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THE IMPACT OF COVID-19 ON THE ROMANIAN HOSPITALS' EXPENSES. A CASE STUDY TOWARD THE FINANCIAL RESILIENCE AFTER THE PANDEMIC

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Abstract

The Coronavirus disease 2019 (COVID-19) affected almost all activities worldwide. The medical sector was one of those which were most significantly impacted because the medical infrastructure was not sized for such a high scale shock, specialized human resources and medical infrastructure proving to be much undersized and with slow growth potential. Many changes were required, important financial resources being mobilized in order to motivate medical staff, offer treatments for the most severely affected patients, but also to create new facilities where the increasing number of sick persons could be cured.

In our research we want to offer a hospital cost perspective based on empirical analysis of the COVID-19 impact on different categories of expenses made by Romanian hospitals that treated patients with COVID-19 in different stages of their disease. The period analyzed was January 2019 to December 2020 on a monthly basis. Our results showed that expenses with goods and services, drugs, reagents and human resources are influenced by COVID-19 in a significant manner.

Keywords: hospital costs, COVID-19 impact, resilience in hospitals, expenses.

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1. Introduction

The Coronavirus disease 2019 (COVID-19) affected unexpectedly the current activities worldwide. In a short time, governments had to react in order to offer treatment to those affected by this virus and mitigate its effects in almost all fields of activity. Thus, governments introduced gradual measures as they managed to identify levers presumed to be effective; these measures ranged from the simplest to the most drastic lockdowns for quite significant periods of time.

Under the aforementioned unpredictable and uncertain environment, different activities from various domains had to change and adapt in order to survive, to further offer the goods and services for which they were established, and to be in line with the needs of clients and beneficiaries.

The medical sector was one of those which were most significantly impacted because the source of the problem was the pandemic of coronavirus disease. The medical infrastructure was not sized for a high scale shock, specialized human resources and medical infrastructure proving to be much undersized and with slow growth potential in comparison with the evolution of specialized medical needs. Hospitals were the frontrunners in this field, taking into account the needs for long-lasting treatment and recovery, in many cases with connectivity to oxygen facilities for invasive or non-invasive ventilation. Thus, activities specific to infectious diseases have exploded, being offered in spaces that were not long ago used to treat other types of diseases. In order to realize such shifts, important financial resources were reoriented in this regard.

In our research we want to offer a slightly different perspective and fill a gap in the literature because 'a detailed analysis of hospital cost structure remains an unexplored area in the literature' (Bai and Zare, 2020, p. 2807). Thus, we analyze the impact of COVID-19 over the main categories of expenses of all Romanian hospitals which were designated to officially hospitalize patients with symptomatic COVID-19 and provide treatment for moderate, severe and critical forms of the disease in order to explain the variance of hospital expenses, helping to understand how medical sector resilience can be faster and better fulfilled and offer a tool for predictability of expenses. In this regard, in the second section we presented the relevant literature which focuses on hospital costing, especially during pandemics. In the third and fourth sections we presented two case studies which highlight the impact of COVID-19 on different variables that explain the variance of hospital expenses using the OLS method with fix effects. In the fourth section we selected for each hospital, on a monthly basis, the expenses related to compensation of employees, use of goods and services, depreciation of fixed capital, drugs, sanitary materials, reagents, disinfectants, and laboratory materials, in order to compare with the monthly number of sick cases due to COVID-19, respectively with the number of deceased due to COVID-19.

2. Literature review

International Health Regulations adopted by the World Health Organization (WHO) define officially what public health emergencies of international concerns are (WHO, 2016, p. 9). Since its revision in 2007, nine health events were counted: the influenza A (H1N1) pandemic, the Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak, the international spread of poliovirus, the West Africa Ebola virus disease outbreak, the Zika virus outbreak, yellow fever, the 9th and 10th Ebola virus disease outbreak, and the on-going epidemic of COVID-19 (Mullen *et al.*, 2020, p. 2).

COVID-19 generated a change in the activity of hospitals, the number of patients they treated, the ailments which needed medical support. All these caused changes in the level and structure of the expenses; all the main categories (staff remuneration, consumables, and fixes assets) were affected, but each category reacted differently.

In periods of severe pandemics, authorities can decide that selected hospitals will cease all day-to-day activities and shift completely to fight against the challenge represented by the new virus. As in the case of the influenza pandemic, this is happening because 'hospitals will need to allocate limited healthcare resources in a rational, ethical, and organized way so as to do the greatest good for the greatest number of people. This can be done by deferring nonemergency care and, if necessary, instituting alternative patient care routines' (Toner and Waldhorn, 2006, p. 400).

Staff remuneration expenses increased in some cases because in many countries new health workers were hired (Hernández-Quevedo *et al.*, 2020, p. 42), and in other cases bonuses were approved for existing workers.

From the perspective of medical supplies, COVID-19 required larger quantities of oxygen for ventilation, specific drugs recommended for treatments, but also different sanitary materials, reagents, disinfectants, and laboratory materials. For example, Al-Gheethi *et al.* (2020, p. 10) pointed out that 'the survival of the virus on surfaces requires effective disinfection to ensure that the virus has become inactive', a process which generates costs.

During COVID-19, respiratory therapy was an important component of healing many hospitalized patients. A similar situation was also due to 2009 H1N1 influenza, when Wiesen *et al.* (2012, p. 7) compared the consumption of resources, as measured by hospital charges, in the case of patients with acute lung injury (ALI) or acute respiratory distress syndrome (ARDS) confirmed or suspected H1N1 infection vs. ALI/ARDS arising from other etiologies (non-influenza group); the authors concluded that 'respiratory charges are more likely a reflection of duration of mechanical ventilation rather than the degree of ventilator support necessary'. But, absolute intensive care unit (ICU) 'charges for room and board, blood products, pharmacy, radiology, average daily charge, and overall charge per patient were larger in the noninfluenza group. ICU charges for blood products in the noninfluenza group were greater by a factor of four, and pharmacy charges double that of the H1N1 group. This finding is likely a reflection of the higher prevalence of underlying comorbid medical con-

ditions in the noninfluenza group, such as malignancy and cirrhosis, which require expensive medications and predispose to anemia. Moreover, the high mortality in this cohort likely precluded even higher hospital charges. Nevertheless, the H1N1 cohort amassed charges of similar magnitude to the most ill and expensive patients in the ICU, indicating the abundant health care resources consumed by severe pandemic influenza infection' (Wiesen *et al.,* 2012, p. 7).

Fixed assets are the main component of the infrastructure used by medical units to offer services. Catană (2020, p. 172) highlighted the fact that the historical investments in the healthcare system in EU countries did not lead to a limitation of the number of deaths.

In regard to the efficiency of measurement of medical outputs in a pandemic, it could be based on the number of sick cases and the number of deceased due to COVID-19. This approach was also used by Dan *et al.* (2009, p. 1911) when they quantified how the virulence or case-fatality rate of a respiratory viral infection had a serious impact on the hospital infection control response using the actual number of deaths and ill persons.

3. COVID-19 impact on expense aggregates

In this section, our goal is to reveal the impact of the recent sanitary crisis on hospitals, respectively on the expenses of Romanian hospitals most involved in treating COVID-19 patients. In this sense, our sample consists of all 10 healthcare units which hospitalized patients with symptomatic COVID-19 and provided treatment for moderate, severe and critical forms of the disease, in accordance with the designation made by the Ministry of Health through Order no. 555 from April 3, 2020. The 10 hospitals included in our sample are representative for Romania, being the only hospitals considered by the Ministry of Health prepared from all perspectives to deal with moderate, severe and critical forms of the disease. These hospitals are located in Baia Mare, Brașov, Bucharest (two hospitals), Cluj-Napoca, Constanța, Craiova, Iași, Suceava, and Timișoara. Nine of them are infectious disease hospitals, while the tenth was serving the area of Suceava declared in lock-down for a long period during 2020. From a geographical point of view, all regions were covered in a balanced way, although each hospital had to take cases from any region if some of these hospitals reached their maximum capacity. These hospitals were best prepared to fight COVID-19, being mainly situated in important medical university centers, having strong teams specialized in infectious diseases, and more than 4,000 beds in these hospitals (in some periods of time dedicated mainly, or even exclusively, to treat COVID-19 cases).

A limitation of our study regards the number of ICU beds due to the lack of data for each hospital. Although, the Ministry of Health named the aforementioned hospitals to treat most affected patients with COVID-19, the number of ICU beds available for COVID-19 patients is absent. Thus, it was impossible to construct a correlation between the registered cases of COVID-19 and the number of ICU beds during the sanitary crisis.

3.1 Research methodology

Our case study starts by analyzing the impact of the COVID-19 evolution on different expense categories in the previously mentioned COVID-19 hospitals. The period analyzed is on monthly basis starting from January 2019 until December 2020.

The dependent variables of this research are different expense items classified taking into account the methodological guidance offered by the latest edition of IMF's Government finance statistics manual (IMF, 2014). We offer a separate analysis on large aggregates composing total expenses (adjusted total expenses, constant human resource expenses, use of goods and services, and depreciation of fixed capital), but also distinct analyses for components of human resource expenses and different medical supplies.

The adjusted total expenses include all the expenses made by the hospital in the reference period, but exclude non-depreciable assets (non-depreciable assets in hospitals are represented mainly by goods that belong to the public domain and lands). The exclusion is justified because these items are recorded with the whole value as expenses in a single month, although they are used on a long term basis. Due to this accounting treatment, the values from certain months may present significantly deviated values compared to the previous and following months.

Constant human resource expenses, use of goods and services, and depreciation of fixed capital were proposed as the main components of the adjusted total expenses. We opted for those aggregates because they are reflecting costs with very different types of resources used in the activity of hospitals. Besides, these elements are consecrated in financial research, since in the medical sector it is well known that 'key hospital inputs are salaries, supplies and funding for capital investment' (Hassan, 2005, p. 131).

Medical human resources are very important in fighting COVID-19. For this reason we analyzed the correlation of the main categories of expenses with the compensations of hospital's staff. Under 'Constant human resource expenses' we included all payable amounts in cash or in kind offered in return for work performed (salaries or resident doctor scholarships, including social security schemes and vouchers), while only the special allowance for treating COVID-19 were considered separately. This allowance was introduced in mid-2020 and it was paid only in certain months depending on the available budgetary resources.

The quality of healthcare services is closely linked to the usage of medical supplies. In this regard we looked for the correlation of expenses with the consumptions of drugs, sanitary materials, reagents, disinfectants, and laboratory materials. We opted to emphasize and detail this structure having in regard the specific needs generated by COVID-19 from the perspective of personal protective equipment, respectively the perspective of the patients. In the category of procurements of personal protective equipment WHO issued very detailed technical specifications regarding gloves, goggles, face shields, masks, scrubs, aprons, gowns, hand rubs and so on (WHO, 2020, pp. 4–6). In the case of treatments, numerous drugs were recommended during the

pandemic, a full treatment might have varied between less than 1 USD and several thousands of USD (Hill *et al.*, 2020, p. 63).

The econometric method employed is OLS on panel data. The general equation of the model is as given bellow in equation 1:

$$Y_{it}=\alpha+\beta X1+\delta_{it} \quad (1),$$

where:

- i = number of hospitals, thus i=1...10;
- t = period analyzed, respectively monthly data, thus t=1...24;
- Y – is the dependent variable consisting of different expense items;
- α – intercept term;
- β – coefficient of Xs;
- X – independent variable, respectively proxy for COVID-19;
- δ – error term.

All the data has been collected from the hospitals' balance sheets prepared on a monthly basis according to the official accounting standards using accrual accounting principles. The variables used in the regression models are listed in Table 1.

Table 1: Variables used in the regression models and their acronyms

Variables	Acronym	Type of variable
Dependent variables		
Adjusted total expenses	LogATE	Dependent
Compensation of employees	LogCE	Dependent
Use of goods and services	LogUGS	Dependent
Depreciation of fixed capital	LogDFC	Dependent
Constant human resource expenses	LogCHRE	Dependent
Special allowance for treating COVID-19	LogSA	Dependent
Expenses with drugs	LogED	Dependent
Expenses with sanitary materials	LogESM	Dependent
Expenses with reagents	LogER	Dependent
Expenses with disinfectants	LogEDI	Dependent
Expenses with laboratory materials	LogELM	Dependent
COVID-19 variables		
Type of hospital	TH	Dummy (if in the analyzed period there was a hospital providing healthcare to patients tested positive for COVID-19 it had a value of 1 or zero otherwise) and independent
Number of monthly sick cases due to COVID-19	LogNB	Independent
Number of monthly deceased due to COVID-19	LogND	Independent

Source: Made by authors

Table 2 reveals the descriptive statistics for the variables considered in the regression models. Thus, the number of observations is between 86 and 90, while the minimum value for COVID-19 variables (LogNB, LogND) are between 3.8 and 2.8 whereas their maximum values are 5.3 and 4.1 with a standard deviation of 0.5 and 0.4.

Table 2: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
LogNB	90	4.544	0.541	3.846	5.369
LogND	90	3.540	0.426	2.841	4.197
LogATE	90	0.483	0.342	-0.132	1.764
LogCE	90	0.326	0.227	-0.172	1.219
LogUGS	90	0.915	0.843	-0.410	3.936
LogDFC	90	0.415	1.096	-8.771	2.326
LogCHRE	90	0.272	0.213	-0.151	1.196
LogED	90	0.251	0.734	-0.824	2.687
LogESM	90	11.612	10.967	-19.554	54.544
LogER	88	4.509	9.723	-1.111	82.640
LogEDI	89	5.341	14.541	-0.163	108.896
LogELM	86	1740.763	16065.76	-4.134	148995.6

Source: Made by authors

Table 3 shows the correlation matrices for variables considered in the regression models. In this paper we considered that coefficients with a value higher than 0.7 are highly correlated and therefore will not be used in the same regression model.

Table 3: Pearson correlation matrices

	LogNB	LogND	LogATE	LogCE	LogUGS	LogDFC	LogCHR	LogED	LogESM	LogER	LogEDI	LogELM
LogNB	1											
LogND	0.948	1										
LogATE	0.45	0.44	1									
LogCE	-0.04	0.01	0.53	1								
LogUGS	0.52	0.50	0.88	0.19	1							
LogDFC	-0.10	-0.13	-0.34	-0.12	-0.33	1						
LogCHRE	0.08	0.12	0.52	0.89	0.26	-0.16	1					
LogED	0.63	0.60	0.63	0.06	0.73	-0.22	0.12	1				
LogESM	0.04	0.01	0.38	0.29	0.30	-0.10	0.32	0.01	1			
LogER	0.19	0.19	0.42	0.10	0.55	-0.25	0.15	0.30	0.15	1		
LogEDI	-0.04	-0.05	-0.05	0.13	-0.07	0.06	0.13	-0.08	0.09	-0.05	1	
LogELM	-0.14	-0.21	-0.003	-0.02	-0.04	0.09	-0.04	-0.04	0.26	-0.007	0.01	1

Source: Made by authors

3.2 Regressions results and discussion

The aim of this research is to examine from an empirical point of view the impact of COVID-19 on different variables that explain the variance of hospital expenses using OLS method with fix effects. In this sense we considered a sample of 10 hospitals where patients with COVID-19 symptoms received treatment for different stages of the disease. The analyzed period was January 2019 to December 2020.

When we consider the impact of COVID-19 on different categories of expenses in Table 4, the type of hospital has a negative impact on the adjusted total expenses. The number of deceased and sick cases due to COVID-19 virus has a positive impact on total expenses (model 1 and 2). The first 2 models from table 3 have an R-squared of 0.54, respectively 0.44. This means that the variation of type of hospital — TH and number of monthly deceased due to COVID-19 — LogND, explains the variation of adjusted total expenses in a proportion of 54%, whereas the variation of TH and the number of monthly sick cases due to COVID-19 — LogNB explains the variation of adjusted total expense in a proportion of 44%. In the models with Depreciation of fixed capital as dependent variable, TH did not reveal any statistical significance to explain the impact of COVID-19 on adjusted total expenses (models 7 and 8). Moreover, LogNB also showed no statistical significance whereas logND is statistically significant at 10%. Therefore, the number of monthly deceased due to COVID-19 influences positively the depreciation of fixed capital. The model 6 explains the variation of dependent variables of 61% by the variation of independent variables. Moreover, the number of monthly deceased and the type of hospital are strongly significant, respectively at 1%. Furthermore, TH has a negative impact on the use of goods and services while LogND have a positive impact. The Governments around the world took measures in order to prevent the spread of COVID-19. The fact that our results reveal a positive impact between COVID-19 patients and hospital expenses, is underlined by the financial effort of the Romanian government. As our sample comprises all hospitals approved by the Romanian Government to treat patients affected by moderate, severe and critical forms of COVID-19, our outcomes show that, in line with each country around the word, Romania also took measures to counteract the spread of this new pandemic virus, among which the increase of all the expenses within a hospital are imperative during sanitary crisis.

In table 5 we analyzed the impact on human resources expenses. We found a positive and statistically significant relation of TH on Constant human resource expenses and on Special allowance for treating COVID-19 as well. Models having as dependent variable Special allowance for treating COVID-19 have the greatest impact when TH and number of monthly deceased due to COVID-19 virus was considered (model 11). Furthermore, model 11 reveals that the LogND has a negative impact on LogSA. The number of sick cases due to COVID-19 has a negative and statistical significance on Special allowance for treating COVID-19, but the impact is less than LogND which showed a greater impact on dependent variables. The expense with human resources is statistically significant as in 2020 the Ministry of Health required Romanian gov-

Table 4: Fixed-effects regression outcomes regarding the impact of COVID-19 on category of expenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log ATE	**Log ATE**	**Log CE**	**Log CE**	**Log UGS**	**Log UGS**	**Log DFC**	**Log DFC**
TH	-0.059*	0.032	0.104***	0.107***	-0.252***	-0.051	-0.053	0.006
	(-2.098)	(1.148)	(3.871)	(5.025)	(-5.165)	(-0.967)	(-0.777)	(0.120)
LogND	0.139***		-0.003		0.317***		0.093*	
	(8.318)		(-0.217)		(11.013)		(2.321)	
LogNB		0.036***		-0.002		0.088***		0.023
		(4.368)		(-0.374)		(5.560)		(1.419)
_cons	6.650***	6.822***	6.651***	6.648***	5.902***	6.279***	4.921***	5.044***
	(186.087)	(306.858)	(197.203)	(391.888)	(95.845)	(148.928)	(56.984)	(114.933)
F stat	52.34***	37.99***	15.08***	30.03***	70.14***	31.27***	3.645***	3.081**
R-squared	0.543	0.437	0.255	0.380	0.614	0.390	0.0765	0.0591
Obs.	100	110	100	110	100	110	100	110
N	10	10	10	10	10	10	10	10

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Made by authors

ernment to allocate special allowance for medical personnel that work in the hospital, respectively departments that treat patients affected by COVID-19 due to risk exposure. Subsequently, these results reinforce the allocation of this special allowance as well as law enforcement.

Table 5: Fixed-effects regression outcomes regarding the impact of COVID-19 on human resources expenses

	(9)	(10)	(11)	(12)
	Log CHRE	**Log CHRE**	**Log SA**	**Log SA**
TH	0.065*	0.073**	0.079*	0.085**
	(2.341)	(3.291)	(1.240)	(2.803)
LogND	0.012		-1.143**	
	(0.760)		(-3.804)	
LogNB		0.003		-0.704**
		(0.521)		(-3.197)
_cons	6.619***	6.635***	9.093***	8.715***
	(186.460)	(372.172)	(10.040)	(9.088)
F stat	9.490***	18.52***	14.48***	10.22***
R-squared	0.177	0.274	0.475	0.390
Obs.	100	110	27	27
N	10	10	10	10

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Made by authors

From the point of view of the expenses regarding the use of medical supplies, the regression results having as dependent variable consumption of drugs, sanitary materials and reagent showed an R-squared of 55% (model 13), 51% (model 16) and 24% (model 18). These results are listed in table 6. In the last two models mentioned earlier, correspondingly 16 and 18, LogNB is statistically significant at 1%, respectively 10%. Thus, an increase in the number of sick cases due to COVID-19 would increase the consumption of sanitary materials and reagent. On the other hand, the expenses with sanitary materials are proven to have a higher impact than reagent as the coefficient of LogNB is greater in model 16. The model with the highest R^2 from Table 6, namely model 13, showed that LogND has a positive statistically significance on drugs consumption. Therefore, an increase of logND would enlarge logED with approximately 49%. Likewise, if the number of COVID-19 cases increases the expenses with sanitary materials, drugs and reagent enhances as more of this supply is used in order to treat and to prevent the virus.

Table 6: Fixed-effects regression outcomes regarding the impact of COVID-19 on expenses concerning the use of medical supplies

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	LogED	**LogED**	**LogESM**	**LogESM**	**LogER**	**LogER**	**LogEDI**	**LogEDI**	**LogELM**	**LogELM**
TH	-0.539***	-0.223*	0.0401	0.102	-0.0007	0.168	-0.041	-0.020	0.343	0.343
	(-6.590)	(-2.542)	(0.3572)	(1.0772)	(-0.005)	(1.362)	(-0.477)	(-0.263)	(1.410)	(1.410)
LogND	0.496***		0.141*		0.266**		0.0428		-0.146	-0.146
	(10.278)		(2.123)		(3.075)		(0.829)		(-1.002)	(-1.002)
LogNB		0.106***		0.152***		0.0814*		0.0821***		
		(3.988)		(5.329)		(2.194)		(3.569)		
_cons	5.198***	5.934***	5.332***	5.015***	5.009***	5.293***	4.640***	4.377***	4.317***	4.317***
	(50.418)	(84.580)	(37.674)	(66.430)	(27.121)	(53.877)	(42.035)	(71.746)	(13.803)	(13.803)
F stat	53.87***	8.462***	6.288***	51.78***	10.38***	15.36***	0.363	15.17***	0.996	0.996
R-sq	0.550	0.147	0.125	0.514	0.193	0.241	0.008	0.236	0.024	0.024
Obs.	100	110	100	110	99	109	100	110	92	92
N	10	10	10	10	10	10	10	10	10	10

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Made by authors

4. COVID-19 severity impact on expense aggregates

This section proposes to emphasize the changes of hospitals' expense items considering the severity of COVID-19. In order to take into account seasonality, the assessment was made by comparing a certain month with the similar month of the previous year. The analyzed hospitals are the same as the ones described in the previous section.

4.1 Research methodology

Data is presented on a monthly basis. The period analyzed covers April to December 2020 (months in which COVID-19 patients were treated in hospitals), percentage changes being computed having as reference April to December 2019. Dependent variables are the percentage changes of expense items described in the previous case study.

Table 7: Variables used in the regression models and their acronyms

Variables	Acronym	Type of variable
Dependent variables		
Change in adjusted total expenses	%ATE	Dependent
Change in compensation of employees	%CE	Dependent
Change in use of goods and services	%UGS	Dependent
Change in depreciation of fixed capital	%DFC	Dependent
Change in constant human resource expenses	%CHRE	Dependent
Change in expenses with drugs	%ED	Dependent
Change in expenses with sanitary materials	%ESM	Dependent
Change in expenses with reagents	%ER	Dependent
Change in expenses with disinfectants	%EDI	Dependent
Change in expenses with laboratory materials	%ELM	Dependent
COVID-19 variables		
Number of monthly sick cases due to COVID-19	LogNB	independent
Number of monthly deceased due to COVID-19	LogND	independent

Source: Made by authors

4.2 Regressions results and discussion

In order to examine if there were changes in hospitals expense categories, we ran regressions by comparing with 2019. Table 8 shows that LogNB influence positively %ATE and %UGS (model 1 and 5). The number of monthly deceased due to COVID-19 variable has a positive impact on %ATE and %UGS in models 2 and 6, while the number of monthly sick cases due to COVID-19 has a negative impact on %CE and %DFC is not statistically significant (model 3 and 8). The increased expenses are associated with the number of sick and deceased persons due to COVID-19 as the Romanian Government made a great financial effort to stop (as much as possible) the spread of the virus. Therefore, the results confirm the Government financial effort in order to protect the population from getting infected with COVID-19.

Table 8: Fixed-effects regression outcomes regarding the impact of COVID-19 on category of expenses for changes in 2020 vs. 2019

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	%ATE	%ATE	%CE	%CE	%UGS	%UGS	%DFC	%DFC
LogNB	0.286***		-0.0144		0.806***		-0.195	
	(5.9400)		(-0.3553)		(7.5828)		(-1.0003)	
LogND		0.360***		0.0102		0.984***		-0.318
		(5.8652)		(0.1969)		(7.0954)		(-1.2937)
_cons	-0.817***	-0.791***	0.392*	0.290	-2.749***	-2.567***	1.299	1.541†
	(-3.7062)	(-3.6153)	(2.1085)	(1.5787)	(-5.6486)	(-5.1930)	(1.4598)	(1.7582)
F stat	35.28***	34.40***	0.126	0.0388	57.50***	50.34***	1.001	1.674
R-sq	0.309	0.303	0.00160	0.000490	0.421	0.389	0.0125	0.0207
Obs	90	90	90	90	90	90	90	90
N Hospitals	10	10	10	10	10	10	10	10

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Made by authors

In Table 9, the result regarding the impact of COVID-19 on human resource expenses and use of medical supplies for 2020 vs 2019 are shown. The models with the highest R-squared are 11 and 12, respectively between 0.44–0.39. Variable LogNB and LogND are statistically significant at 1% level of significance and positively influence 'Change in medical expenses with drugs' — %ED. Our results are supported by the literature in the field as well. Dalu *et al.* (2021) analyzed the Italian region Lombardy,

Table 9: Fixed-effects regression outcomes regarding the impact of COVID-19 on human resource expenses and use of medical supplies for 2020 vs 2019

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	%ED	%ED	%ESM	%ESM	%ER	%ER	%EDI	%EDI	%ELM	%ELM
LogNB	0.857***		-0.193		3.515*		0.204		-1012.1	
	(7.891)		(-0.097)		(2.081)		(0.077)		(-0.309)	
LogND		1.029***		-1.590		4.449*		-0.363		-1711.3
		(7.173)		(-0.632)		(2.087)		(-0.109)		(-0.410)
_cons	-3.644***	-3.392***	12.49	17.24†	-11.44	-11.23	4.414	6.627	6340.6	7801.6
	(-7.329)	(-6.629)	(1.3754)	(1.9241)	(-1.482)	(-1.478)	(0.367)	(0.558)	(0.424)	(0.524)
F stat	62.27***	51.45***	0.009	0.400	4.332***	4.357***	0.006	0.011	0.096	0.168
R-squared	0.441	0.394	0.0001	0.005	0.053	0.053	0.00007	0.0001	0.001	0.002
Obs.	90	90	90	90	88	88	89	89	86	86
N Hospitals	10	10	10	10	10	10	10	10	10	10

Note: *t* statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Made by authors

respectively the Luigi Sacco Hospital which had, in the highest influx of COVID-19 patients, a number of 280 beds out of which 30 in the Intensive Care Unit (ICU). The authors' research underlines the importance of medical attention and drugs during the pandemic. Therefore, the increased expenses with drugs in the face of such disease which spreads exponentially is crucial in order to decrease the number of sick or deceased persons due to COVID-19.

5. Conclusions

Resilience after a huge shock such as COVID-19 and the predictability of expenses in hospitals is vital for a better financial management. If recent balance sheet data can be used in order to estimate future changes that will help hospitals prepare the organization for the future challenges that are expected to happen.

Our study presented, for the first time as far as we are aware, the structural modification of different expense categories in public hospitals as a result of shifting their activity to fight exclusively against a pandemic. Having in regard that any expense category reacts differently and presents different correlation strength, we captured the connection of the most important expense categories with indicators reflecting the magnitude of the pandemic.

We found that the Romanian hospitals used in our sample, dedicated to treating the COVID-19 cases showed, from a statistical point of view, that adjusted total expenses is positive and stronger related with the number of monthly deceased persons than with the number of monthly sick cases due to COVID-19. Similarly, a positive and statistical significant relation has been identified between the use of goods and services with the number of monthly deceased due to COVID-19. From the human resources expense point of view, the independent variable that underlines the number of monthly deceased due to COVID-19 confirms the previous results, respectively it has been shown to be statistically significant at a 5% level but it has a negative impact on the expenses with special allowance. In these models both variables that are used for COVID-19, namely the number of sick persons and deceased due to the pandemic are statistically significant and have a negative impact on the special allowance received by the hospital personnel.

However, the model where the number of deceased persons due to COVID-19 had been considered better explains the variance of special allowance expenses, respectively with approximately 48%, representing the highest value.

Regarding the medical supplies, only expenses with drugs and sanitary materials seem to be strongly significant with COVID-19 outputs, while expenses with reagents, disinfectants, and laboratory materials were not directly influenced by the magnitude of the pandemic.

Furthermore, when we compared the changes in expenses, the impact of Covid-19 over the period of 2020 vs. 2019, our results were reinforced by the previous outcomes, respectively the expenses by category where the number of monthly sick

cases and deceased due to COVID-19 has a positive impact on %ATE and %UGS at 1% level of statistically significance. Also, the outcomes of the regressions revealed that the models with the monthly sick cases variable better explain the variance of expenses (adjusted total expenses and the use of goods and services). On the other hand, the results concerning the medical supply expenses hold only for drugs whereas the models with sanitary materials as dependent variable barely showed values for R-squared (0.01% and 0.5%). Instead, models having as dependent variable expenses with reagents are influenced by the number of monthly sick cases and deceased at the same level of statistically significance and R-squared.

Lastly, the present paper reveals the measures and financial effort made by the Romanian Government in order to prevent the sanitary crisis. The empirical outcomes may be biased since the selected balance sheets refer to entire hospitals and not only the departments and/or sections concerning COVID-19. However, the aggressive transmission of the virus by air led to the decision that, in the vast majority of time, the sampled infectious disease hospitals were dedicated exclusively to the treatment of COVID-19.

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