



The Paradigm of Financing the Health Services from the Hospital Healthcare under the Impact of the COVID-19 Pandemic

Valentin Marian ANTOHI *

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ABSTRACT

The COVID 19 Pandemic was a significant turning point in the financial management of public health services, each state having to customize the structure of social and health protection measures in relation to available resources and in relation with any additional sources of funding. In Romania, the pandemic had the effect of redistributing budgetary priorities to limit the effects of its spread and the social protection of citizens affected by the economic crisis induced by the pandemic. The objectives of the study are the impact analysis on two scenarios, namely the existence or non-existence of the pandemic regarding the financing of public health services and health outlets on the number of patients treated in hospitals compared to the need for specialized care. The results of the study consist in identifying the impact of the pandemic on the health status of the population in Romania and are useful for decision makers for the development of short and medium term financial and health policies.

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1. Introduction

At the beginning of the 90's we witnessed Romania's transition from the Semashko-type health system to a mixed health system, namely the German health system borrowed from the Bismark model. If the Semashko system was fully financed from the state budget, the decision was made centrally, with an obvious lack of differentiation between beneficiaries or providers of health services and with a strong emphasis on hospital care, the new system would bring through the reforms of 1998 and 2006 decentralization and pluralism of medical services, compulsory social health insurance, contractual relations between service providers and purchasers, easily abandoning the old health infrastructure, characterized by high fragmentation and economic inefficiency.

The new actors of the health system: the Ministry of Health, and the National Health Insurance House (NHIH), aimed to increase access to health services as efficiently as possible, regarding their costs and quality along with the change in the legislative framework through which payments for services have stopped relying on resources and have become new payment methods for each type of medical service: capitation, fees for consultations and clinical or paraclinical medical services, daily rate of hospitalization and case-based payment system (DRG - Diagnostic Related Groups - DRG). The case-based payment system (DRG) is used to pay for hospital care providers, using a variation of the Australian diagnostic group system (A-DRG version 5.1) and uses a scheme to classify patients according to diagnosis.

Through this system of payment of hospital care service providers - DRG rates have been set for each group of diagnosis (or relative values of rates), which are based on the costs adjacent to patients in each group of diagnoses and the allocation of budget allocated to hospital care, starting from the number and type of patients discharged (the case-mix of each hospital) and the list of rates (or relative values) for each DRG.

This funding system with the onset of the Covid-19 pandemic has been functionally diminished, due to increased hospital capacity to provide care to Covid 19 patients and limited patient access to other health care needs, with hospital health care providers being paid at the level of monthly expenses. For the other types of medical care: primary health care, specialized medical and dental care, paraclinical medical services, national health programs, emergency medical services, the forms of financing established by the legislative specifications imposed by the Framework Contract governing the conditions were observed. providing medical care, but in conditions of restricted access, due to epidemiological conditions.

After a period of almost two years, since the onset of the Covid-19 pandemic, there is a permanent concern of the Romanian authorities for achieving the budgetary balance regarding the financing of the health system.

* Dunarea de Jos University of Galati, Transilvania University of Brasov, Romania. E-mail address: valentin_antohi@yahoo.com.

The financing of the health system in Romania is ensured according to the legislation through the unique National Fund of social health insurances and is formed of:

- the contributions of the individuals who are employees or who have the obligation to pay for the social insurance contribution in the quota of 10%, according to the Fiscal Code;
- the amounts that are distributed to the fund from the insurance contribution for work due by individuals and legal entities that are employers or ones assimilated by them and constitute 40% of the contribution in the quota of 2.25%, according to the Fiscal Code;
- subsidies from the state budget;
- interest, donations, sponsorships, incomes obtained from the exploitation of the patrimony of the National Health Insurance House (NHIH), as well as other incomes obtained according to the law;
- amounts from own revenues of the Ministry of Health.

Payments related to hospital health care services have an important share in the expenditures of the national health system from the Single National Health Insurance Fund. Based on public data provided by the National School of Public Health, Management and Professional Development in Bucharest (National School of Public Health, Management and Professional Development, 2021) and the National Health Insurance House (House National Health Insurance, 2019, 2020, 2021a, 2021b), it is possible to observe from table 1 the evolution of the share of payments in lei and the equivalent in euro from the hospital medical activity compared to the total expenses between 2018-2020 and the estimation related to the year 2021. From the analysis one can see the upward trend of total revenues and total expenditures from the Single National Health Insurance Fund, of total expenditures with hospital activity, as well as of average expenditures per patient in lei and euro. On the other hand, there is a downward trend in the number of patients starting with 2020 due to the appearance of the Covid-19 pandemic, compared to the increase in average expenses per patient.

Table 1. The evolution of the main financial and medical indicators in hospital healthcare between 2018 – 2021

(1 euro = 4,950 lei)

Indicators \ Year	Achieved 2018	Achieved 2019	Achieved 2020	Estimated 2021
Total income in lei	35.653.502.000	41.801.359.000	44.873.404.000	47.428.364.000
Total income in euro	7.202.727.677	8.444.718.990	9.065.334.141	9.581.487.677
Total expenses in lei	34.854.140.000	39.052.585.000	45.219.228.000	47.430.649.000
Total expenses in euro	7.041.240.404	7.889.411.111	9.135.197.576	9.581.949.293
Total hospital expenses in lei	10.314.012.000	10.743.171.000	11.473.303.000	11.793.007.000
Total hospital expenses in euro	2.083.638.788	2.170.337.576	2.317.838.990	2.382.425.657
Hospital Expenses share within total of expenses (%)	29,59	27,51	25,37	24,86
Number of treated patients per year	4.137.193	4.150.361	2.520.765	2.565.412
Balanced expenses /patient in lei	2.493	2.588	4.552	4.597
Balanced expcenses/patient in euro	504	523	919	929

In order to achieve the purpose of the research, I set out to achieve the following scientific objectives:

- O1 - critical analysis of the specialized literature regarding the financing of the health services and the vulnerabilities induced by the COVID-19 pandemic;
- O2 - assessment of the need for hospital health care services in Romania under the impact of the COVID-19 pandemic based on public statistical data;
- O3 - designing the econometric model for sizing the impact of the pandemic through the scenario method;
- O4 - dissemination of research results.

The research results are relevant for the development of public policies in the health services sector in Romania.

2. Literature review

The Covid pandemic 19 represented a challenge that imposed in the opinion of some authors (Onofrei et al., 2021) the identification of the vulnerabilities of the health system and the financial impact assimilated to the economic crisis. The authors realized through the Gregory-Hansen cointegration method the relation of public expenditures in relation to GDP, showing through an analysis carried out between 1985 - 2017 that there is a direct link between the two indicators, being able to make predictions of changes of fiscal policy in correlation with the vulnerabilities induced by the pandemic.

Other authors (Cho et al., 2021; Heald & Hodges, 2020; Nemec & Špaček, 2020) have shown that the pandemic crisis has imposed austerity measures that have created an impact on the budgets of the states

where the studies were conducted. International experts have a unified view on the priority of measures to eliminate the budgetary impact induced by the pandemic, but the methods for solving these challenges are different both in scope (local, regional or national level) and in structure, activating some national community or socio-economic mechanisms.

In his opinion Cifuentes-Faura (Cifuentes-Faura, 2021) the economic measures during the pandemic have particularities that clearly differentiate them from the measures taken during other crises and in their analysis must take into account the Community strategies and policies that have been integrated in the European space to combat the spread of the Covid 19 pandemic.

Regarding the global analysis of the impact of Covid-19 on financial security and related fiscal risks (Bedrunka et al., 2021; Makin & Layton, 2021), the authors pointed out that there is an increase in fiscal policy to cover public health expenditures, which leads to some risks of over-taxation and system errors in immediate measures implemented without a preliminary impact study, which may also lead to a deterioration of fiscal policies, which may lead to future economic crises. In this regard (Castellarin, 2020), it is of the opinion that the financial capacity of the European Union regarding the unitary financing of the measures to combat the Covid-19 pandemic has generated an extensive budget rectification process in 2020 and the implementation of the Multiannual Financial Framework (MFF) for 2021-2027.

Analysis at the EU member states level made by international experts (Achim et al., 2021; Davidescu et al., 2021; Gherghina et al., 2021; Luca, 2021; Panait & Panait, Alexandru, 2020; Thomson et al., 2021) show that the impact of the pandemic on public debt is significant, which could lead to a short-term lack of liquidity that could affect the entire economy. The access to borrowed funds must be used in a sustainable manner, which facilitates recovery and economic growth and not for the specific needs generated by the crisis, the antipole of this use may create restrictions on access to external financing in the medium term.

An analysis of 20 European countries, including Romania on balancing financial incentives during COVID-19, showed that in countries where professionals were paid by salary or per capita, hospitals received global budgets, lost revenue has been reduced compared to countries that have adopted payment by activity, where the loss of income has been offset by higher budgets and fees, introducing new payments for costs related to COVID-19, but also new DRG rates for hospitals (Waitzberg et al., 2021).

3. Metodology

The author analyzed the public databases provided by the National School of Public Health, Management and Professional Development, Bucharest (NSPHMPDB)(National School of Public Health, Management and Professional Development, 2021) and the National Health Insurance House (NHIH) (House National Health Insurance, 2019, 2020, 2021a), regarding the amount of medical services in hospital care offered to patients in relation to the costs incurred for the provision of these services for the period 2018-2021. The information was centralized in a consolidated database on which short-term forecasts 2022-2023 were applied by the method of scenarios like:

Scenario 1 – Covid 19, which involves forecasting the entire analyzed period as a pivot, both in terms of the need for services covered (number of patients treated in hospital units, number of days of hospitalization), and in terms of the size of funding services expenses incurred to cover the costs of medical services in hospital care - euro / year).

Scenario 2 - NonCovid, which involves forecasting the pivot of the preCovid period, with data projection for the pandemic and post-pandemic period, both in terms of the need for services covered (number of patients treated in hospital units, number of days of hospitalization), as well as regarding the size of the financing of the services (expenses incurred to cover the costs of the medical services from the hospital medical assistance - euro / year).

The data was integrated in the Gretl statistical program in order to achieve econometric models.

The following working hypotheses were formulated:

H1 - in the absence of the pandemic, the need for medical services in hospital care tends to remain at the previous level based on the entropy of public health policies;

H2 - in the absence of the pandemic, the number of days of hospital care tends to reach the maximum level related to the need for medical services in relation to the existing hospital infrastructure;

H3 - the expenses incurred to cover the costs of medical services in hospital care tend to be maintained regardless of the onset of the pandemic related to the extent of the maximum revenue's collectible to the state budget, alternative sources of funding being relatively limited.

We designed econometric models based on linear regression with multiple regression function and the use of the least square's method with standard error testing by the Bartlett kernel method.

4. Results and discussion

Following the use of information and its refinement through the methodological process, we obtained the following research results, based on the indicators defined as follows:

- PNNonCov Number of patients predicted in a non-pandemic condition (2018-2019 forecast base)

- DNNonCov Number of days of hospitalization predicted in a non-pandemic condition (2018-2019 forecast basis)
- BEHSNonCov Budget expenditures generated by hospital medical activity forecast in non-pandemic condition (forecast basis 2018-2019)
- PNCov Number of patients predicted in a pandemic condition (2018-2021 forecast base)
- DNCov Number of hospital days forecast in pandemic condition (2018-2021 forecast basis)
- BEHSCov Budget expenditures generated by hospital medical activity forecast in pandemic condition (forecast basis 2018-2021)

In scenario 1- Covid 19, the regression function is defined as follows:

$$\hat{PNCov} = + 0.150 \cdot DNCov - 0.0358 \cdot BEHSCov$$

(0.000557) (0.00132)

T = 6, R-squared = 1.000
(standard errors in parentheses)

According to the regression function, the level of statistical representativeness of the need covered by medical services in hospital care in relation to the level of budget expenditures generated by hospital medical activity and the duration of hospital care provided in specialized units is 100%, which confirms that in the health system in Romania a patient generates on average an increase of 15% of the number of days of hospitalization granted (relationship of direct proportionality), instead in terms of average public spending generated by hospital medical activity is found under the impact of the pandemic decreasing by 3.5% for each new patient admitted under the conditions of pandemic onset (inverse proportionality relationship).

Table 2. Model for Scenario 1 Covid: OLS, using observations 2018-2023 (T = 6)

Dependent variable: PNCov

HAC standard errors, bandwidth 1 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value	
DNCov	0.150481	0.000556739	270.3	<0.0001	***
BEHSCov	-0.0357577	0.00132399	-27.01	<0.0001	***

Mean dependent var	2708939	S.D. dependent var	1232524
Sum squared resid	3.56e+09	S.E. of regression	29828.98
R-squared	0.999931	Adjusted R-squared	0.999914
F (2, 4)	242767.9	P-value(F)	6.79e-11
Log-likelihood	-69.11665	Akaike criterion	142.2333
Schwarz criterion	141.8168	Hannan-Quinn	140.5661
rho	-0.650652	Durbin-Watson	3.230931

From Table no. 2 it is observed that both independent regression variables: DNCov - Number of hospitalization days forecast in pandemic condition (forecast base 2018-2021) and BEHSCov - Budget expenditures generated by hospital medical activity forecast in pandemic condition (forecast base 2018 - 2021), generated p-value < the maximum threshold of statistical representativeness, confirm / validate the alternative hypothesis and rejects the null hypothesis, which leads to the mathematical demonstration of the validity of the model, the level of significance indicated for p-value of the F test being less than 0.0001. The statistical criteria Schwarz, Akaike and Hannan-Quinn generated close values (140, 142 points) which demonstrates that the size of the amplitude of the variation of the regression function falls within a quantifiable range that validates the model.

The average of the dependent variable is 2,708,939 patients with system capacity in conditions of pandemic damage, each of the patients benefiting from an average hospital stay of 10 days, this duration is optimal for Covid-19 treatment. Figure 1 shows that by distributing the dependent variable with the Bartlett kernel function, a quantified prognosis plan is obtained between 500,000 - 4,500,000 patients, quantified for a margin of variation of the costs of hospital medical services between 2,000,000 thousand euros - 2,500,000 thousand euros, which proves that there is at the level of the regression function a reflexivity of the costs for not occupying the beds in the hospital units, assimilated to the fixed marginal cost.

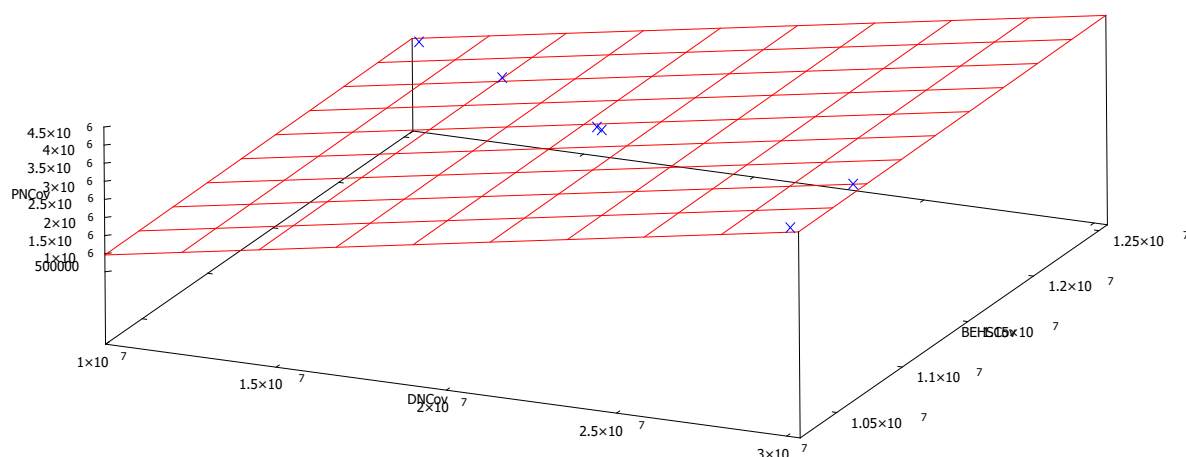


Figure 1. Bartlett kernel diagram of the regression function for Scenario 1 - Covid

In Scenario 2- NonCovid, the regression equation looks like this:

$$\hat{PNNonCov} = + 0.127 \cdot DNNonCov + 0.0311 \cdot BEHSNonCov$$

(4.07e-016) (1.02e-015)

$$T = 6, R\text{-squared} = 1.000$$

(standard errors in parentheses)

According to the regression function, the level of statistical representativeness of the need covered by medical services in hospital care in relation to the level of budget expenditures generated by hospital medical activity and the duration of hospital care provided in specialized units in Scenario 2 -NonCovid is 100%, which confirms the fact that in the Romanian healthcare system a patient generates on average an increase of 12.7% in the number of hospitalization days granted (relationship of direct proportionality), in exchange for the level of average public expenditures generated by hospital medical activity in the absence of the pandemic, there is an increasing trend of 3.11% for each new hospitalized patient. Under the conditions of Scenario 2, the reversal of the correlation trend of public expenditures towards Scenario 1 is observed, which represents an impact marker of the effect of the pandemic on the public strategies for financing hospital care.

Table 3. Model for Scenario 2 NonCovid: OLS, using observations 2018-2023 (T = 6)

Dependent variable: PNNonCov HAC standard errors, bandwidth 1 (Bartlett kernel)					
	Coefficient	Std. Error	t-ratio	p-value	
DNNonCov	0.127258	0.000000	3.123e+014	<0.0001	***
BEHSNonCov	0.0310994	0.000000	3.060e+013	<0.0001	***

Mean dependent var	4170113	S.D. dependent var	24635.07
Sum squared resid	1.11e-17	S.E. of regression	1.66e-09
R-squared	1.000000	Adjusted R-squared	1.000000
F(1, 4)	6.79e+31	P-value(F)	1.30e-63
Log-likelihood	113.9915	Akaike criterion	-223.9831
Schwarz criterion	-224.3996	Hannan-Quinn	-225.6503

From Table no. 3 it is observed that both independent regression variables: DNNonCov Number - hospitalization days forecast in non-pandemic condition (forecast base 2018-2019) and BEHSNonCov - Budget expenditures generated by hospital medical activity forecast in non-pandemic condition (base of forecast 2018-2019), generated p-value <the maximum threshold of statistical representativeness, confirm/validate the alternative hypothesis and rejects the null hypothesis, which leads to the mathematical demonstration of the validity of the model, the level of significance indicated for the p-value of the test F being less than 0.0001. The statistical criteria Schwarz, Akaike and Hannan-Quinn generated close values

(-223, -225 points) which demonstrates that the size of the amplitude of the variation of the regression function was significantly altered by the Covid-19 pandemic (Scenario 1).

The average of the dependent variable is 4,170,113 of patients, compared to 2,708,939 patients as shown in table 1, represents an impairment of the system's care capacity of approximately 50%, an impairment directly attributed to the specific conditions of the pandemic. The average length of hospitalization increased from Scenario 1-Covid to Scenario 2 NonCovid by approximately 50%, respectively showing an increase by 3 days of hospitalization compared to the 7 expected to be required on average for treating patients in NonCovid conditions, which demonstrates the working H2 hypothesis: in the absence of the pandemic, the number of days of hospital care tends to reach the maximum level related to the need for medical services in relation to the existing hospital infrastructure.

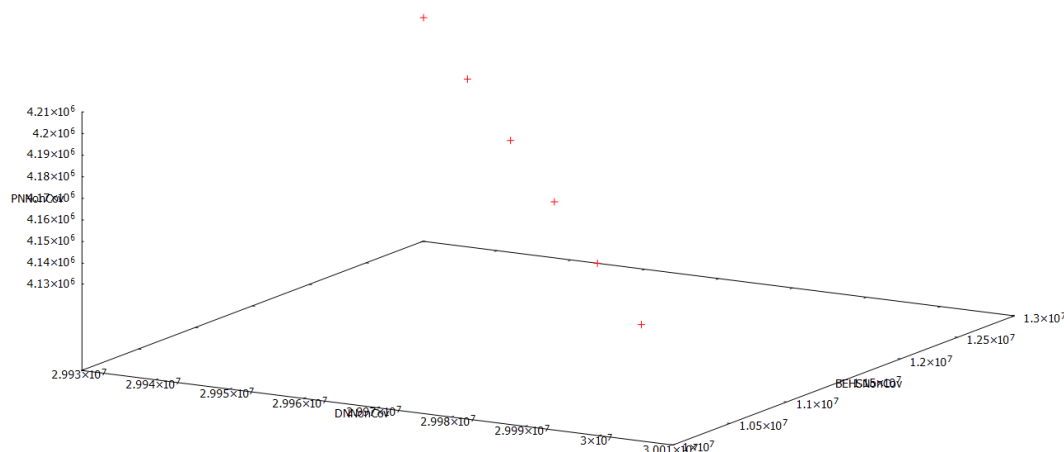


Figure 2. Bartlett kernel diagram of the regression function for Scenario 1 - NonCovid

Figure 2 shows that by distributing the dependent variable with the Bartlett kernel function, a quantified prognosis plan is obtained between 4,130,000 - 4,210,000 patients (aspect that represents a significant reduction of the range of variation of the indicator compared to Scenario 1), which demonstrates the working H1 hypothesis: in the absence of the pandemic, the need for medical services in hospital care tends to remain at the previous level based on the entropy of public health policies. The variation is quantified for a margin of the costs of hospital medical services between 2,000,000 thousand euros - 2,600,000 thousand euros, which proves that there is at the level of the regression function a reflexivity of costs in relation to the hospital infrastructure and the accessible financing sources. The difference in terms of financing capacity of the system on the upper maximum limit between the 2 scenarios is only 100,000 euros, which demonstrates the reflective nature of the interdependence between care capacity and financial need in relation to identifiable funding sources, and proves the working H3 hypothesis: the expenses incurred to cover the costs of medical services in hospital care tend to be maintained regardless of the onset of the pandemic compared to the extent of maximum revenues collectible to the state budget, alternative sources of funding being relatively limited.

5. Conclusions

Following the research carried out considering the scenario method, we made the forecast of the capacity indicators of the medical system in hospital healthcare on the quantitative component (number of treated patients) and on the qualitative component (Average duration of hospitalization). The data was consolidated with the financial dimension, respectively the need to finance the system. Through the critical analysis of the specialized literature regarding the financing of the health services and the vulnerabilities induced by the COVID-19 pandemic, it was observed that these components are interdependent and in balance during the periods of sanitary alkalism.

The onset of a health crisis or a pandemic affects the balance of the system, which reacts especially to the detriment of the care capacity, maintaining the maximum extent of the need for financing. In this sense, the inelasticity of the financing function of the system and the dependence on alternative financing sources are observed. In this sense, the author critically evaluated the need for health services in Romania under the impact of the COVID-19 pandemic based on public statistical data and designed the econometric model for sizing the impact of the pandemic through the scenario method.

The results of the study showed that the function of financing public health services in the case of hospital care is reflective and depends on alternative sources of funding, in the case of pandemic risk, and health outputs (the number of patients treated in hospital units compared to the need of specialized medical assistance and the average duration of hospitalization) represent components with volatility risk in case the system is affected by health crises.

The research results are relevant for the development of public policies in the health services sector in Romania.

The limits of the study consist in the relatively short period of propagation of the effects of the pandemic, so that the observational study has a limited scope in relation to this indicator. Another limitation that can be eliminated by future studies is the relatively small number of indicators taken into account for the development of the model.

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