine, similar to the level of OECD countries. In 2030, the number of surgeons is projected to decrease, with the exception of cardiovascular surgeons.

KEY WORDS: surgeons, density, trends

Wiad Lek. 2022;75(5 p1):1162-1167

INTRODUCTION

In 2015 the World Health Assembly adopted Resolution WHA68.15, in which surgical and anaesthesia care are recognized as the most important components of overall health coverage [1]. The goal of sustainable development of the United Nations are high-priority public investments in surgery, aiming to create sustainable health care systems with public access to comprehensive surgical care [2].

Safe and affordable surgical care, including anaesthesia, obstetrics and trauma care, is an important component of the health care system. However, in many countries globally, especially in those with below-average and low incomes, surgical care remains inaccessible to the population [3].

Lack of affordable surgical care leads to premature death and disabilities, which places a burden on country's economies. This global crisis is worsened by a lack of data on limited surgical infrastructure and manpower in many low- and middle-income countries [4].

Ukraine is a country with a per capita income below the World Bank's average ($ 3,540 per capita in 2020). Ukraine spent 3.2% of gross national product on health care in 2019 [5, 6]. Despite insufficient state funding of the health care system, Ukraine has a significant number of hospitals, beds and doctors. According to the data of Centre for Medical Statistics of the Ministry of Health of Ukraine in 2020, the health care system included 1186 hospitals (institutions), 232393 beds (5.58 beds per 1000), 123645 practitioners (2.96 per 1000) [7]. Physicians' density in Ukraine in 2020 was higher than that of some countries with high per capita incomes. According to the Organization for Economic Co-operation and Development (OECD), the physicians' density in Ukraine was higher than that of Japan (2.49 per 1,000) and Korea (2.39 per 1,000) in 2018.

In 2015, the Lancet Commission on Global Surgery (LCoGS) identified 6 indicators for assessment of the availability, safety, timeliness of surgical and anaesthesia care and the goal of developing surgical care by 2030 [2]. The indicators identified access to timely necessary surgical care, medical density of doctors per 100,000, the volume (extent) of surgery, 30-day mortality, protection against impoverishment and catastrophic costs of surgical treatment. By 2030, it is planned to provide 20 doctors (surgeons, obstetricians, anaesthesiologists) per 100,000 population worldwide.

So, the issue relevance of studying the achievement of the United Nations Sustainable Development Goals in Ukraine, as a representative of the countries with GNI per capita below average, and the availability of surgical care by the indicator of medical density of doctors in the surgical group is evident.

THE AIM

The aim of the study was to establish that there are differences in the density trends of surgeons in some European countries and 16 OECD countries, to compare the trends in density of surgeons in some European countries and 16 OECD member countries during 2005-2018.

MATERIALS AND METHODS

The study used data from the reporting form № 17 «Medical Staff Report» (http://medstat.gov.ua/ukr/statdan.html) of the Centre for Medical Statistics of the Ministry of Health of Ukraine for 2005-2020 and data from the Organization for Economic Co-operation and Development (OECD) for 2005-2018 [8].

The density of surgeons per 1,000 population for Ukraine and 16 OECD member countries (Canada, Estonia, France, Germany, Greece, Israel, Italy, Korea, Latvia, Lithuania, Norway, Poland, Portugal, Slovenia, USA) was calculated. These countries had complete data for the period of 2005-2018, except for Poland (data only for period of 2008-2017 was available) and were included in the group of high-income countries according to GNI per capita. Ukraine is in the group of countries with income below the GNI per capita average.

According to the OECD website, the specialists termed as surgeons include general surgeons, proctologists, oncologists, neurosurgeons, thoracic surgeons, cardiovascular surgeons, orthopaedists, traumatologists, anaesthesiologists, ophthalmologists, urologists, and emergency physicians.

The density of surgeons in Ukraine and 16 OECD countries was analyzed. Differences in the density trends of this group in Ukraine and 16 OECD countries in the period of 2005-2018 were determined using the statistical method Difference-in-Differences (DID). This study design is used to estimate the magnitude of the effect of an event in a study group compared to a control group (not subject to that effect) when observing groups over a period of time [9, 10].

The study group is subject to interference at some (but not initial) point of observation, while the control group is not subject to intervention at any point of time. The magnitude of the effect of the event is estimated by subtracting changes in the control group from the effects in the study group. Thus, DID design will eliminate the impact of trends and persistent differences between the two groups and correctly assess the effect of the intervention.

ATT (Average Time Treatment Effect) is the difference between the change, which took place under the influence of the event (2014 year), in Y (density of doctors in surgical group) since 2014 by the timepoint we are interested in, in the study group (Ukraine) and the control group (OECD countries):

ATT = () – ()

This method was used to assess the differences between trends in the period from 2005 to 2013 and in the period from 2014 to 2018 for Ukraine and OECD countries. In 2014, an extraordinary event took place in Ukraine, which affected population and doctors. This year, a part of Ukraine, along with the population and doctors, was occupied by Russia.

For each specialty of surgical profile in Ukraine, the growth rate was calculated using the method of regression analysis; and the estimated density for 2030 was determined.

Data analysis was performed using the license analysis package MedCalc v.19.4.1 (MedCalc Software Inc, Broekstraat, Belgium, 1993–2020) and statistical software EZR v. 1.54 (graphical user interface for R statistical software version 4.0.3, R Foundation for Statistical Computing, Vienna, Austria) [11].

RESULTS

In 2020, 28,559 surgeons worked in health care institutions of Ukraine (0.687 per 1,000 population or 68.7 per 100,000), which is by 17.7% less than in 2005 (34691 surgeons (0.736 per 1000 population or 73.6 per 100,000) (Figure 1).

In terms of the surgeon's density (0.74 per 1000), Ukraine ranked the 4th among 15 OECD countries in 2005 after Germany, Greece, Italy, and in 2018 ranked the 8th (0.68 per 1000) after Greece, Germany, Lithuania, Italy, Estonia, United Kingdom, Portugal, Latvia (Figure 2).

In the period from 2005 to 2018, the dynamics of surgeon's density in Ukraine, as in the United States, had a downward trend (-7.45% and -2.5% growth rate, respectively). In the other 15 OECD countries, the density of surgical group doctors during this period had a positive trend (Figure 3).

During this period, the largest rate of increase in surgeon's density was in Korea (+ 78.38%), Greece (+ 65.52%), Lithuania (+ 58.57%), Slovenia (+ 45.65%), Portugal (40.74%) (Figure 4).

In Ukraine, the density of surgeons in the period from 2005 to 2020 was described by 2 trends: positive trend from 2005 to 2013 (from 0.74 to 0.77 per 1000) and negative trend from 2014 to 2020 (from 0.69 to 0.68 per 1000) (Chart 1). In 2014, a part of Ukraine, together with the population and doctors, was occupied by Russia. This extraordinary event affected the population and the density of surgeons.

Using the DID method, we compared density of surgeon's trends in Ukraine and 16 OECD countries from 2005 to 2013 and from 2014 to 2018. For the DID method, surgeon's density indicators in Ukraine were included in the study group indicators, and the density indicators of 16 OECD countries were included in the control group indicators. Initially, differences in surgeon's density trends up to 2014 between the study group (Ukraine) and the control group (OECD countries) were clarified. No significant differences in trends during this period between Ukraine and 16 OECD countries were found (p-value for pre-test of parallel trends assumption: 0.9864).

The results of determining the differences in the change of the indicator (Δ = ATT) in the period from 2005 to 2018, i.e., the differences in the change in the density of surgeons

Fig. 1. Dynamics of the quantity and density of surgeons per 1000 population in Ukraine, 2005- 2020

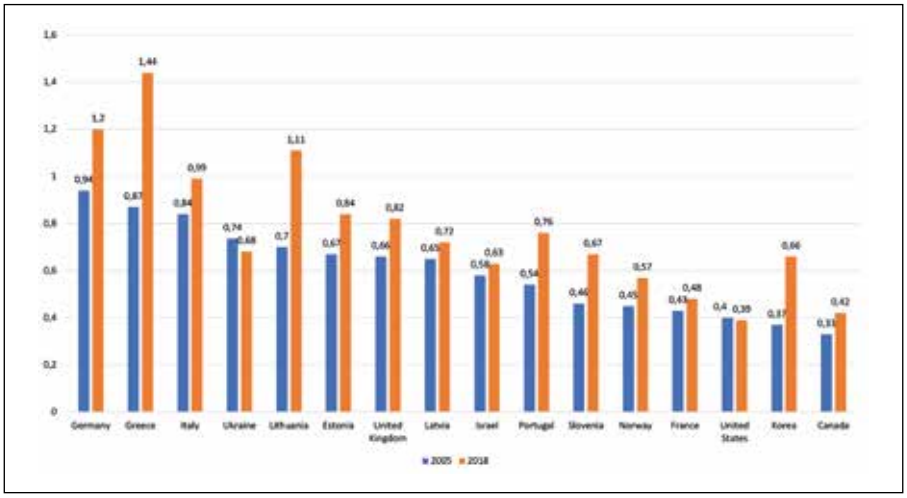

Fig 2. Surgeons in Ukraine and OECD countries. Density per 1000 population, 2005; 2018

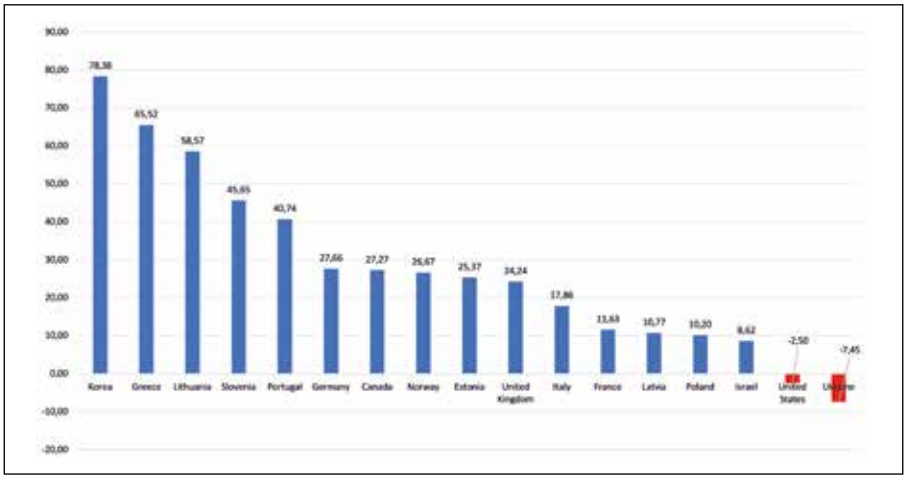

Fig 3. Density growth rate of surgeons in Ukraine and OECD countries, 2005-2018

in Ukraine and OECD countries are presented in Figure 5.

And if prior to 2014 there were practically no differences between the two groups – in 2013 Δ = – 0.020 (95% CI – 0.036 – – 0.004) Units, there was indeed a difference in 2014 between the change in the density of doctors of surgical group in Ukraine and OECD countries, Δ = –0.107 (95% VI – 0.176 – – 0.038 Units. The difference has been growing since 2014, by an average of 0.015 Units per year and in 2018 reached Δ = – 0.165 (95% CI – 0.239 – – 0.090) Units. DID-method confirms the significant impact of the events of 2014 on the dynamics of the density of surgeons in Ukraine. Therefore, the forecast of surgeon's density can be calculated only in the period from 2014 to 2020. The surgeons include 11 specialties (general surgeons, proctologists, oncologists-surgeons, neurosurgeons, thoracic surgeons, cardiovascular surgeons, orthopaedists-traumatologists, anaesthesiologists, ophthalmologists, urologists, emergency physicians).

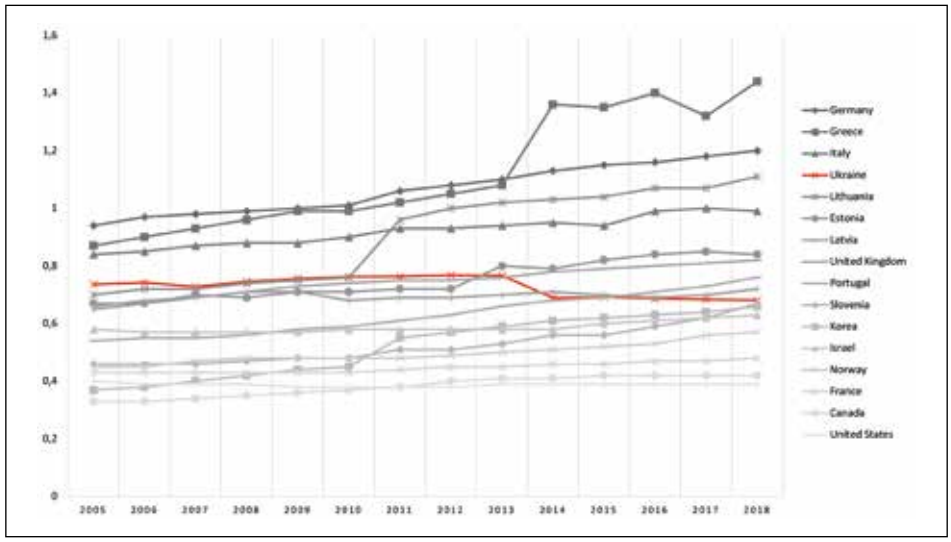

Fig 4. Density dynamics of surgeons in Ukraine and OECD countries, 2005-2018

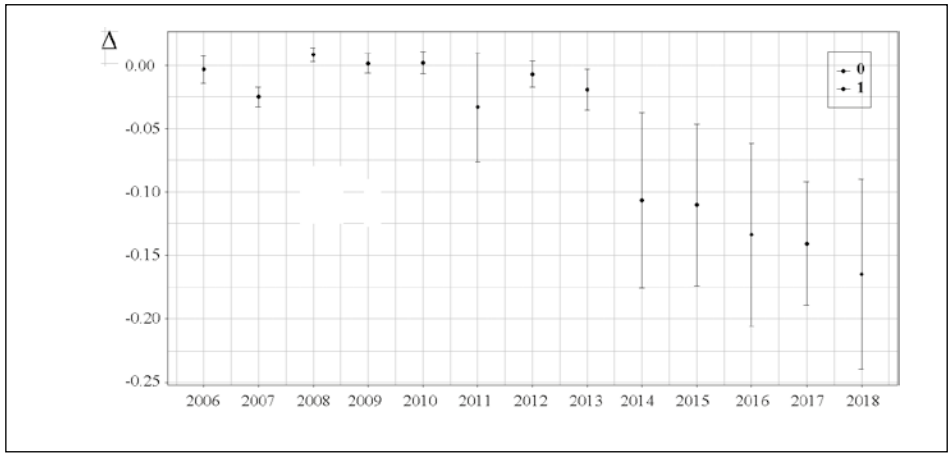

Fig 5. The results of determining the differences in the change of the indicator (Δ=ATT(g,t)), 0 – there are no differences, 1 – differences are identified.

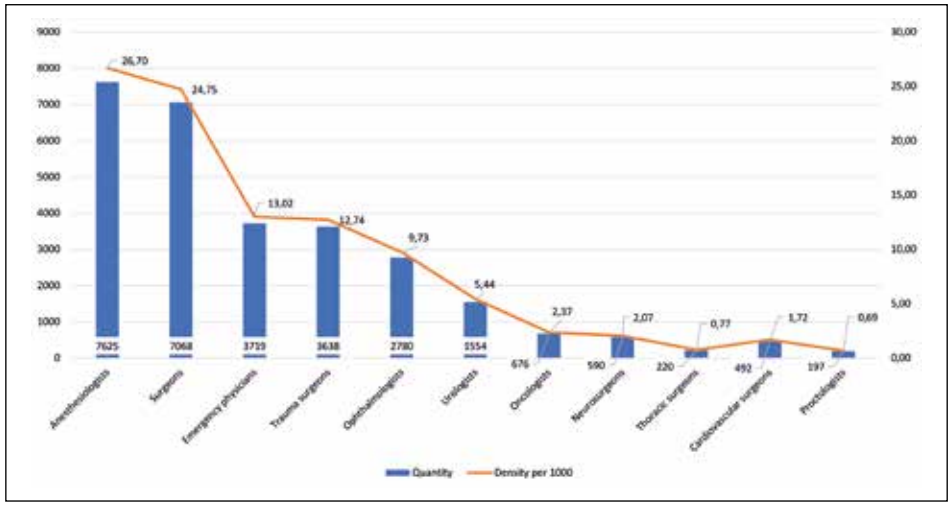

Fig 6. The quantity and density of surgeons by specialties in 2020 in Ukraine

The number and density of surgeons per 1000 population by specialties in Ukraine in 2020 is presented in Figure 6.

Using the method of regression analysis, we identified trends in the number of surgeons by specialty based on the indicators of 2014-2020. This period was chosen due to the change in the trend of surgeon's density in 2014. We found no significant dynamics of changes in the number of proctologists (R2 = 0.47, p = 0.0874), oncology surgeons (R2 = 0.53, p = 0.0653), neurosurgeons (R2 = 0, 52, p = 0.0676), thoracic surgeons (R2 = 0.30, p = 0.20), orthopaedist and traumatologists (R2 = 0.38, p = 0.1432), anaesthesiologists (R2 = 0.52, p = 0.0690) during the period. For these specialties, the correlation of the change in the number of surgeons and the year in Ukraine is not defined (p> 0.05). The number of surgeons and the number of general surgeons, cardiovascular surgeons, ophthalmologists,

Table I. The quantity of the surgeons by specialties is projected in 2030

Name of specialty	Coefficient of determination R2	p	The actual quantity of surgeons in 2020	Estimated number of surgeons in 2030	Growth rate from 2020 to 2030,%
Surgeons (all specialties)	0,9598	0,0001	28559	26520	-7,69
General surgeons	0,9427	0,0003	7068	5817	-21,51
Cardiovascular surgeons	0,9447	0,0002	492	630	+21,90
Ophthalmologists	0,9953	<0,0001	2780	2111	-31,69
Urologists	0,8741	0,002	1554	1451	-7,09
Emergency physicians	0,7812	0,0083	3719	3154	-17,91

urologists, doctors of the Ministry of Emergencies in the period from 2014 to 2020 shows a significant correlation with the year (p <0,05). For this group, using the method of regression analysis, we calculated their probable number in 2030. (Table I).

Therefore, in 2030 in Ukraine the number of cardiovascular surgeons is projected to increase, the number of doctors of surgical group, general surgeons, ophthalmologists, urologists, MOE doctors will decrease and the number of proctologists, oncologists-surgeons, neurosurgeons orthopaedists-traumatologists, anaesthesiologists will remain unchanged.

DISCUSSION

Based on the results of the study, Ukraine has reached the Lancet Commission on Global Surgery (LCoGS) recommended by 2030 target for the development of surgical care in countries with low and below average GNI per capita: by the surgeon's density per 100,000 population indicator in 2020, even without obstetricians and gynaecologists [2]. This figure in Ukraine is 68 per 100,000, which is three times more than the recommended indicator. The density of surgeons in Ukraine in 2017-2018 was higher than in high-income countries (Korea, Israel, France, Canada, Slovenia, USA, Norway, Poland). Thus, per surgeon's density indicator, Ukraine has already made partial progress in universal coverage of available surgical care. However, it is known that the key factor for achieving total universal coverage of health services is public funding, and, in particular, funding from national revenues. World experience has shown that the countries closest to the goals of universal coverage of health services, spend more than 80% of resources on health care from public sources [12]. Countries with GNI per capita with below average income, in particular Ukraine, spend on average only 40% of public funds [13]. The share of out-of-pocket expenditures on medical care in Ukraine in 2016 was 52.3%. [12]. This indicator leads to limited access to surgical care and impoverishment of the households, when it is necessary to receive surgical care.

It is known that in countries with below-average and low-income incomes, increasing health care costs will increase investment in facilities and human resources [14]. In Ukraine, it is not enough to increase funding for health care, it is necessary to optimize assets and human resources. As per the joint report made by the WHO European Bureau and the World Bank, only 24% of cases in Ukrainian hospitals are accompanied by surgery, compared to 70% in other countries [12].

In the period from 2005 to 2020 in Ukraine there has been an increase in per capita income from $ 1829.2 (2005) to 3725.6% (2020) [15]. At the same time, in contrast to OECD countries, there is a decrease in the density of surgeons (-7.45%), due to the surplus of these doctors in Ukraine.

In 2030, Ukraine is expected to reduce the number of surgeons, with the exception of cardiovascular surgeons. It is known that in high-income countries the density of cardiac surgeons is 7.15 surgeons per million population, and in low-income countries only 0.04 per million [16]. In Ukraine in 2020, the rate of cardiovascular surgeons was 12 per million population. However, this group of doctors includes vascular surgeons and cardiac surgeons. In Ukraine, the group of cardiac surgeons was not reported separately [17]. Therefore, we can only talk about a certain trend of growth within number of cardiac surgeons as well. The growth of this group is relevant against the background of the need to develop reperfusion centres in Ukraine for surgical care of patients with acute myocardial infarction [12].

CONCLUSIONS

In Ukraine, the availability of surgical care is ensured as an indicator of the density of surgeons at the level of OECD countries. In 2030, the number of surgeons is projected to decrease, with the exception of cardiovascular surgeons. At the same time, regarding Ukraine, it is necessary to ensure the availability, timeliness, safety of surgical care as indicators of prevention of catastrophic household payments.

REFERENCES

1. Price R., Makasa E., Hollands M. World Health Assembly Resolution WHA68.15: "Strengthening Emergency and Essential Surgical Care and Anesthesia as a Component of Universal Health Coverage" - Addressing the Public Health Gaps Arising from Lack of Safe, Affordable and Accessible Surgical and Anesthetic Services. World J Surg. 2015;39(9):2115–2125. doi: 10.1007/s00268-015-3153-y.
2. Meara J.G., Leather A.J., Hagander L. et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. Lancet. 2015;386(9993):569–624. doi: 10.1016/S0140-6736(15)60160-X.
3. Bouchard M.E., Justiniano J., Vervoort D. et al. Cross-sectional analysis tracking workforce density in surgery, anesthesia, and obstetrics as an indicator of progress toward improved global surgical access. International Journal of Surgery: Global Health. 2020;3(6):e26–e32. doi: 10.1097/GH9.0000000000000026.
4. Dell A.J., Kahn D. Surgical Resources in South Africa: An International Comparison and Deficit Calculation. World J Surg. 2018;42(2):541–548. doi: 10.1007/s00268-017-4176-3.
5. GNI per capita, Atlas method (current US$) – Ukraine. https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=UA [date access 06.07.2021].
6. Budgetary space for health in Ukraine. Policy document to support budget preparation dialogue for 2021(2020). https://www.euro.who.int/__data/assets/pdf_file/0007/463327/UKR-Budgetary-space-for-health.pdf [date access 06.07.2021].
7. Center for Medical Statistics of the Ministry of Health of Ukraine. http://medstat.gov.ua/ukr/statdan.html [date access 06.07.2021].
8. OECD Statistics Portal. https://stats.oecd.org [date access 06.07.2021].
9. Angrist J.D., Pischke J-S. Mostly Harmless Econometrics: An Empiricist's Companion. Princeton, NJ: Princeton University Press. 2009, 392 p.
10. Sasabuchi Yu. Introduction to Difference-in-differences Design. Annals of Clinical Epidemiology. 2021;3(3):74–77. doi:10.37737/ace.3.3_74.
11. Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. Bone Marrow Transplant. 2013;48(3):452–458. doi: 10.1038/bmt.2012.244.
12. Ukraine: Review of Health Care Financing Reform 2016-2019. Joint WHO and World Bank Report. https://www.euro.who.int/__data/assets/pdf_file/0008/416681/WHO-WB-Joint-Report_Full-report_Web.pdf [date access 06.07.2021].
13. Vezhnovets T.A., Gurianov V.G., Prus N.V. et al. Health care expenditures of 179 countries with different GNI per capita in 2018. Wiad Lek. 2021;74(3 p II):678–683.
14. Prinja S., Nandi A., Horton S. et al. Costs, Effectiveness, and Cost-Effectiveness of Selected Surgical Procedures and Platforms. Chapter 18. In: Debas H.T, Donkor P., Gawande A. et al. editors. Essential Surgery: Disease Control Priorities. Washington (DC): The International Bank for Reconstruction and Development. The World Bank; 2015. doi: 10.1596/978-1-4648-0346-8_ch18.
15. Ministry of Finance of Ukraine, official portal. https://index.minfin.com.ua/ua/economy/gdp/ [date access 06.07.2021].
16. Vervoort D. Global Cardiac Surgery and the COVID-19 Pandemic: Bouncing Back, Higher Than Before?. 2020. doi:10.25373/ctsnet.12702329.
17. Gruzyeva T.S., Pel`o I.M., Smiyanov V.A., Galiyenko L.I. Kontseptualni pidkhody do obhruntuvannia systemy pidhotovky kadriv dlia sluzhby hromadskoho zdorovia v Ukraini [Conceptual assumptions to create a system for preparation of healthcare human resources in Ukraine]. Wiad Lek. 2016;69(6):719–725. (In Ukrainian).

This article was performed in the framework of the scientific research work «Methodology of formation of the mechanism of state regulation of the use of health care technologies in medical institutions» (2020-2022, № state registration 0120U101466).

ORCID and contributionship:
Tatiana A. Vezhnovets: 0000-0003-1156-8614[A, B, F]
Vitalyi G. Gurianov: 0000-0001-8509-6301[C]
Valentin D. Paryi: 0000-0003-4996-0056[E]
Oleksandr V. Korotky:, 0000-0002-5682-7926 [D]

Conflict of interest:
The Authors declare conflict of interest.

CORRESPONDING AUTHOR
Oleksandr V. Korotkyi
Bogomolets National Medical University
13 Taras Shevchenko Blv., 01601 Kyiv, Ukraine
tel: +380976408950
e-mail: korotkiy.md@gmail.com

Received: 19.10.2021
Accepted: 06.04.2022

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article