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STATE POLICY OF ENSURING THE FINANCIAL SECURITY OF THE HEALTHCARE SYSTEM IN CRISIS CONDITIONS

ABSTRACT

The healthcare system in crisis conditions faces a combination of price pressure, instability of budget planning, changes in the structure of demand for medical services, and an increase in the risk of accumulating overdue liabilities, which directly affects the financial security and continuity of assistance to the population. The purpose of the work is to substantiate adaptive approaches to the state policy of financial security of healthcare based on econometric modeling and scenario forecasting. The methodological basis of the study is the construction of a panel data set for 2020–2024 for the western regions, assessment of the relationships between key financial and operational indicators, as well as regression modeling of the financing deficit. In the model, the deficit is interpreted as a gap between the need for spending and available financing, and its dynamics are explained by the intensity of demand, which is reflected through the volume of hospitalizations, inflationary pressure in the medical segment, which is taken into account with a nonlinear effect, and the structural shift of the crisis period. Additionally, an integral risk index was formed that aggregates deficit pressure, debt burden, the impact of inflation, and the compensating effect of covering the need with financing, which allows assessing financial security not by a single indicator, but as a multi-component state of the system. At the final stage, a scenario forecast for 2026 was performed for alternative conditions that differ in the growth rate of financing, the trajectory of demand, and price parameters.

The proposed approach can be used by state authorities and regional managers to implement an adaptive policy of financial security in healthcare. The proposed solutions include mechanisms for automated adjustment of financial parameters, early warning rules for deficits, tools for smoothing budget fluctuations, and debt burden control.

Keywords: public policy, financial security, healthcare system, crisis conditions, budget financing, prioritization of expenditures, risk management

JEL Classification: I18, H51, H12

INTRODUCTION

The relevance of the topic of state policy to ensure the financial security of the healthcare system has increased sharply due to the full-scale armed invasion, since the very logic of the functioning of medicine during war changes. Therefore, the need for medical services is increasing, in particular due to injuries, rehabilitation, the needs of internally displaced persons, worsening of chronic diseases, and increased demand for psychosocial support. On the other hand, the financial base of the system is weakening due to the decline in economic activity, pressure on the state budget, and competition for resources between defense, social protection, and other critical areas. Moreover, an additional shock is created by direct losses of infrastructure and security risks for institutions and personnel, because the World Health Organization itself regularly records attacks on medical care in Ukraine, which directly affects costs, logistics, availability of services, and the need for reserve funding. In such conditions, the financial security of the healthcare system means the state's ability to continuously pay for a guaranteed package of services, maintain a network of institutions, provide medicines and consumables, support emergency medicine, and make stable payments to service providers even when supply chains are disrupted, migration waves occur, and the structure of the

population's needs changes. That is why research into public policy is necessary, because without a scientifically sound set of tools, prioritization rules, redistribution mechanisms, and control of financial flows, the system may lose control, and the population may experience an increase in its own costs for treatment and, as a result, a decrease in access to care. At the same time, the war in our country is testing the strength and reform of healthcare financing, built around state financial guarantees, where it is important not only to preserve achievements, but also to adapt them to military risks. The importance of this topic lies in the fact that the financial security of healthcare in a crisis is not only a question of expenditure, but also a question of the stability of the state, the trust of citizens, and the ability of society to recover. Our state must simultaneously solve several complex tasks, ensure transparent and fair financing of guaranteed services, adjust the payment of medical care to the real costs of institutions in war, reduce financial barriers for patients, and build a control system that restrains abuse in conditions of urgent procurement and high uncertainty. It is also important that the military financing model inevitably combines domestic resources with donor support, so state policy must create rules for coordination, program compatibility, reporting, and accountability so that external funds strengthen national mechanisms, rather than replace them with temporary solutions.

LITERATURE REVIEW

In modern scientific and practical literature, the state policy of financial security of the health care system is most often revealed through the concept of fiscal space, which the authors associate with the state's ability to mobilize additional resources without destroying macro-financial stability, as well as with how effectively existing funds are converted into real services. For example, Meheus and McIntyre (2017) emphasize that in countries with budget constraints, domestic sources of financing, tax policy, prioritization of expenditures, and the government's ability to reconcile health care needs with other social obligations become crucial.

In the same vein, Barroy et al. (2018) consider the assessment of fiscal space in the context of the Sustainable Development Goals and show that the potential for expanding financing for health care is determined not only by technical calculations, but also by institutional conditions, budget rules, public finance management, and the political economy of resource redistribution. An important addition is the position of Zeng et al. (2020), who review the evidence based on whether efficiency gains and waste reduction can create additional resources for the sector, emphasizing that the link between efficiency and real increases in fiscal space is not automatic and depends on redistribution mechanisms, incentives, and budget procedures.

A comparative macro-level perspective is added by Micah et al. (2019), who, using country-specific data, demonstrate that the dynamics of public health spending vary significantly across countries and are determined by a set of drivers, including economic growth, total government spending, and structural factors. Stuckler et al. (2009), based on cross-country analysis, show that labor market shocks and economic downturns can worsen health outcomes, but the magnitude of the effects depends significantly on alternative policy responses, primarily social protection and active support programs.

In the context of fiscal dynamics, Cylus et al. (2012) find that after economic downturns, the growth of public health spending tends to slow down compared to the trajectory that would be expected under long-term trends, i.e., the crisis itself poses the risk of pro-cyclical financing squeezes.

In European work, Karanikolos et al. (2013) and Quaglio et al. (2013) systematize the consequences of the financial crisis and austerity policies, highlighting that the combination of fiscal constraints and insufficient social protection can increase inequalities in access to care and undermine the sustainability of health systems.

Empirical studies in EU countries deepen this understanding at the household level. Chantzaras and Yfantopoulos (2018) analyze household financial protection against health costs during the crisis and show the risks of increasing out-of-pocket burdens and uneven impact on different population groups. Crookes et al. (2020) demonstrate, through an analysis of interrupted time series, the changing trends in household health expenditure during the crisis and the shifts in the structure of expenditure, illustrating how budgetary decisions and co-payment mechanisms can shift the financial burden to the population.

Gadsden et al. (2022) summarize the first stages of the financial policy response, describing the combinations of coverage, payment, and financing solutions that countries used to rapidly expand access, support health care providers, and provide additional resources for emergency needs. For the topic of financial security in crises, this material is important because it demonstrates the practical need for pre-prepared rules for flexible reallocation of funds, for mechanisms for rapid contracting and tariff adjustments, for special funds or budget programs, and for control procedures that maintain accountability even with accelerated procurement and urgent payments.

Combining these findings with the approaches to fiscal space and efficiency proposed by Meheus and McIntyre (2017), Barroy et al. (2018), and Zeng et al. (2020), it becomes clear that fiscal resilience in a crisis requires not a single solution but a holistic policy architecture where macrofiscal capacity, budgetary rules, efficiency incentives, household protection instruments, and emergency financing regimes are aligned. For the war context, Kim et al. (2024) provide a typology of verified attacks on health care and show persistent pressure on facilities and transports, while Haque et al. (2022) describe displacement and infrastructure destruction as key drivers of additional stress for service delivery and financing.

AIMS AND OBJECTIVES

The purpose of the study is to substantiate the approaches of the state policy of ensuring the financial security of the healthcare system in crisis conditions based on econometric modeling of the factors of the funding deficit and scenario forecasting for the western regions of our country. To achieve the goal:

- a system of indicators of the financial security of healthcare for the regional level was formed;
- the influence of key factors is estimated using a regression model, taking into account structural changes in the crisis period;
- an integral risk index was constructed, and its dynamics were interpreted in connection with the indicator of coverage of the need by funding;
- a scenario forecast for 2026 was performed for alternative development conditions, and management levers were identified that allow reducing the deficit and financial risk.

METHODS

The research methodology is built as a sequential chain of quantitative procedures that allows you to move from the formation of a database to explaining the reasons for the funding deficit, assessing risk, and predicting possible scenarios. This kind of methodological approach is especially appropriate in crisis conditions, since state policy should be based not on one-time assessments, but on reproducible rules. The first stage is the construction of a data set for 2020–2024 for selected western regions. This format means that for each region, the observation is repeated in time, which allows you to analyze the dynamics and compare territories with each other. The main variables were budget financing, estimated expenditure needs, deficit gap, financing needs coverage indicator, debt burden proxy, overdue liabilities proxy, medical inflation, and hospital load indicator due to the volume of hospitalizations.

Correlation analysis was applied. Its content is the direction of the linear relationship between pairs of variables, which is especially important for understanding which indicators move in concert and which compensate each other. In our work, correlations were presented as a rating of pairs of variables by the absolute value of the coefficient. This format is more applicable to public policy because it immediately shows the strongest relationships, for example, the relationship between the deficit and the risk index, the relationship between coverage and risk, and the relationship between arrears and debt burden.

Regression modeling was used, which is the basis of our methodology. The purpose of regression is to assess how changes in factors affect the financing gap, which we denote as the Gap. Regression modeling is the core of our methodology. We estimate an econometric regression model for the financing gap (Gap), interpreted as the difference between expenditure needs and available funding. The model specification is (1):

$$\text{Gap}_{i,t} = \beta_0 + \beta_1 \text{MedInfl}_{i,t} + \beta_2 \text{MedInfl}_{i,t}^2 + \beta_3 \text{Hosp}_{i,t} + \beta_4 \text{Post2022}_t + u_{i,t}, \quad (1)$$

where i denotes the region, and t denotes the year. $\text{MedInfl}_{i,t}$ is medical inflation in %, $\text{Hosp}_{i,t}$ is the volume of hospital admissions (thousand), and Post2022_t is an indicator equal to 1 for years 2022–2024 and 0 otherwise. The quadratic term MedInfl^2 captures nonlinearity, meaning that the marginal effect of inflation on the gap depends on its level.

An index method is used, that is, the construction of an integral risk index D. Its content consists of the aggregation of several partial components that reflect various channels of financial danger, deficit pressure, debt constraints, delinquency, inflationary pressure, and the compensating effect of coverage (2):

$$D_{i,t} = w_1 \text{Gap}_{i,t} + w_2 \text{DebtLoad_ratio}_{i,t} + w_3 \text{Arrears}_{i,t} + w_4 \text{MedInfl}_{i,t} + w_5 (1 - \text{Coverage_ratio}_{i,t}) \quad (2)$$

We construct an integral risk index $D_{i,t}$ by aggregating several partial components that represent key channels of financial danger.

RESULTS

It should be noted that we take only the western regions of our country, because they are characterized by higher continuity of the organization of medical services compared to the territories where active hostilities are taking place, that is, the eastern regions. Therefore, this is important precisely for the stress test, since our goal is not to record extreme destruction, but to check whether the system is able to maintain financial stability when demand and costs grow, and financing does not always keep up with expenses. The period from 2020 to 2024 allows us to see a change in equilibrium in several consecutive phases of the crisis external environment, when the population's needs for medical services and resource prices changed simultaneously.

At the same time, we immediately separate what input data is from what our calculations are. The input data are the volumes of financing, actual expenditures, overdue liabilities, hospitalizations, and the medical inflation indicator. The indicators we calculated are the financial gap Gap, the coverage ratio Coverage_ratio, and the relative debt load Debt_Load_ratio. Thus, in 2020 and 2021, financing almost covers expenditures, so the Gap is relatively small, and the Coverage_ratio is around 0.96–0.97 (Table 1).

Table 1. The main health-finance indicators, Western Regions, 2020–2024. (Source: State Statistics Service of Ukraine)

Region	Year	Funding, B, UAH million	Expenditure, E, UAH million	Arrears, UAH million	Hospital Admissions, thousand	Medical Inflation, %	Gap, UAH million	Coverage_ratio	Debt_Load_ratio
Lviv	2020	24025.901	24901.202	513.508	212.07	6.71	875.301	0.9648	0.0214
	2021	25389.315	26212.145	514.308	224.96	10.29	822.83	0.9686	0.0203
	2022	28074.749	30573.89	901.189	247.48	25.12	2499.141	0.9183	0.0321
	2023	30426.96	32035.031	732.74	239.93	15.19	1608.071	0.9498	0.0241
	2024	32984.287	34435.312	672.006	231.66	7.99	1451.025	0.9579	0.0204
Ivano-Frankivsk	2020	12420.809	12902.113	289.54	122.06	7.07	481.304	0.9627	0.0233
	2021	13259.782	13885.946	306.414	127.1	10.23	626.164	0.9549	0.0231
	2022	15066.458	16584.053	512.601	138.29	24.4	1517.595	0.9085	0.034
	2023	16436.107	17144.883	442.229	132.22	14.55	708.776	0.9587	0.0269
	2024	17871.524	18531.878	384.521	131.36	7.88	660.354	0.9644	0.0215
Ternopil	2020	9049.274	9372.475	202.247	92.85	6.83	323.201	0.9655	0.0224
	2021	9658.313	10041.859	209.402	98.28	10.09	383.546	0.9628	0.0217
	2022	11006.347	12291.355	377.537	109.62	24.05	1285.008	0.8952	0.0343
	2023	12005.184	12515.709	323.409	105.62	14.26	510.525	0.9592	0.0269
	2024	12946.02	13628.064	279.682	103.71	7.65	682.044	0.95	0.0216
Volyn	2020	9765.215	10169.314	223.934	97.37	6.9	404.099	0.9602	0.0229
	2021	10443.452	10819.677	229.312	104.66	10.07	376.225	0.9652	0.022
	2022	11875.762	13290.718	424.353	117.46	24.25	1414.956	0.8934	0.0357
	2023	12827.216	13400.148	350.84	112.78	14.5	572.932	0.9572	0.0273
	2024	14037.718	14653.2	310.546	110.74	7.79	615.482	0.9579	0.0221
Rivne	2020	10180.44	10561.785	229.398	104.77	6.97	381.345	0.964	0.0225
	2021	10839.193	11264.64	240.913	111.58	10.07	425.447	0.9622	0.0222
	2023	13735.223	14223.404	377.96	120.93	14.88	488.181	0.9657	0.0275
	2024	14972.432	15672.768	342.305	117.96	8.06	700.336	0.9553	0.0229
Zakarpattia	2020	8779.269	9109.75	194.225	90.31	6.58	330.481	0.9637	0.0221
	2021	9179.656	9491.924	200.417	95.13	9.78	312.268	0.9671	0.0218
	2022	10523.834	11673.634	363.056	107.99	23.62	1149.8	0.9015	0.0345
	2023	11768.313	12225.821	307.149	103.55	14.05	457.508	0.9626	0.0261
	2024	12770.72	13315.71	272.391	100.96	7.55	544.99	0.9591	0.0213
Chernivtsi	2020	7618.713	7899.089	169.903	76.93	6.47	280.376	0.9645	0.0223
	2021	7990.886	8305.604	180.844	83.42	9.69	314.718	0.9621	0.0226
	2022	9302.389	10409.064	318.916	95.35	23.44	1106.675	0.8934	0.0343
	2023	10172.058	10612.031	280.642	91.41	13.89	439.973	0.9585	0.0276

The data from Table 2 is needed for an initial check of realism before we move on to the actual stress scenarios and probability estimates. It can be seen here that average expenditures are higher than average financing, so the deficit is a systemic risk, not a random anomaly. For example, Coverage_ratio is on average about 0.95, which means that the deficit is on average a few percent of the needs. It is important that DebtLoad_ratio also has an upper limit of about 0.039, which is similar to a situation where overdue liabilities can still be managed to “stretch” over time, but with an additional shock, they quickly turn into a structural problem (Table 2).

Table 2. Descriptive evidence on the healthcare financial security indicator.

Variable	Mean	StdDev	Min	Max
Funding, B, UAH million	13944.779	6038.846	7618.713	32984.287
Expenditure, E, UAH million	14652.733	6347.176	7899.089	34435.312
Arrears, UAH million	347.678	156.965	169.903	901.189
Hospital Admissions, thousand	125.099	43.424	76.93	247.48
Medical Inflation, %	12.644	6.58	6.468	25.117
Gap, UAH million	707.955	485.328	280.376	2499.141
Coverage_ratio	0.951	0.026	0.891	0.9722
DebtLoad_ratio	0.025	0.006	0.018	0.039

Let us present the Average Coverage Ratio (Figure 1). Thus, we see a more stable coverage level in 2020 and 2021, then a noticeable deterioration occurs in 2022, after which a partial recovery is observed in 2023 and 2024. This is a key motivation for the stress test, since it is the fall in Coverage_ratio that indicates that the system is entering the zone of increased risk of deficit, and we need scenarios that explain under which combinations of shocks this fall becomes critical. This graph is also the basis for the next step, where we will compare the average values before 2022 and after 2022, and show which factors shift the equilibrium the most.

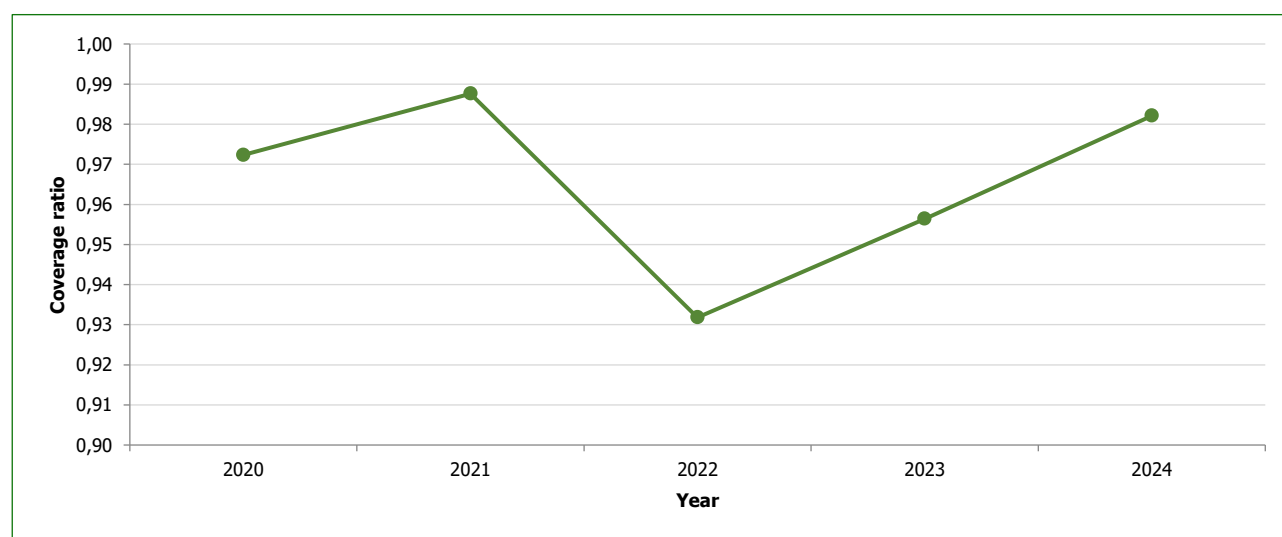


Figure 1. Average Coverage Ratio (Funding / Expenditure), Western Regions, 2020 to 2024.

Table 3 shows the “turning point” in the financial security of the healthcare system in our country between two phases, before 2022 and after 2022. In the post-crisis phase, the average Expenditure_E increases, and the growth of Funding_B does not keep up with expenses, so the Gap increases significantly, which is a direct marker of the deterioration of financial sustainability. At the same time, Arrears increase, that is, the system begins to transfer the deficit to future periods, which is risky, because delays increase the likelihood of procurement disruptions and delays in payment for critical services. Separately, it is seen that MedicalInflation almost doubles, and Coverage_ratio decreases.

Table 3. Comparison of mean values before 2022 and after 2022.

Variable	Pre 2022, mean	Pre 2022, std	Post 2022, mean	Post 2022, std	Delta, mean
Funding, B, UAH million	11964.645	5205.922	15280.93	6265.068	3316.284
Expenditure, E, UAH million	12408.161	5377.076	16247.421	6564.067	3839.259
Arrears, UAH million	262.173	104.593	412.904	156.156	150.731
Hospital Admissions, thousand	116.975	41.964	129.89	44.454	12.915
Medical Inflation, %	8.433	1.684	15.479	6.935	7.046
Gap, UAH million	443.516	222.48	966.491	625.69	522.975
Coverage_ratio	0.966	0.003	0.94	0.028	-0.026
DebtLoad_ratio	0.022	0.001	0.028	0.006	0.006

In correlations, we see two key elements that are important specifically for the state policy of financial security. Thus, the “scale” itself, because financing, expenditures, and hospitalizations move together, is a normal property of large regions. Also, it is “shock”, and it is critically important. MedInfl has a strong negative relationship with Coverage, and a strong positive relationship with Gap and DebtLoad. This means that inflationary pressure in the healthcare system in our country simultaneously worsens the coverage of needs and strengthens the mechanism of accumulation of overdue obligations. Arrears are also strongly related to Gap, so the deficit does not remain “just a calculated value”, but actually turns into debt pressure. That is why we further test not only the linear form of the model, but also the nonlinear one, because with high inflation, the deficit response usually accelerates (Table 4).

Table 4. Ranking pairs of variables by strength of association.

Variable 1	Variable 2	Correlation r	Strength
Funding, B, UAH million	Expenditure, E, UAH million	0.9783	Very strong
Gap, UAH million	Risk Index, D	0.9549	Very strong
Coverage_ratio	Risk Index, D	-0.9505	Very strong
Medical Inflation, %	Risk Index, D	0.9443	Very strong
Expenditure, E, UAH million	Arrears, UAH million	0.9215	Very strong
DebtLoad_ratio	Arrears, UAH million	0.9157	Very strong
Gap, UAH million	Debt Load, ratio	0.9034	Very strong
Gap, UAH million	Medical Inflation, %	0.9014	Very strong
DebtLoad_ratio	Risk Index, D	0.8788	Very strong
Gap, UAH million	Coverage_ratio	-0.8682	Very strong
Coverage_ratio	Medical Inflation, %	-0.8632	Very strong
Funding, B, UAH million	Arrears, UAH million	0.8386	Very strong

Table 5 shows that the best model is the Quadratic inflation (Gap), i.e., a model with a quadratic effect of inflation. This is an important result for public policy because it means that the deficit responds to inflation at an accelerated rate. Simply put, with each subsequent point increase in inflation, the deficit increases more than the previous one. In such a situation, standard “linear” budget adjustment mechanisms may not keep up, and then delays accumulate.

Table 5. Comparison of functional forms.

Model	AIC	BIC	Adj_R2	RMSE	MAE
Quadratic inflation (Gap)	500.481	510.615	0.943	108.535	81.167
Log-linear (exp fitted)	3.084	11.529	0.824	162.555	129.799
Linear (Gap)	543.98	552.425	0.827	191.677	149.32

Next, we present the result of the selected regression model for the funding gap, i.e., Gap. We have retained precisely those variables that provide a stable interpretation for the state policy of financial security of the healthcare system in our country. The key point is that Gap is the difference between the need for spending and available funding, so including funding as an explanatory variable often creates an algebraic dependence and distorts the signs of the coefficients (Table 6).

Table 6. Coefficients of the selected model.

Term	Coefficient	Standard error	t statistic	p value	95 percent confidence interval lower	95 percent confidence interval upper
Constant	411.977	102.398	4.024	0.0002	203.616	620.338
Medical inflation, %	-129.769	21.21	-6.117	<0.0001	-172.965	-86.572
Medical inflation squared	5.396	1.073	5.028	<0.0001	3.209	7.582
Hospital admissions, thousand	6.222	0.653	9.532	<0.0001	4.892	7.552
Post 2022 indicator	213.4	38.041	5.61	<0.0001	136.017	290.783

We used three scenarios to show not one “average” trajectory but a range of possible outcomes in a crisis, as key drivers of the deficit are uncertain, primarily inflationary pressures, hospitalizations, and budget decisions on compensation. This allows us to test the robustness of conclusions and policies, i.e., whether the financing system “breaks” under the worst shock, and at the same time assess what effect a more favorable combination of conditions would have in an optimistic scenario. Thus, the baseline scenario reflects the most likely course of events if current trends continue, the optimistic scenario shows what results can be achieved with better demand management, more efficient procurement, and more predictable indexation of financing, and the stress scenario sets a “strength test,” i.e., conditions under which the deficit and risk can increase sharply due to the simultaneous deterioration of key factors. The scenario approach is needed to see in advance how the deficit, coverage, and risk profile will change under different conditions, and on this basis to form response rules, backup mechanisms, and policy priorities, rather than making decisions after financial instability has manifested itself in the form of accumulated debts and arrears.

Next, we will present a direct scenario forecast for 2026, which is needed for completion, because policy always works through a comparison of regimes, not through a single trajectory. In the Baseline scenario, we see some moderate growth in funding and moderate growth in demand. In the Optimistic scenario, we can see better demand management, i.e., a lower trajectory of hospitalizations, as well as parameters that correspond to better stabilization of financial processes. In the Stress scenario, we observe a negative cost shock and a higher trajectory of hospitalizations, which puts pressure on the Gap even in the presence of an increase in funding (Figure 4).

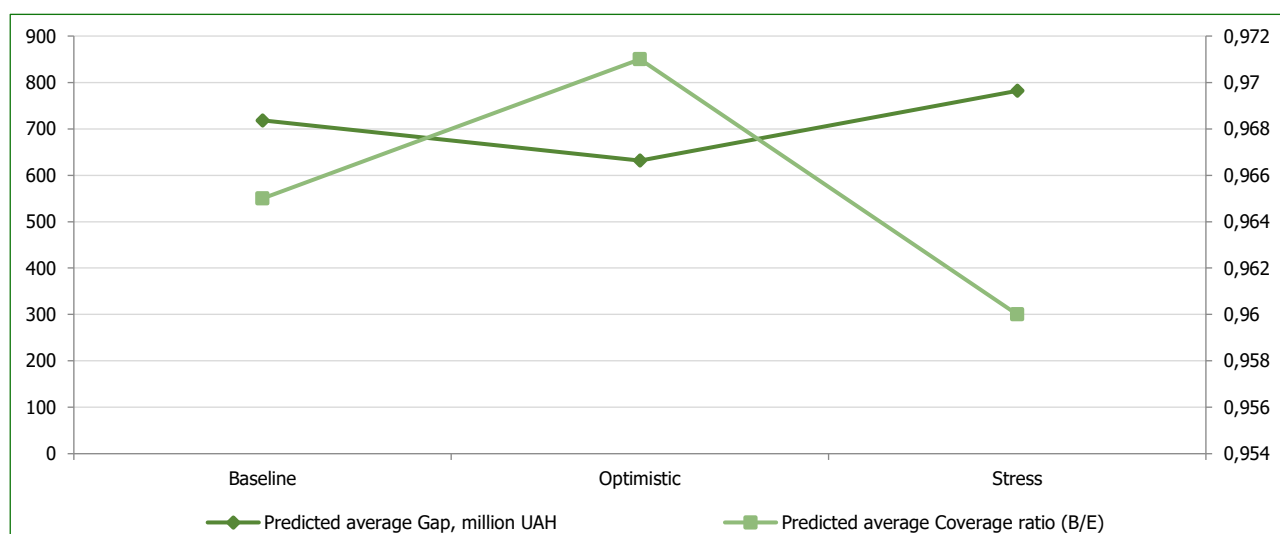


Figure 4. Scenario Forecast 2026, Western Regions Average.

Our analysis for the western regions of our country showed that the financial security of the healthcare system is formed not only by the level of budget financing, but also by how quickly and accurately the system “adjusts” financing to changing

needs. According to the Gap deficit model, the key drivers are the intensity of demand, which we reflected through the volume of hospitalizations, as well as inflationary pressure in the medical segment, which has a nonlinear effect and can accelerate the deterioration of indicators when going beyond a certain range. The correlation structure confirmed that the deficit and arrears are interconnected with the debt burden; therefore, policy should simultaneously “close” the deficit and prevent the accumulation of debt. The 2026 scenario forecast emphasized that even in relatively stable regions, different trajectories are possible, where the optimistic scenario is achieved not only by greater financing, but also by demand management and cost-smoothing tools. Now, based on the analysis above, we will present our own vision of the recommendations (Figure 5).

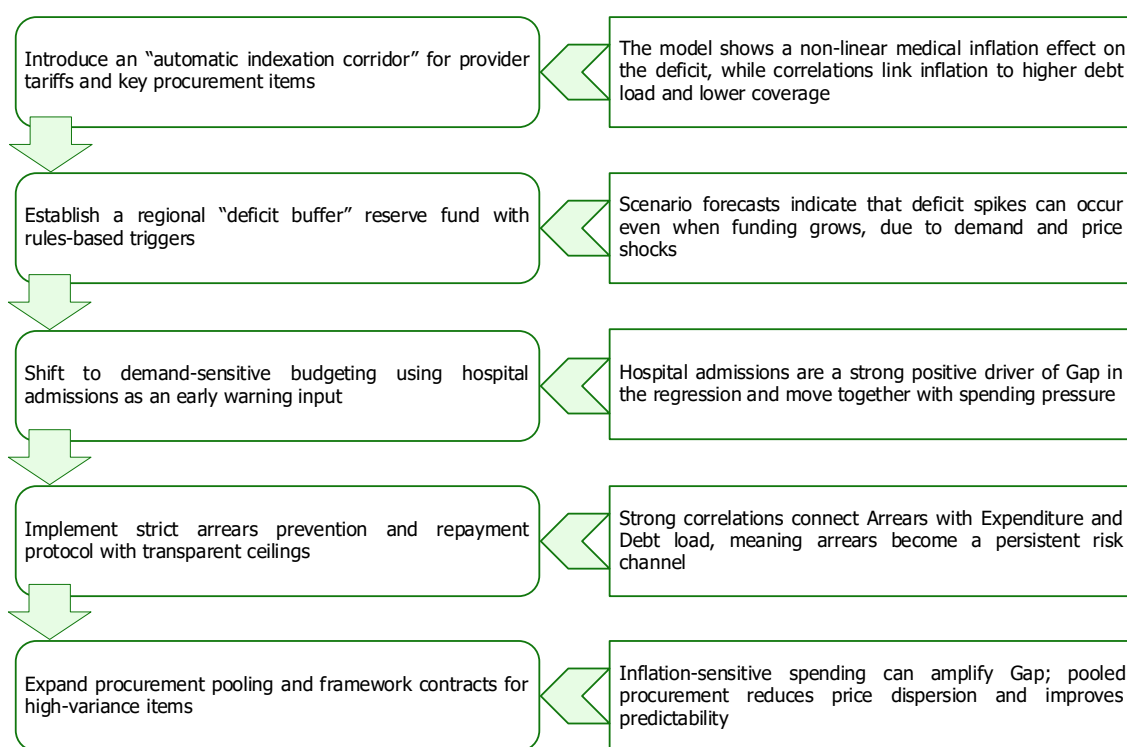


Figure 5. Policy recommendations for selected Western Regions.

The results of the study showed that the growth of hospitalizations is a systemic driver of the increase in the deficit, and medical inflation affects the deficit nonlinearly, which explains the risk of accelerating the financial gap when the parameters go beyond the manageable range. The correlation structure confirmed the close relationship between deficit, debt burden, and overdue obligations, and the indicator of financing needs coverage has a stable inverse relationship with integral risk. The scenario forecast demonstrated that improving financial security is achieved not only through increasing financing, but also through demand management, forecast-oriented budgeting, indexation tools, and protocols for preventing overdue payments.

DISCUSSION

The results obtained demonstrate that in crisis conditions, the financial security of the healthcare system in our country cannot be considered as a simple function of increasing budget allocations. On the contrary, the key is how the system “transforms” existing funding into the ability to cover growing needs, preventing the accumulation of deficits, debt burdens, and overdue obligations. In modern scientific and practical literature, there is a constant emphasis on the role of strategic procurement mechanisms and the adjustment of payments to healthcare providers as tools for increasing the resilience of the system, which was manifested during the COVID-19 pandemic in nineteen European countries (Montás et al., 2022). Our results develop this logic, as they show that for the western regions of our country, even with a relatively stable average coverage of the need with funding, the risk may increase due to a combination of demand shock, inflationary pressure, and debt constraints, which is not always “visible” in the basic budget indicators. Compared to studies that treat fiscal space expansion as the main condition for improving health financing, our approach demonstrates a more complex causal mechanism. For example, empirical findings on the relationship between fiscal space expansion and actual growth in health financing are ambiguous, as fiscal resources alone do not guarantee effective redistribution and sustainable

financing if institutional rules are weak or the response to shocks is delayed (Doherty et al., 2018). In our modeling, this is reflected through the systemic impact of hospital burden and inflation on the Gap deficit, as well as the fact that debt burden and arrears form a risk "locking" channel. That is, our contribution is that we have shown how the deficit is formed in dynamics, and why increasing financing without parallel demand management, indexation, and debt rules does not provide sustainable improvement. In the context of European discussions on the consequences of financial crises and austerity policies for the health system, it is important that our model allows us to quantitatively separate the effect of the crisis regime as a structural shift from the effects of annual fluctuations (De Vogli, 2014). We, on the contrary, recorded a nonlinear effect of medical inflation, which explains why the deficit may accelerate not proportionally, but in a jump-like manner when conditions worsen. This is where a debatable question arises that is important for public policy. Is it enough for us to focus on "how much to add" to the budget, or should we focus on "how to set the rules" that automatically adapt financing to needs and limit debt accumulation?

Another aspect of the discussion is that international comparisons highlight the importance of balancing financial incentives, in particular by adjusting payment mechanisms for providers during shocks, in order to maintain the availability of services and avoid financial exhaustion of the system (Waitzberg et al., 2022). In our work, this aspect is integrated through the indicators of Coverage ratio, Gap deficit, arrears, and the integral risk index D , which allows us to assess not only the "fact of financing", but also the quality of financial sustainability. Therefore, this is a methodological advantage compared to approaches limited to descriptive indicators, as we have obtained a practical tool for scenario forecasting and checking policy decisions for consistency.

The novelty of our study lies in combining panel modeling for a group of Western regions with the construction of a scenario forecast, which allows us to move from *ex post facto* assessment to preventive financial risk management. In this sense, our work is conceptually consistent with the findings of international reviews of financing policies during the COVID-19 pandemic, which emphasize that resilience is achieved through a set of coordinated financial instruments, rather than through a single "big" reform or a one-time injection of funds (De Foo et al., 2023). At the same time, we add a regional focus to the scientific discussion, which is important, since even within a single country, the risk profile can vary significantly depending on the structure of demand, demographics, logistics, and the cost of providing services. Therefore, the practical result of our work is that the proposed system of indicators and the forecasting model can be used as a basis for regional decisions on public financial security policy, with an emphasis on early warning of deficits and prevention of debt inertia.

Regarding limitations, we note that our analysis covers only the western regions, so the conclusions cannot be automatically transferred to other parts of our country, especially in territories with a different intensity of military risks and destruction.

CONCLUSIONS

In general, we can say that the financial security of the healthcare system in crisis conditions in our country is determined not only by the volume of budget financing, but also by the ability of management to quickly coordinate financial flows with the real dynamics of the need for medical services. The modeling conducted for the western regions showed that the financing deficit, which we described as the Gap, systematically increases along with the increase in the load on the hospital, which is reflected in the volume of hospitalizations. Therefore, this means that the risk of financial instability is formed through the demand channel, and therefore, the policy of financial security should be based on mechanisms for early detection and demand management, and not only on compensatory increases in expenditures after the fact. The results also confirmed that inflationary pressure in the medical segment does not act linearly. In the model, we recorded the nonlinear effect of medical inflation, which explains why the deficit can grow even in a situation where nominal budget volumes increase. This conclusion is reinforced by the structure of correlations, where the deficit is associated with arrears and debt burden, and the coverage of the need by financing has a stable inverse relationship with the integral risk. Thus, financial security turns out to be multi-component and requires simultaneous control of coverage, deficit, and arrears indicators, rather than focusing on a single budget indicator. At the same time, already within the framework of the scenario forecast for 2026, we have shown that even for relatively stable Western regions, significantly different trajectories of financial security are possible. The optimistic scenario is formed not only due to a higher growth rate of financing, but also due to curbing the growth of hospitalizations, stabilizing the cost of key items, as well as reducing debt constraints and arrears. The stress scenario, on the contrary, demonstrates that the combination of increased demand for inpatient services and price pressure quickly worsens coverage and increases the deficit, which leads to an expansion of the risk profile of the system. This means that public policy must be adaptive, that is, have predefined rules of response, rather than one-off solutions in response to an already existing deficit.

In future studies, the integral risk index can be further validated by alternative normalization and weighting schemes, and the scenario forecast can be upgraded to a probabilistic framework that explicitly models uncertainty in inflation, service demand, and budget rules, enabling policy evaluation under quantified risk bounds.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ДЕРЖАВНА ПОЛІТИКА ЗАБЕЗПЕЧЕННЯ ФІНАНСОВОЇ БЕЗПЕКИ СИСТЕМИ ОХОРОНИ ЗДОРОВ'Я В КРИЗОВИХ УМОВАХ

Система охорони здоров'я в більш кризових умовах стикається з поєднанням цінового тиску, нестабільності бюджетного планування, зміни структури попиту на медичні послуги та зростання ризику накопичення прострочених зобов'язань, що прямо впливає на фінансову безпеку й безперервність надання допомоги населенню. Метою роботи є обґрунтування адаптивних підходів державної політики фінансової безпеки охорони здоров'я на основі економічного моделювання та сценарного прогнозування. Методологічною основою дослідження є побудова панельного набору даних за 2020–2024 роки для західних областей, оцінювання взаємозв'язків між ключовими фінансовими та операційними показниками, а також регресійне моделювання дефіциту фінансування. У моделі дефіцит інтерпретовано як розрив між потребою у видатках і доступним фінансуванням, а його динаміка пояснена інтенсивністю попиту, яку відображено через обсяг госпіталізацій, інфляційним тиском у медичному сегменті, який ураховано з нелінійним ефектом, і структурним зсувом кризового періоду. Додатково сформовано інтегральний індекс ризику, що агрегує дефіцитний тиск, боргове навантаження, вплив інфляції та компенсаторний ефект покриття потреби фінансуванням, що дозволяє оцінювати фінансову безпеку не за одним індикатором, а як багатокомпонентний стан системи. На завершальному етапі виконано сценарний прогноз на 2026 рік для альтернативних умов, що вирізняються темпами зростання фінансування, траєкторією попиту й ціновими параметрами.

Запропонований підхід може бути використаний органами державної та регіональної влади для впровадження адаптивної політики фінансової безпеки охорони здоров'я. Запропоновані рішення включають механізми автоматизованого коригування фінансових параметрів, правила раннього попередження дефіцитів, інструменти згладжування бюджетних коливань і контроль боргового навантаження.

Ключові слова: державна політика, фінансова безпека, система охорони здоров'я, кризові умови, бюджетне фінансування, пріоритизація видатків, управління ризиками

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