Impact of expenditures with human and non-human resources on medical efficiency indicators

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Abstract. The most valuable resource of an organization is the human resource, especially in the area of health care. The specific problem of the public medical systems is that some managers of hospital institutions do not have strategies for employees' compensation. In this paper, we propose to evaluate the impact of significant changes in the levels and the structure of budgetary allocation on the medical efficiency indicators of a public hospital from Romania, as well as the effects of changing reward policies on the hospital efficiency indicators. The paper provides a useful tool for hospital managers, which allows them to assess the impact of budgetary allocations for human and non-human resources (HNHR) on medical efficiency indicators of a public hospital.

Keywords: budget allocations, payments for personnel, payments for goods and services, medical efficiency indicators, case mix index.

Introduction

Precarious health care system is a worry that is object of many controversies in Romania. A problem faced by the health care system is the shortage of adequate resources to provide medical services, such as talented health professionals (Hernandez, 2009, Anthun, 2017; Anthun şi Anthun, 2017; Kittelsen, 2018). In Romania, this problem has been approached, very recently, by repeated wage increases and the promotion of physicians and nurses to a higher position in the wage grid of the budgetary sector staff. Due to the growing number of physicians and nurses emigrating, an increasing number of healthcare workers will have to manage a growing amount of patients. Therefore, in addition to financial rewards, better working time management is needed (Vărzaru, 2015). Another way to develop the rewards system to address the issue of human resource migration is the implementation of non-financial rewarding systems that can take on the pressure on net income growth (Adzei & Atinga, 2012; Sorup & Jacobsen, 2013; Chowdhury, 2014; Vărzaru şi Vărzaru, 2016; Fried & Fottler, 2017). Medical organizations need to develop effective policies to motivate employees to improve performance.

Many healthcare workers may leave the organization because of lack of motivation. There is a challenge to maintain talent within the organization because of the migration challenges faced by human resources managers in health care around the world. The intention to leave the organization, especially for the medical sector, is a challenging problem facing other sectors as well. However, healthcare organizations need to play an active role in recruitment and employment. Fried and Fottler (2017) agreed that the employees' turnover rate in the healthcare organization is a widespread problem in the vast majority of post-industrialized countries, where the employees' turnover rate is a persistent phenomenon that produces a serious problem for organizations. Some employees are unhappy with the job and decide to leave the organization or switch to another profession after they realize that a job does not meet their expectations (Niles, 2012). Keeping the employees can be accomplished successfully through various methods such as job satisfaction, recognition of merit and status, and reward. However, financial reward is a tool that cannot be ignored, having a significant impact on labor productivity and the employees' turnover rate (Sitnikov şi Bocean, 2010; Bocean şi Sitnikov, 2015).

In this paper, we addressed the issue of the impact of the change in the budget allocation structure on the public health efficiency indicators. We chose a public hospital in Romania (Slatina County Emergency Hospital - SCEH) for the empirical study, because in Romania the Government has promoted a new approach in the area of health since 2017, based on an aggressive increase in rewards offered to medical staff. Although the budgets of hospitals as a whole have increased, the increase in staff costs has been at the expense of resources allocated for the purchase of goods and services (drugs, medical equipment, medical instruments, food, medical and non-medical services, etc.). The main objective of the paper is to assess the impact of the change in the budget allocation structure on indicators of medical efficiency in a hospital. As a follow-up objective, we intend to evaluate the effects of changing reward policies on health efficiency indicators.

The paper is structured in six sections. After a brief introduction about the research, section two presents the design and methodology of research, and section three sets out empirical results and discussions. In the fourth section, we draw the conclusions.

2. Research methodology and design

Organizations use various resources in the production process to obtain goods and services: financial resources (capital), material resources, technological resources and human resources, which can be grouped

into two main categories: human resources and non-human resources, each of these categories having different productivity levels and specifics. Most economists have argued that the most valuable resource of an organization is the human resource, especially in the social area, and therefore it is necessary to manage it efficiently to ensure increased labor productivity.

Therefore in our research we propose to address the issue of impact of the budget allocation changing structure and the level of budgetary allocations for the two main categories of resources (human resources and non-human resources on the medical efficiency indicators of a public hospital).

3. Results and discussions

In order to make a quantitative research, we collected annual data for period 2010-2018 that characterize amounts spent with HNHR, quality and medical efficiency indicators (Table 1). These data will be used to determine the impact of personnel payments and payments for goods and services levels on indicators that express medical efficiency.

Table 1. Amounts spent on HNHR, service usage, quality and efficacy indicators for 2010-2018

	Payments for personnel - PP	Payments for goods and services - PBS	Total budget - BT	PP percent	PBS percent	Bed occupancy rate - RUP	Case mix index - ICM	Rate of nosocomial infections - RIN	Diagnostic concordance index - ICD	Mortality rate - RM
	mil. lei	mil. lei	mil. lei	%	%	%	Units	%	%	%
2010	72,02	35,45	110,26	65,32%	32,15%	89,8%	1,1	0,04%	78%	0,65%
2011	58,04	36,44	96,55	60,11%	37,74%	85,4%	1,06	0,07%	74%	0,68%
2012	60,98	41,07	105,32	57,90%	39,00%	92,3%	1,04	0,04%	73%	0,74%
2013	72,68	43,12	117,30	61,96%	36,76%	89,5%	1,14	0,03%	75%	0,85%
2014	71,36	42,16	119,01	59,97%	35,43%	80,5%	1,12	0,19%	76%	0,94%
2015	76,35	45,65	123,03	62,06%	37,11%	78,4%	1,12	0,31%	76%	1,22%
2016	94,05	46,36	145,86	64,48%	31,78%	77,3%	1,24	0,27%	76%	1,40%
2017	126,16	46,79	178,63	70,63%	26,20%	76,5%	1,32	0,56%	74%	1,40%
2018	167,77	48,91	231,29	72,54%	21,15%	77,9%	1,38	0,57%	78%	1,40%

Source: Collected data from SCEH

The analysis of the amounts spent with HNHR within the SCEH led to the conclusion that during the 9 years (2010-2018) budget allocations increased at a high rate. The total budget recorded a percentage increase of 109.76% in 2018 compared to 2010 (Figure 1).

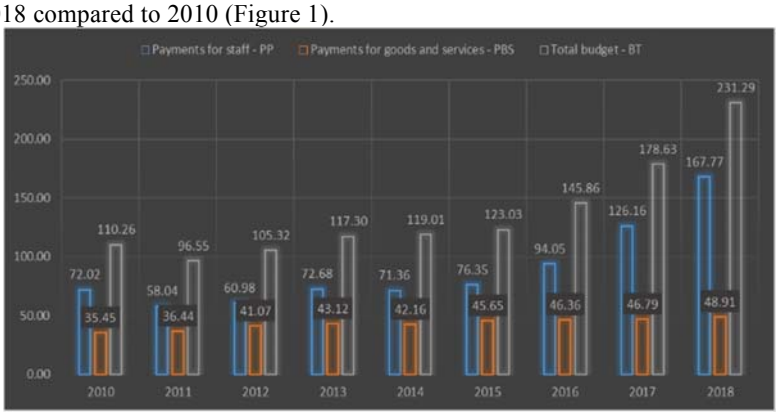

Figure 1. Evolution of staff expenditure, expenditure on goods and services and total budget
Source: Developed by the authors based on collected data

The growth rate of the total budget was determined by the increase in wages as a result of the declaration of health as a priority area for the Government of Romania, which led to a sharp rise in staff expenditure (which increased by 132.95% in the year 2018 as compared to 2010). Payments for goods and services rose at a much lower rate (an increase of 37.95% in 2018 compared to 2010), but higher than the inflation rate during this period (a cumulative inflation of 24.1% in 2018 as compared to 2010), according to the National Statistics Institute (INS, 2019).

Figure 2, which shows the percentage of personnel payments and payments for goods and services within the total budget, illustrates the gap between the allocation of amounts for HNHR. The share of personnel payments in the total budget (PPP) has a completely opposite trend against the share of payments for goods and services within the total budget (PPBS) during the studied period (2010-2018).

It can be deduced from the evolution of these indicators that special importance was given to the rewarding of human resources in order to increase their motivation and to stop the drain of qualified and talented human resources to the private sector and especially to the health care systems in the European Union countries.

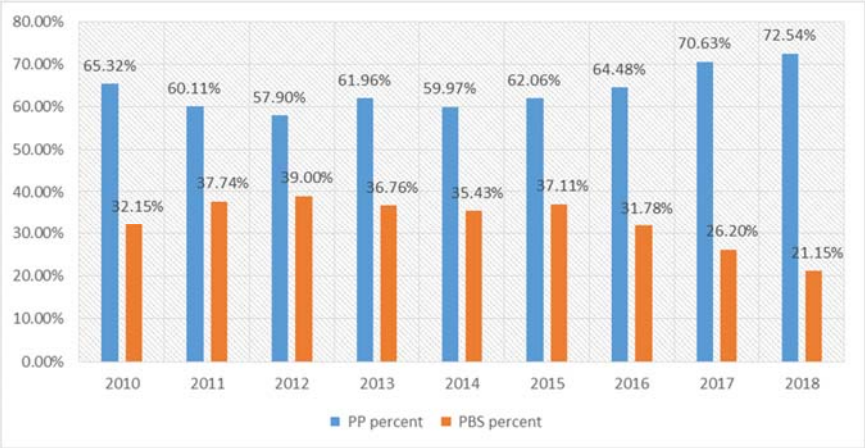

Figure 2. Percentage of staff expenditure and expenditure for the purchase of goods and services within the total budget during 2010-2018

Source: Developed by the authors based on collected data

Indicators that characterize allocations to non-human resources (investment in equipment, drugs, repairs, etc.) have seen modest increases relative to those characterizing allocations to human resources. Therefore, it is essential to investigate the effects of the differentiated increase of the amounts spent with HNHR on the indicators that characterize medical efficiency.

Bed occupancy rate decreased during the reference period (Figure 3). This indicator indicates the percentage of occupied beds, offering an overview of the quantity of services rendered, which can also illustrate the evolution of the quality of the services offered by the analysis in correlation with other indicators.

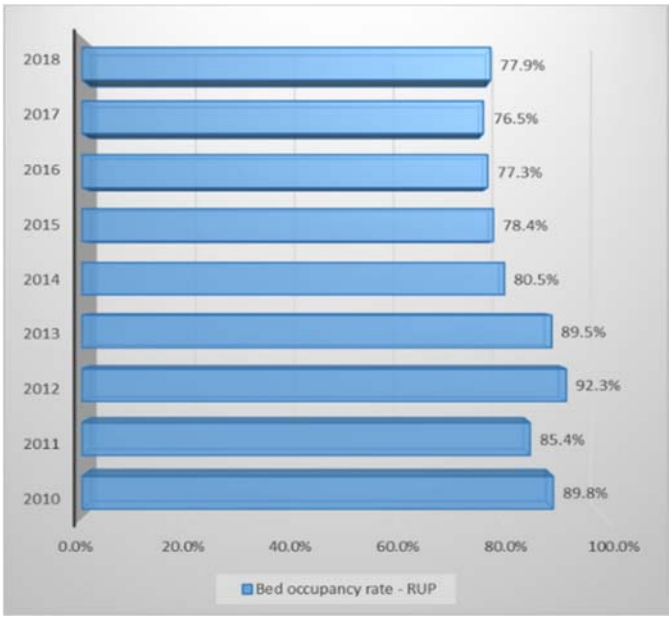

Figure 3. Evolution of bed occupancy rate (RUP) during 2010-2018

Source: Developed by the authors based on collected data

This indicator fell due to the diminishing of budget allocations for goods and services, which led management to restrict the amount of medical services offered.

The evolution of another service usage indicator (case mix index) is upward during the reference period, driven by higher personnel costs, especially in 2017 and 2018. This indicator of service use indicates an increased complexity of the cases solved, thus increasing the quality of the services (Figure 4).

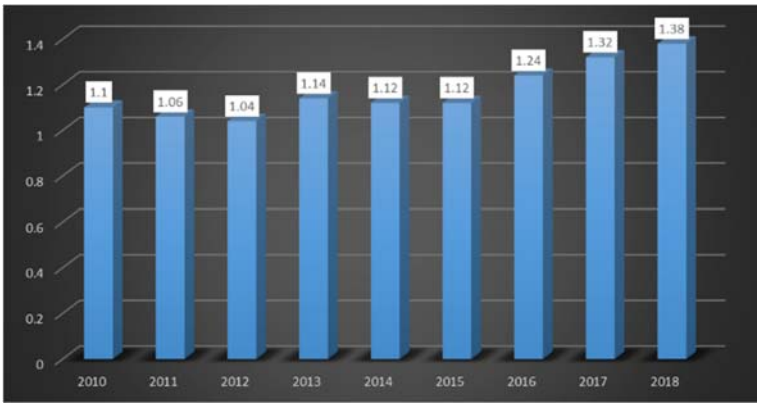

Figure 4. Evolution of the case mix index (ICM) during the period 2010-2018
Source: Developed by the authors based on collected data

Two of the quality indicators (nosocomial infections rate and mortality rate) had an upward, unfavorable evolution, determined by a stricter recording of cases, rather than a deterioration in the quality of services (Figure 5).

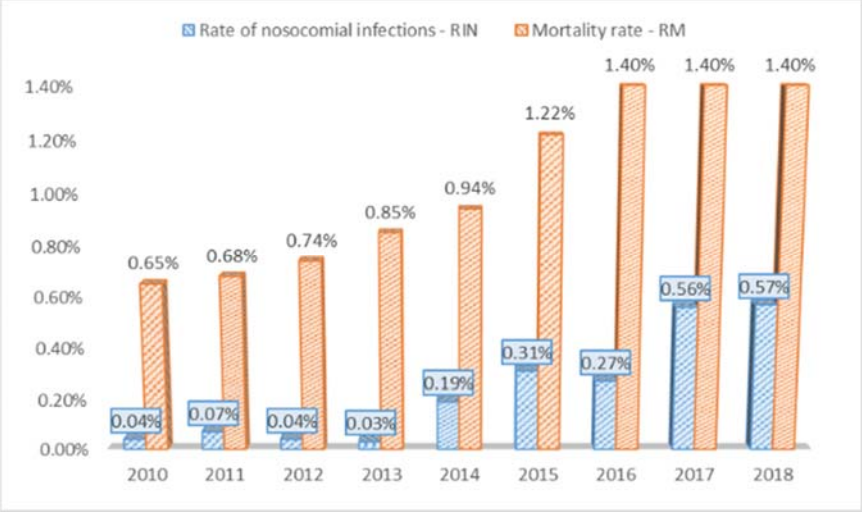

Figure 5. Evolution of nosocomial infections rate (RIN) and mortality rate (RM) during 2010-2018
Source: Developed by the authors based on collected data

Even considering the data are not very reliable, we can see a stagnation of these indicators in the years 2017 and 2018, when the levels of reward for medical staff doubled. Future developments will be edifying as regards the reward effects on these quality indicators.

Another indicator, illustrating the quality and efficiency of medical services, is diagnosis concordance index (Figure 6). Evolution of this indicator does not show a very clear trend. However, the same aspect can be observed as in previous quality indicators, the value of this index being higher in 2018 compared to 2017 by about 4 percent, an influence being the substantial increase of rewards.

The inferential statistical investigation started from the indicators' correlations analysis illustrating the amounts spent with the HNHR within the SCEH (absolute and relative personnel payments and payments for goods and services in absolute and relative terms, absolute budget in absolute terms) with other indicators illustrating medical efficiency, quality and use of services (bed occupancy rate, nosocomial infections rate, mortality rate, case mix index, diagnosis concordance index).

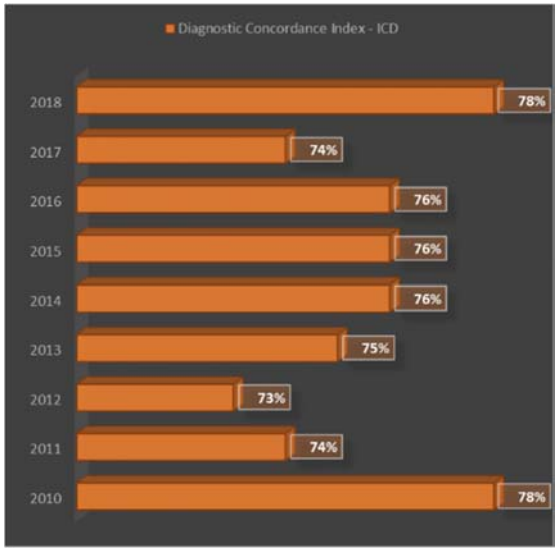

Figure 6. Evolution of diagnosis concordance index (ICD) during 2010-2018
Source: Developed by the authors based on collected data

Table 2 shows the correlations that are established among these indicators during 2010-2018 reference period.

Table 2. The correlations among the indicators illustrating the amounts spent, the indicators of efficiency, quality and service use

		PP	PBS	BT	PPP	PPBS	RUP	RIN	RM	ICM	ICD
PP	Pearson corr.	1	0.739*	0.997**	0.936**	-0.958**	-0.629	0.901**	0.775*	0.962**	0.421
	Significance		0.023	0.000	0.000	0.000	0.070	0.001	0.014	0.000	0.260
PBS	Pearson corr.	0.739*	1	0.778*	0.571	-0.572	-0.730*	0.810**	0.926**	0.789*	0.116
	Significance	0.023		0.014	0.108	0.107	0.026	0.008	0.000	0.012	0.767
BT	Pearson corr.	0.997**	0.778*	1	0.912**	-0.942**	-0.648	0.906**	0.800**	0.963**	0.407
	Significance	0.000	0.014		0.001	0.000	0.059	0.001	0.010	0.000	0.277
PPP	Pearson corr.	0.936**	0.571	0.912**	1	-0.968**	-0.569	0.847**	0.685*	0.927**	0.474
	Significance	0.000	0.108	0.001		0.000	0.110	0.004	0.042	0.000	0.197
PPBS	Pearson corr.	-0.958**	-0.572	-0.942**	-0.968**	1	0.586	-0.847**	-0.681*	-0.933**	-0.523
	Significance	0.000	0.107	0.000	0.000		0.097	0.004	0.044	0.000	0.148
RUP	Pearson corr.	-0.629	-0.730*	-0.648	-0.569	0.586	1	-0.849**	-0.891**	-0.722*	-0.261
	Significance	0.070	0.026	0.059	0.110	0.097		0.004	0.001	0.028	0.498
RIN	Pearson corr.	0.901**	0.810**	0.906**	0.847**	-0.847**	-0.849**	1	0.903**	0.912**	0.237
	Significance	0.001	0.008	0.001	0.004	0.004	0.004		0.001	0.001	0.539
RM	Pearson corr.	0.775*	0.926**	0.800**	0.685*	-0.681*	-0.891**	0.903**	1	0.859**	0.221
	Significance	0.014	0.000	0.010	0.042	0.044	0.001	0.001		0.003	0.568
ICM	Pearson corr.	0.962**	0.789*	0.963**	0.927**	-0.933**	-0.722*	0.912**	0.859**	1	0.375
	Significance	0.000	0.012	0.000	0.000	0.000	0.028	0.001	0.003		0.320
ICD	Pearson corr.	0.421	0.116	0.407	0.474	-0.523	-0.261	0.237	0.221	0.375	1
	Significance	0.260	0.767	0.277	0.197	0.148	0.498	0.539	0.568	0.320	

Note: **. The correlation is significant. *. The correlation is average.
Source: Developed by the authors based on collected data

Based on correlation analysis, it can be observed that while the case mix index (ICM) correlates with indicators that illustrate the amounts spent on HNHR, the diagnosis concordance index (ICD) does not correlate with these indicators. Indicators illustrating the amounts spent with HNHR, in absolute terms, are directly correlated with the ICM, which shows that the allocation of higher amounts leads to an increase in the complexity of the cases that doctors treat. This conclusion is also reinforced by the analysis of the correlations of the indicators illustrating the amounts spent with HNHR, expressed in percentage terms (as a ratio between the amounts allocated for each resource type and the total budget) with the ICM. It is noted that there is a strong

direct correlation (correlation index being 0.927) between the percentage of personnel payments from the total budget and the ICM, and an inversely proportional correlation (correlation index being -0.933) between the percentage of payments for goods and services from the total budget and ICM. This result is determined by the decrease in budget allocations, in relative term, for the purchase of goods and services, which negatively affects the ICM.

Since the evolution of DCI in the reference period was sinuous, with no clear trend, the correlations established between the indicators illustrating the amounts spent with HNHR and this index do not record significant values. As a result of the unfavorable upward evolution, determined by a stricter recording of the cases than by the deterioration of the quality, the correlations of the RIN and RM indicators are not very relevant, because the methodological and normative influences cause the possibility to detect the influences that are set among these indicators and the other indicators. Research on these indicators will become relevant during 2019-2027, as data collection methodology has improved since 2017 as a result of normative measures. These measures were implemented because it was found that during the period 2010-2016 the real rates of these indicators (RM and RIN) were not well recorded.

Figure 7 illustrates the evolution of correlations among indicators that illustrate the amounts spent with HNHR and the main indicators of medical efficiency: ICM and ICD.

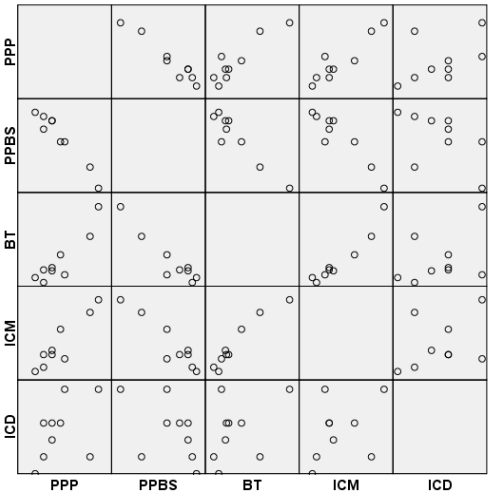

Figure 7. Scatter matrix of variables illustrating the amounts spent with HNHR and medical efficiency
Source: Developed by the authors based on collected data

Figure 7 shows relevant correlations between ICM and indicators that illustrate the amounts spent with HNHR (PPP, PPBS and BT), either direct or inverse. The values recorded by these variables are grouped and recorded on a curve. ICD, however, does not correlate with the indicators illustrating the amounts spent with HNHR, nor with the ICM, the recorded values being scattered, not having a specific pattern.

Conclusions

Health care systems around the world are failing to produce optimal health outcomes, and successive reforms have sought to make them more effective, equitable and more responsive. In this paper we examine the impact that the amount and structure of budgetary allocations have on the medical efficiency indicators that illustrate the productivity of work and organizational performance.

In order to determine the impact of the two major categories of budget allocations on the indicators of quality, productivity and medical efficiency, we conducted an inferential statistical investigation that started from the analysis of the correlations of the indicators illustrating the amounts spent with HNHR within the Slatina County Emergency Hospital (staff costs and expenditures for the purchase of goods and services in absolute and relative terms, total budget in absolute amount) with the other indicators illustrating labor productivity, medical efficiency, quality and use of services (bed occupancy rate, nosocomial infections rate, mortality rate, case-mix index, diagnosis concordance index).

Following research, using neural network analysis and complex forecasting models, we came to the conclusion that allocating more resources for staff payments determines an increase in the case-mix index. However, without measures to increase the allocation of budgetary resources for the purchase of goods and services, the impact is moderate, motivated human resources lacking the material tools needed to achieve very good results.

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