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ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ

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EVALUATION OF COUNTRIES' HEALTH SYSTEMS EFFECTIVENESS IN THE CONTEXT OF THE COVID-19 PANDEMIC INFLUENCE ON MACROECONOMIC STABILITY[1]

ОЦІНКА ЕФЕКТИВНОСТІ СИСТЕМ ОХОРОНИ ЗДОРОВ'Я КРАЇН У КОНТЕКСТІ ВПЛИВУ ПАНДЕМІЇ COVID-19 НА МАКРОЕКОНОМІЧНУ СТАБІЛЬНІСТЬ

ANNOTATION

This study aimed to evaluate the effectiveness of the EU countries and Ukraine's health systems in macroeconomic instability due to COVID-19 influence. To evaluate the effectiveness of national models (Beveridge (to which Ukraine belongs), Bismarck and mixed), a toolkit for their comparison was developed, based on the methods of the main components and Data Envelopment Analysis (DEA). The calculations did not show an "ideal" model

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that was exceptionally effective. According to each of the models in the group of countries, there are countries whose healthcare systems have shown better results, and there are outsider countries that need additional efforts from the state to improve their resistance. As recommendations for countries with the Beveridge model to improve risk resistance, it is proposed to pay attention to the behavioral and financing factors. For the Bismarck countries, information and resource work and a review of the supply of human resources are recommended. For countries with a mixed model, it is recommended to strengthen information work and emphasize promotional activities within the vaccination campaign.

Key words: COVID-19, health policy, health care model, resilience of the health care system, epidemic threats, macroeconomic instability.

АНОТАЦІЯ

Системи охорони здоров'я та їх потенціал до розвитку на сьогодні перебувають у фокусі підвищеної уваги, зокрема після 2020 року з початком та наростанням подій у соціально-економічному житті суспільства під впливом пандемії COVID-19. У статті поставлено за мету оцінити ефективність систем охорони здоров'я країн ЄС та України в умовах макроекономічної нестабільності внаслідок впливу COVID-19. Для оцінювання ефективності національних моделей (Бевериджа (до якої належить Україна), Бісмарка та змішаної) розроблено інструментарій для їх порівняння на основі методів основних компонентів та методу оболонкового аналізу даних (DEA). Розрахунки не показали «ідеальної» моделі, яка була б виключно ефективною. За кожною з моделей у групі країн є ті, чиї системи охорони здоров'я показали кращі результати, і є аутсайдери, які потребують додаткових зусиль з боку держави для підвищення резистентності. У якості рекомендацій для країн з моделлю Бевериджа щодо підвищення стійкості до ризику пропонується звернути увагу на поведінкові та фінансові фактори. Крім того, рекомендації охоплюють необхідність збільшення фінансування медицини та соціального захисту. Країнам, що мають невисокі позиції ефективності системи охорони здоров'я за моделлю Бісмарка серед заходів, що рекомендовані, першочерговими є ті, які мають інформаційно-ресурсне спрямування, спрямовані на підтримку та стимулювання здорового способу життя, а також забезпечення медичної системи кадровими ресурсами. Для групи країн змішаної моделі такого роду рекомендації будуть стосуватися вже покращання інформаційної роботи з населенням та акценту на вакцинаційній кампанії. Висновки з даного дослідження можуть бути корисними при розробленні національних стратегій розвитку систем охорони здоров'я, а також при виборі векторів, на яких доцільно концентрувати зусилля в умовах факторів загроз громадському здоров'ю, один із який детально проаналізований у даному дослідженні – пандемія COVID-19. У майбутньому планується доповнити аналіз показниками, що стимулюють національний розвиток і одночасно можуть слугувати індикаторами ефективності медичного забезпечення в країні.

Ключові слова: COVID-19, політика охорони здоров'я, модель охорони здоров'я, стійкість системи охорони здоров'я, епідемічні загрози, макроекономічна нестабільність.

Introduction. Healthcare systems and their potential for development are currently the focus of increased attention, particularly after 2020 with the onset and increase of events in society's socio-economic life under the influence of the COVID-19 pandemic. In particular, in the 20s of the 21st century, specialists in various fields became most interested in the issue of disease prevention and leveling the impact of risk factors on public health. Restrictive measures introduced in response to the spread of the coronavirus by countries and entire regions have significantly changed medium-term and even long-term forecasts of global economic development. There was a transformation of approaches to managing countries' medical systems, which was determined by the need to prevent the consequences of epidemic threats. Changes in medical systems are non-trivial due to the nature of the determinants.

In 2023, according to forecasts [1], one of the lowest growth rates of the world economy is expected in the last few decades – 1.9%. It is noteworthy that such a recession will significantly threaten not only developing countries but also developed countries. Advanced economies will experience a slowdown in their economies of up to 0.5% (depending on the region of the countries) in 2023. For example, the growth of the EU economy in 2021 was 5.3%, in 2022 it was 3.3%, and in 2023 – only 0.2%. Global inflation, which reached a multi-year high of 9% in 2022, will remain high at over 6% in 2023. The spending priorities of countries to stimulate the economy are undergoing changes, which requires the strengthening of the medical and social security systems of the population. Therefore, it is an important task to determine the effectiveness of models of the organization of the health care system depending on their resistance to epidemiological challenges, which will allow, in addition to saving human lives, to reduce the losses of the world economy [2].

The authors of the article set out to evaluate the effectiveness of the systems of medical care of the countries of the European Union and Ukraine and to develop appropriate measures to strengthen their sustainability in modern realities.

Literature review. The question of the effectiveness of health care systems and their comparison with each other was considered in the works of the economic and medical direction and was raised by scientists of a number of schools studying the sphere of providing medical needs for the population. Among them, it is necessary to note the most meaningful and those that have gained greater resonance in the scientific community. For this, a meta-analysis of the scientific landscape on the functioning of public health models was carried out (Figure 1).

Figure 1 shows that since 2019 (the greatest concentration of research comes precisely in 2020), research on health care models' effectiveness in the COVID-19 pandemic has gained popularity in the scientific community. Different scientific schools pay attention to the aspect of medical efficiency and setting criteria for health care provision success ability [3-28]. Among investigations one could pay attention to human-centered approach in health care models of 23 countries in the European region [29].

The authors investigated the features of the operation of three models – Beveridge, Bismarck and the mixed model. Scientists proved that countries that use the Beveridge model have better positions in terms of compliance with the principles of the concept of person-oriented care compared to other models, and, therefore, are more effective in meeting the medical needs of the population.

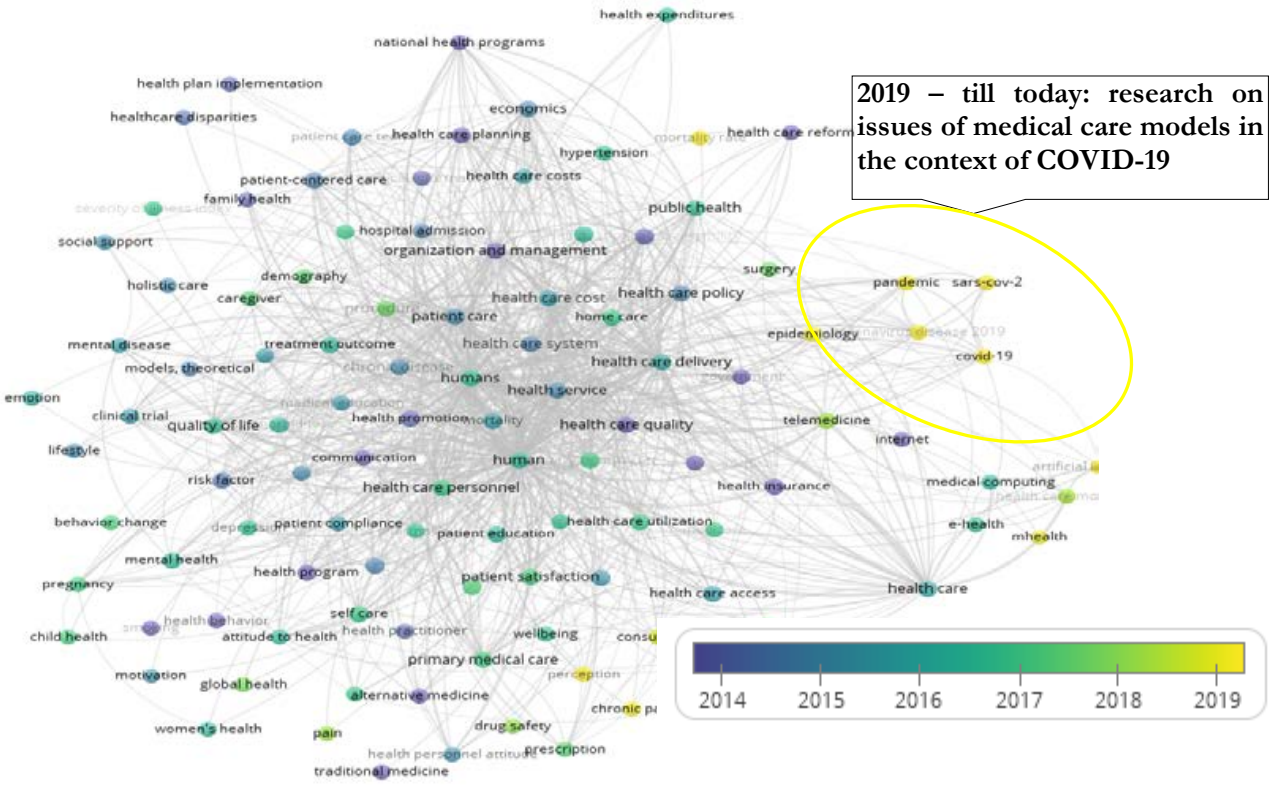

Figure 1. The results of the evolutionary meta-analysis of the scientific basis of the value of the concept of the «health care model» in the conditions of the COVID-19 pandemic

The other article focuses on the nature of the differences between countries that use the Beveridge and Bismarck models in approaches to financing and organizing health care, and the choice of the service provider [30]. The authors conclude that in countries with the Beveridge model, the choice of service providers is encouraged. Whereas in countries with the Bismarck model, the choice of specialists is limited by control or choice of the insurer based on contracts. Arguments and counter-arguments in favor of each of the models and their effectiveness in various conditions of functioning of the medical market are provided. Other scientists focused on the analysis of four models defined by the WHO: the Beveridge model, the Bismarck model, the National Health Insurance model and the out-of-pocket model [31]. They analyzed the response of health care systems to the COVID-19 pandemic by comparing the time in days to the doubling of deaths from the coronavirus. Their calculations were limited to 56 countries, which together make up to 70% of the world's population. In the research methodology, the authors used Mud's median test method. The results showed high variability of time trends in each group of countries. From their conclusions, it is clear that none of the health care models during the analyzed periods was effective. Stable interquartile ranges of values were not observed. It was noted significant difference between health care systems in financing, regulation, management, and organization. However, their main common feature is their desire to improve the health of the population and to solve the problems of prioritizing the satisfaction of health needs [32]. It is noteworthy that this work was written even before the occurrence of world events related to COVID-19, and the authors of this article note that the world is experiencing a deterioration of the general state of the environment, the lifestyle of the population of a number of countries, the growth of medical needs of people, which makes it necessary in expensive medical equipment, medicines, highly qualified personnel. All this leads to an increase in financial costs, and the authors analyze how each of the health care models is ready for this. There were analyzed scientific and theoretical approaches to evaluating the effectiveness of three health care systems – the Beveridge model, the Bismarck model, and the voluntary health insurance model. The authors concluded that the majority of measurement scales take into account parameters of technical efficiency, productivity and fairness. At the same time, there is no agreement on a single efficiency evaluation system among the theoretical and methodological approaches of scientists from different countries. Health care financing models in the context of the ability to cover the population and the ability to be self-sufficient during a pandemic were compared [33]. The author compares three basic models: Bismarck, Beveridge and the model of private health insurance, using as the initial parameters of the analysis such indicators as coverage of the population with health

care services, the share of public and private payments in health care expenditures, measures to finance services and the state health care during the COVID-19 pandemic. There were analyzed the economic efficiency of health care systems and their resilience to the impact of COVID-19 [34]. The analysis was carried out based on the use of data from 22 countries of the world. Calculations showed that the system built according to the Beveridge principle is more resistant to the impact of the pandemic than others and has the highest indicators of economic efficiency. The evolution of health care systems in response to gains in resilience in the context of the COVID-19 pandemic was examined [35]. Based on the obtained results, the authors concluded that there are disparities in the health care sectors of the EU countries regarding resistance to this factor.

As for the sphere of health care in Ukraine, scientists made a significant contribution to the study of the trends of its changes [36–47]. It is appropriate to note that various scientists measured the effectiveness of macroeconomic policy and resistance to threats from the external environment not only by comparing the effectiveness of the health care systems of the countries of the world, and in particular Ukraine, but also by other factors that are in one way or another related to health population gaps: energy efficiency, green efficiency, marketing efficiency, innovative component

Main material. The countries of the European region were chosen as the subjects of the study to evaluate the effectiveness of the population's medical care systems. Despite the existence of single development strategy trajectories for EU countries, which are prescribed in such documents as, for example, EU Global Health Strategy, EU Cohesion Policy, European Care System, countries use different models of health care system organization: Beveridge model, Bismarck model, mixed model. Among the key features of the Beveridge model is the exclusive role of the state in the health care system, which is financed mainly from the state budget through taxes collected from the population and economic entities. The population receives medical care free of charge, with the exception of a small number of services. The state is the main buyer and provider of medical services. Due to it the level of public health is maintained and improved. The payment of doctors' work depends proportionally on the number of registered and served patients – "money follows the patient". Patients could choose a doctor whose remuneration depends on the number of patients, their age, gender and social status. This approach encourages doctors to do preventive work in a timely and qualitative manner: it is more cost-effective than dealing with the consequences of diseases later. Otto von Bismarck's social health insurance system is a regulated health insurance system. It integrates the market of medical services with social guarantees and a developed system of state regulation. Medical insurance for all residents of the country with the participation of the state as a guarantor of meeting the needs of the entire society in obtaining quality medical services is mandatory. The market is a mechanism for additional satisfaction of the needs for maintaining and improving the health indicators of the population. Financing of the model is formed from the profit of insurance organizations, the state budget and deductions from the wages of employees. The proportions of funding sources depend on each specific country. In the 21st century, there is a tendency in countries with health care systems based on the Beveridge model to apply the characteristics of the Bismarck model or vice versa, which leads to the fact that the policy in the medical care in certain countries (for example, in the European region – Hungary and Slovakia) is mixed. Ukraine was also chosen for the study, whose progressive policy vector is the further approximation of all spheres of life to EU requirements, in particular the health care system, which needs to concentrate efforts on improving and increasing its compliance with EU requirements (in the European Commission's report on enlargement, published in February 2023, according to the health indicator, Ukraine received only 2 compliance points out of 5 points. It is appropriate to compare countries by groups according to health care models. The first group includes countries that follow the Beveridge model (9 countries): Greece, Denmark, Ireland, Spain, Italy, Portugal, Finland, Sweden and Ukraine. The second group (Bismarck model) includes 11 countries: Austria, Belgium, Bulgaria, Estonia, Luxembourg, the Netherlands, Germany, Poland, Slovenia, France, the Czech Republic. It is also distinguished 8 countries with a mixed system: Cyprus, Latvia, Lithuania, Malta, Romania, Slovakia, Hungary and Croatia. To investigate the effectiveness of medical care systems the number of deaths caused by COVID-19 per 100,000 of the country's existing population was chosen as a key indicator. This is an indicator capable of demonstrating the effectiveness of health care systems in leveling the negative consequences of a risk factor. It is unregulated. Indicators that also provide an opportunity to analyze efficiency (they are partially regulable):

1. The spending on health care represents the financial component of efficiency as a percentage of GDP. This indicator is within the same limits for all three groups: for the first group – from 6.68 (Ireland) to 10.87 (Sweden); for the second group – from 5.37 (Luxembourg) to 11.7 (Germany); for the third group – from 5.74 (Romania) to 8.21 (Malta).

2. The state of provision of medical and social protection of the population is represented by the number of doctors per 1,000 population. This indicator is the largest on average for the countries belonging to the Beveridge model (4.18), and the smallest in the countries of the mixed model

(3.17) and takes the average values for the countries with the Bismarck model (3.73).

3. Economic equality is demonstrated by the coefficient of uniformity of income distribution in the country – the Gini index. Moreover, when comparing the three groups, the value for the first ranges from 64.1 to 73.4; for the second group – 58.7-75.4; for the third group – 64.2-75.

4. The level of social development can be measured by the percentage of GDP allocated to the social protection of the population. The lowest level of this indicator is in countries with a mixed system – from 11.9 to 16.3%, in countries with the Beveridge model it ranges from 10.2 to 25.7%, and in countries with the Bismarck model – from 13.1 to 27.9%.

5. Behavioral indicators include, on the one hand, financing of physical activity as regulated by the country's government, and on the other hand, the percentage of smokers as regulated by the population itself. So, for the mixed system, the average values of the indicators are respectively 0.4 and 22.6, for the Beveridge model 0.4 and 16.64, and for the Bismarck model 0.41 and 20.37.

6. Volumes of the fully vaccinated population demonstrate the quality of the vaccination campaign, which for the first group of countries ranges from 38.2 (Ukraine) to 86.6 (Spain); for the second group – from 5.9 (Luxembourg) to 78.65 (Belgium); for the third group – from 41.28 (Romania) to 88.38 (Malta).

7. The quality and cost of medical services reflect the ranking of countries by the level of medicine. The best value according to this indicator has the countries following the Bismarck model (average value 72.7), the next group is the Beveridge model (68.13), mixed (62.7).

8. The country's rating by the level of development of information services demonstrates the quality and availability of information services for citizens and the literacy of the population. This parameter shows how ready society is to carry out information campaigns on the prevention and treatment of diseases. According to this indicator, countries with the Bismarck model (6.9-8.7) as the basis of their health care system have the highest value, countries with the Beveridge model (5.6-8.7) have the lowest value, countries with an average value with a mixed model (6.5-7.9).

Thus, a statistical research base was formed for 27 EU countries and Ukraine, which were previously divided into three groups according to the organization of the health care system. A key indicator has been selected that will make it possible to check how effectively the system of medical and social security of the population worked during the pandemic, and indicators with the help of which the state can change its management policy in the health care system.

Taking into account the nature of indicators. Among indicators that were selected for the study, there are stimulators (their increase contributes to the increase in the efficiency of the health care system: Health care costs, Number of doctors per 1 thousand people, Gini inequality index (by rating – the higher the value, the lower the inequality in society), Percentage of social protection expenditures, Total state spending on recreation and sports, Volume of fully vaccinated people per 100 people against COVID-19, the ranking of the country by the level of medicine, the ranking of the country by the level of development of information services, and also destimulants, i.e. a lower value of the indicator corresponds to a better situation in the system of medical and social welfare of the population: Number of deaths caused by the coronavirus, Number of cigarette smokers.

It is necessary to bring the indicators into a comparable form, that is, to turn the disincentives into stimulators for the next stages of the study, applying a relative normalization (1), which allows the worst value to be matched with the least, and the best value (for example, the lowest in the group of mortality rates from COVID-19) – the most and at the same time get rid of zero values that will be unacceptable for the next stage of DEA analysis:

$$x^*_{ij} = \frac{\min\limits_j x_i}{x_{ij}} \qquad (1)$$

where x_{ij} – input value of the i-th country, j-th indicator of the destimulator, x^*_{ij} – a the normalized value of the i-th country, j-th indicator.

Calculation of weighting factors. For the next stage of assessing the effectiveness of the population medical care system in terms of one of the three models of health care organization, it is necessary to find out the weight coefficients for each input indicator. One of the options for calculating the weighting coefficients is to assume that they are the same for nine variables by $\frac{100}{9}\%$. It is advisable to reject the hypothesis that the contribution of variables to the total dispersion of the array will be uniform and to apply suitable mathematical methods of their calculation. It should be used the method of principal components if the percentage of the total variance of the array explained by the first factor is sufficient (>75%). The Statistica software package, the Multivariate Analysis/Principal Component Analysis and Classification module were used for the calculations.

Analysis of Table 1 allows to conclude the significance of each factor selected for the study. The largest influence for the first group (corresponding to the Beveridge model) will be the number of vaccinated population, the Gini index and the ranking of the country according to the level of medicine, respectively, the values of the weighting coefficients are 26.7, 18.9 and 18.8. Variables with the least weight will be the percentage of GDP for social benefits, the number of smokers among the population, percentage of GDP for health care payments – 1.2, 2.5, and 5.7. For the second group, the set of most significant

indicators consists of the same indicators, but in a different order: the ranking of the country by the level of medicine (26.7), the Gini index (23.43) and the number of vaccinated population (14.6). The least weighty indicators of the second group include the percentage of GDP for social benefits (0.7), the percentage of GDP for health care payments (4.3) and the country's ranking according to the availability of information (4.8). For the third grou, the Gini index, the ranking of the country by the level of medicine and the number of vaccinated population were the most significant. The values of the weighting coefficients were 26.8, 19.5 and 19.3. The least weighted are the percentage of GDP for social benefits (1.6), the country's ranking according to the availability of information (4.5), percentage of GDP that constitutes health care payments (4.7).

The obtained results confirm the feasibility of dividing countries according to the models of organization of the health care system because there is a certain similarity between the list of the most important factors and, conversely, the least important. The order of variables and their weighting coefficients are different for each group of countries. Determining the efficiency of the population health care system using frontier Data Envelopment Analysis (DEA analysis). Among many efficiency measurement methods, DEA analysis was chosen as it allows taking into account several factors at once. In addition, the DEA analysis itself has several key models at its disposal, including the CCR model and the BCC model [48]. Historically, the CCR model was the first to be developed, but it was not always applicable. Therefore, the BCC model was chosen for further research, which can be considered a specific method of linear programming (2), according to which there is an objective function that must be maximized under a certain system of constraints [49]. According to the BCC model, unlike the CCR model, the place of the studied variable in a certain interval is determined from the point of view of satisfying the system of constraints and maximizing the objective function [50].

$$Death_{invers} = \sum_j w_j y_j - A \to max;$$

$$\begin{cases} \sum_i w_i x_i = 1 \\ \sum_j w_j y_j - \sum_i w_i x_i \le A \\ w_j \ge \varepsilon \end{cases} \quad (2)$$

where $Death_{invers}$ – the nverted normalized value of the number of deaths caused by the virus COVID-19; w_j – specific weight of the j-th indicator; y_j and x_i – j-th and i-th characteristics of conditional outputs/inputs, A – constant.

With the help of the Frontier Analyst software, an assessment of the effectiveness of the population health care system was carried out across three groups of European countries using the BCC model, depending on the type of health care organization system. The results of the analysis are presented in Table 2.

The analysis of Table 2 shows that Luxembourg, Netherlands, and Cyprus have the maximum marginal value. Among the countries with the lowest efficiency (less than 40%): Hungary (20.1), Croatia (23.3), Lithuania (27.4), Latvia (31.2), Greece (31.6), Italy (34.5), Spain (38.4), Slovakia (28.6), Czech Republic (37.2), Bulgaria (39.3), Romania (33.7) and Portugal (39.7). Countries with higher indicators of the marginal value of the efficiency of the health care system are more resistant to the influence of public health risk factors. They can mobilize available resources more effectively to achieve the strategic goals of stopping the negative impact of pandemics and other threats of this type. It is more difficult for countries with low efficiency to maintain the pre-crisis level of health system regulation. As a result, they experience greater levels of negative consequences from public health impacts.

A more detailed analysis of the results of DEA modeling and the identification of reserves and potentials for each factor involved in the study are presented in tables 3-5. The model for countries with the Beveridge model demonstrated that for Ireland and Ukraine, all indicators of the sys-

Table 1

Weighting coefficients

	1st group	2nd group	3rd group
% of total variance explained by the first factor	97.52	95.5	97.72
Health spending as a percent of GDP	5.68	4.3	4.71
Doctors per 1000 people	8.56	7.11	6.77
Gini inequality index	18.91	23.43	26.81
Social protection expenditures of GDP	1.17	0.69	1.62
General government expenditures on recreation and sports of GDP	11.23	9.29	8.6
Covid fully vaccinated people per hundred people	26.74	14.59	19.25
Daily smokers of cigarettes	2.5	9.09	8.29
Ranking of countries by the level of medicine	18.79	26.7	19.45
Ranking of countries by the level of development of information services	6.41	4.81	4.5
Total	100	100	100

Table 2

The effectiveness of the system of medical provision of the population of European countries

1st group		2nd group		3rd group	
Greece	31.6	Austria	61.3	Cyprus	100
Denmark	66.5	Belgium	48.4	Latvia	31.2
Ireland	83.8	Bulgaria	39.3	Lithuania	27.4
Spain	38.4	Estonia	67.9	Malta	47.8
Italy	34.5	Luxemburg	100	Romania	33.7
Portugal	39.7	Netherlands	100	Slovakia	28.6
Finland	59.7	Germany	72.1	Hungary	20.1
Sweden	41.1	Poland	55.2	Croatia	23.3
Ukraine	64.4	Slovenia	47.1		
		France	54.5		
		Czech Republic	37.2		

tem of medical and social security of the population coincide with the marginal values. The governments of other countries need to adjust their policies to have higher values. For Greece it is fundamental to reduce the number of smokers, increase health care costs and improve the country's ranking in terms of medicine; at the same time, there is a sufficient reserve for state support for sports and the number of doctors. Decrease in these indicators by the specified percentage will not worsen the overall level of effectiveness of the system of medical and social welfare of the population. Denmark has a high level of efficiency (68%). But the general mortality rate of the population from COVID-19 is critical. It is advisable to increase the number of doctors and medical expenses. On the contrary, it has reservations about those vaccinated against COVID-19, and the country's rating both in terms of the level of medicine and in terms of the availability of information. It is advisable for the Spanish government to review the possibilities of influencing the population to reduce the number of smokers, to increase spending on health care; reserves are available for the number of vaccinated population and the amount of social benefits. Portugal should increase the number of doctors, reduce the number of smokers; there are reserves for the number of vaccinated and for state payments for sports. Finland should increase the number of doctors and medical expenses; its reserve are state payments for sports and social protection. Sweden is recommended to increase the number of doctors and the amount of social benefits; the reserve exists for state payments for sports and the number of smokers. Most of the countries of the Beveridge model group should pay attention to the behavioral aspects of strengthening measures to counter threats to public health and to the financial indicators of expenditures on medicine and social protection. A detailed analysis of Table 4 makes it possible to formulate advice for the countries of the second group with the Bismarck model on improving the efficiency of the system of medical and social welfare of the population. Among the countries of this group, Bulgaria, Luxembourg, and the Netherlands have an "ideal" marginal efficiency value, the rest of the countries should review their indicators for the possibility of their improvement; reserves are available regarding the number of doctors and the number of the fully vaccinated population against COVID-19. Belgium should increase the number of doctors and sports funding; however, there are reserves in the number of vaccinated and payments to the medical sector.

Estonia should reduce the number of smokers and increase budget spending on social benefits; there are reserves in the number of vaccinated population and in the amount of sports funding. Germany should reconsider its policy on increasing funding for physical activity; reserves are available for social security payments, the number of vaccinated population and the number of smokers. Poland needs to increase the number of doctors, improve the country's rating in terms of medicine; reserves include the number of vaccinated population and the indicator of social inequality – the Gini index. It is advisable for Slovenia to increase funding for sports, improve its position in the ranking by the level of medicine; reserves include the number of vaccinated population and state payments for medicine. France should increase the number of doctors and reduce the number of smokers; reserves include payments for social protection and state financing of sports. The Czech Republic needs to reduce the number of smokers and increase the level of social assistance; reserves – the number of vaccinated population and the number of doctors. So, in the group of countries with the Bismarck model of the health care system, among the measures to improve the efficiency of the medical care system, informational and resource-related measures prevail, namely, the financing of physical activity and, as a result, the promotion of a healthy lifestyle, and an increase in the number of doctors.

A detailed analysis of Table 5 makes it possible to formulate advice for countries with a mixed health care model to improve the efficiency of the health care system. Among the 8 countries in this group, Cyprus and Romania have the best marginal efficiency value. The governments of the rest of the countries should adjust their poli-

Table 3

Availability of reserves and development potential of countries with the Beveridge model according to DEA analysis, %

	Death/100K population	Health spending as a percent of GDP	Doctors per 1000 people	Gini inequality index	Social protection expenditures	Government expenditures on recreation and sports	Covid fully vaccinated people	Daily smokers of cigarettes, %	Ranking level of medicine	Ranking of the level of development information
Greece	216.3	20.9	-27.2	-2.8	-12.3	-27.9	-8.7	94.6	19.4	5.5
Denmark	50.3	6.7	21	1.8	-1.7	1	-6.8	-0.6	-4.6	-1.8
Ireland	19.4	2.6	-4.2	-31.3	39.8	160.5	-39.9	-33.8	-6.8	5.8
Spain	160.5	12.1	8.1	7.8	-4	-2.7	-15.2	72.7	-6.8	5.8
Italy	189.5	7.6	12.8	0.2	-22.6	18.2	-18.6	23.4	0.3	6.7
Portugal	151.8	3.4	42.7	2	8.5	-6.4	-19.3	22.1	-1.7	11.2
Finland	67.4	14.9	46.2	-0.5	-14.8	-33.4	-5	-7.2	-1.2	7.4
Sweden	143.4	-4	17.6	2.5	-14.8	-33.9	2.2	-31	8.8	-0.1
Ukraine	55.3	-19.7	-8.4	-46.5	-25.8	116.8	5.9	8.4	-23.4	-18.3

* a negative value – there is a certain reserve, the value can be reduced if necessary; positive value – the value should be increased to achieve the ultimate, maximum efficiency

Table 4

Availability of reserves and development potential of countries with the Bismarck model according to DEA analysis, %

	Death/100K population	Health spending as a percent of GDP	Doctors per 1000 people	Gini inequality index	Social protection expenditures	Government expenditures on recreation and sports	Covid fully vaccinated people	Daily smokers of cigarettes, %	Ranking level of medicine	Ranking of the level of development information
Austria	63.1	-9.4	-34.5	-3.1	-29.6	55.5	-16.8	29.6	-9.9	-1.3
Belgium	106.6	-7.1	16.6	-3.5	-25.6	22.2	-15.4	-2.3	-1.5	6.2
Bulgaria	154.2	-9.1	-38.6	-21.6	-16	60	42.4	1.6	-13.6	-20.8
Estonia	47.2	39.3	1.9	-4.5	8.3	-22.9	-1.5	22.2	-3.7	-3.5
Luxemburg	0	0	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0	0	0
Germany	38.7	-17.2	-18.1	0.9	-24.6	59.3	-14.6	-16.6	-1.8	-3.3
Poland	81.1	25.4	28.5	-17.7	-24.5	-0.2	-4.2	1.7	3.8	-1.6
Slovenia	112.2	2.7	0.3	-17.6	-20.5	44	2	-9.6	0.3	-0.6
France	83.7	-8.3	20.9	6.5	-36.9	-16.6	-13	19.3	-6.4	3.1
Czech Republic	168.5	21.5	-12.3	-10	13	17.4	-2.6	15.8	-5.6	11.4

* a negative value – there is a certain reserve, the value can be reduced if necessary; positive value – the value should be increased to achieve the ultimate, maximum efficiency

cies to improve the effectiveness of the system of medical and social protection of the population. In particular, Latvia should improve the level of information available for the population and the percentage of payments for medicine; reserves are available in the number of doctors and the country's rating by the level of medicine. Lithuania should improve informatization and the dynamics of the vaccination campaign; reserves are the number of doctors and the amount of sports funding. Malta should increase the amount of social protection; the reserve is in the ranking of the country by the level of medicine and the number of doctors. Slovakia needs to increase the pace of the vaccination campaign and increase the amount of sports funding; reserves are the number of doctors and the amount of social protection. Hungary needs to increase the pace of the vaccination campaign and improve the level of informatization; reserves include the amount of funding for sports and the number of doctors. Croatia should increase the pace of the vaccination campaign, improve the availability of information for the population; reserves are in the financing of physical activity and the number of doctors. To summarize, the countries in this group have the worst performance on average and tend to have low values of vaccinated populations, but all have a sufficient number of qualified doctors.

For this group of countries, the predominant growth factors are improving the availability of information for the population (informatization

Table 5

Availability of reserves and development potential of countries with a mixed model according to DEA analysis, %

	Death/100K population	Health spending as percent of GDP	Doctors per 1000 people	Gini inequality index	Social protection expenditures	Government expenditures on recreation and sports	Covid fully vaccinated people	Daily smokers of cigarettes, %	Ranking level of medicine	Ranking of the level of development information
Cyprus	0	0	0	0	0	0	0	0	0	0
Latvia	220.8	10.6	-39.4	7.6	3	3.8	6	-0.8	-12	11.1
Lithuania	264.8	11.3	-51.6	16.5	-8.5	-25.8	17.4	-10.8	-17.4	20.1
Malta	109.2	2.2	-19.5	13	34.8	19.7	-2.3	-10.2	-24.2	-18.2
Romania	196.6	10.3	-40.9	-5.3	-11.6	-39.8	57.8	-29	-15.1	8.3
Slovakia	249.8	-2.3	-47	-12.9	-18.2	-3	53.1	-13	-16	6.9
Hungary	397.1	16.6	-34.4	0.9	4	-83.8	22.2	8.1	7.8	18.1
Croatia	328.6	5.5	-31.7	0.6	-10.9	-47.5	35.7	2.2	-13.8	12.3

* a negative value – there is a certain reserve, the value can be reduced if necessary; positive value – the value should be increased to achieve the ultimate, maximum efficiency

level) and adjusting the pace of the vaccination campaign.

Conclusions. According to the results of the conducted research on the analysis of the effectiveness of the medical care systems of the EU countries and Ukraine using frontier analysis, no model that could be called exceptionally effective was found. According to each model, there are countries that are close to the "ideal" state of efficiency, those that have a certain reserve of indicators to reach the marginal state, and those countries that are far behind others and need additional government efforts to improve their resistance to epidemic threats. The best positions in terms of efficiency are in such countries according to the Berevage model as Ireland, Ukraine; according to the Bismarck model – Bulgaria, Luxembourg, Netherlands; according to the mixed model – Cyprus and Romania. According to the Beveridge model, it is advisable for other countries to pay attention to the behavioral factor of the effectiveness of their health care systems, which is demonstrated in this analysis by the population's tendency to smoke. In addition, the recommendations cover the need to increase funding for medicine and social protection. Among the measures recommended for countries that have low positions in the efficiency of the health care system according to the Bismarck model, are those that have an informational and resource orientation, aimed at supporting and stimulating a healthy lifestyle, as well as providing the medical system with human resources, are of primary importance. For the group of countries of the mixed model, recommendations of this kind will already concern improving information work with the population and emphasis on the vaccination campaign. The conclusions of this study can be useful in the development of national strategies for the development of health care systems, as well as in the selection of vectors on which it is appropriate to concentrate efforts in the conditions of factors that threaten public health, one of which is analyzed in detail in this study – the COVID- 19. In the future, it is planned to supplement the analysis with indicators that stimulate national development and at the same time could serve as indicators of the effectiveness of medical care in the country.

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