THE HUMAN RESOURCES USING EFFICIENCY IN POLISH PUBLIC HOSPITALS - SPATIO-TEMPORAL ANALYSIS

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Abstract

Within many health care systems worldwide, increased attention is being focused on human resources management (HRM). Specifically, human resources are one of three principle health system inputs, with the other two major inputs: physical capital and consumables. Human resources, when pertaining to health care, can be defined as the different kinds of clinical and non-clinical staff responsible for public and individual health intervention. As arguably the most important of the health system inputs, the performance and the benefits the system can deliver, depend largely upon the knowledge, skills and motivation of those individuals responsible for delivering health services. The article is focused on an identification of spatio-temporal diversification of human resources using efficiency in Polish public hospitals. The data collection was achieved through secondary sources such as The Ministry of Health in Poland. The main human resources issues and questions, along with the analysis of the human resources impact on the health care system was examined, as well as the identification of the trends in health sector reform. These trends include efficiency, equity and quality objectives.

Key words

efficiency, public hospital, human resources

JEL Classification: O15, D61, D60

1. Introduction

In recent years an increasing interest of searching the determinants of the public hospitals efficiency is observed. The competition among healthcare entities is growing – they have to cope a constantly adaptation to occurring challenges. It seems to be especially difficult for public hospitals.

The public hospitals resources protect their functioning, at the same time determining the efficiency achievement of the objectives. However it should be noted, that with the time passing and environmental conditions changing, some hospitals resources become less important in building its development strategy, while others are more important, which significantly affects the formation of hospitals distinctive competences. Therefore, resources are the basis for the public hospitals efficiency and competitiveness.

J.B. Barney, the forerunner of the resources based view (*RBV*) has identified three categories of resources (Barney, 1991, pp. 99 – 120): material, human and organizational. Due to the specific of public hospitals, in the article the analysis of human resources are done, because knowledge and skills of medical personnel have the greatest impact on the medical services provided in these facilities.

The efficiency is one of the organization characteristic that determines its functioning and development. The article is focused on an identification of spatio-temporal diversification of human resources using efficiency in Polish public hospitals.

2. Human resources of public hospitals and their efficiency - terms interpretation

In many definitions the utility of resources for the organization is emphasized, e.g. there are considered as input factors controlled and used by organizations to develop and implement their strategies (Olivier, 1997, p. 700). E.T. Penrose - precursor of the resources approach - defines resources as a bundle of specific services which are able to provide the organization (Penrose, 1959, p. 25). The resources can be divided according to many criteria, e.g.:

- subject - type of resource, e.g. human, financial, material;

- functions or subsystems of the organization - marketing, financial, used in the production;

- characteristics of resources - visible and invisible, material and immaterial, "hard" and "soft".

Among the proposals of resources classification according to the objective criterion, the classification of C. Hofer and D. Schendel often is invoked, who

distinguished five types of resources (Hofer, Schendel, 1978, p. 146):

- material (land, buildings, structures, machinery, equipment);
- human;
- financial;
- technological (creation of high-quality products, responding to market changes, etc.);
- organization, e.g. corporate culture.

In all these classifications the authors take notice to the importance of human resources. Taking into account the specific character of public hospitals, their most important human resources seem to be "white medical staff" (doctors and nurses), which have the most significant impact on the quality of medical services in these facilities (Krawczyk-Sołtys, 2013, p.192).

M. Bielski assumes that the achievement of specific goals is a major prerequisite for the organization creation and people so in the process of its formation, as well as managing, act rationally (Bielski, 1996, pp. 103-112). In this sense, the efficiency is expressed by achieving goals of public hospitals and shaping expected relations between the achieved effects and incurred expenditures (rationality).

Because of existing multiple perspectives of efficiency evaluation, there are many dimensions of this concept. To the basic categories of efficiency in health care can be included: allocative efficiency (also called Pareto efficiency) and technical efficiency (Golinowska (Ed.), 2012, p. 198). The allocative efficiency refers to the results evaluation, their distribution in the spatial and social structure and its relation to incurred expenditures. The assumption of this efficiency category is the assertion about limited resources, which are supposed to be reallocated in order to bring the best health outcomes to whole society. The allocative efficiency depends on the decision of entities responsible for the location of resources in the health care system. In Poland, these entities are: payers contracting health services, institutions that deliver these services (including public hospitals) and control organizations. It can be assumed that achieving allocative efficiency occurs when the position of the entity cannot be improved without deterioration others (Dubas, 2011, p. 104). In this way, the health benefits for the whole population (measured by such indicators as life expectancy, average life expectancy in good health) and not for the selected social group are maximized. The purpose of this efficiency category is to obtain answers the questions about resources distribution, e.g.: What

types of health services, diseases, patients or subjects should be financed?

The technical efficiency can be understood as creation a certain number of services at the least possible effort, or creation as many services as possible at a certain expenditures.

Therefore, it generally refers to verify the efficiency of various health entities, to assess, how an organization manages its resources (personnel, technical equipment, infrastructure, materials and tools, finances, etc.). This kind of efficiency is measured by a number of indicators, of which the most common are as follows:

- evaluating the level of resources using, e.g. the level of medical personnel and hospital beds using;
- specifying the amount of resources per capita, e.g. the number of doctors and nurses and hospital beds per 10 thous. residents.

In order to determine the technical efficiency regulation by indicators, it is necessary to make a comparison with the standard or other entities (benchmarking). This is due to the fact that paying attention to obtain the best indicators may not affect on decreasing the quality of medical services. The most important factor determining the health care system efficiency and developing the quality of medical services is human resources (Bloor, Maynard, 2003; Elarabi, Johari, 2014, pp. 13-22; Kane, Lum, Degenholtz, Yu, 2007, pp. 832-839; Harris, Cortvriend, Hyde, 2007, pp. 448-459; Keating, 2011, pp. 677-692; Zairi, 1998, pp. 88-99). Patients health and lives and the quality of medical services depends on the personnel competence and quality management. Occurring stronger environment pressure forcing an increasing quality of services and preserving the economic efficiency, determines the identification and focusing of management changes, allowing on better use of public hospitals resources.

3. Methodology

Efficiency is one of the most important economical categories, it lets to analyze activity, its perceived as estimation of correctness of completing a task through a certain system. Efficiency reflects relations between effects, goals, issues and costs considered in structural and dynamic recognition (Blaik, 2010, p. 411; Manheim, Feinglass, Shortell, Hughes, 1992, pp. 55 – 66). In general meaning efficiency is a ratio of effects and issues which can be shown as an equation (Diez – Ticio, Mancebon, 2002, pp. 51-62; Hofmarcher, Paterson, Riedel, 2002, pp. 7-14):

$$E = \frac{e}{n} \qquad (1)$$

where :

E – efficiency;

e – obtained effects;

n – incurred issues.

Measurement of efficiency can be made in different ways depending on range system operation. We can distinguish organizational efficiency which means ability of the system to adapting to changes of the environment and beneficial use of sources. Economical efficiency concerning rational managing of sources. Another kinds of efficiency is technical efficiency that measures value size of production with use of issues, next one is quality efficiency that reflects competitiveness of system relatively to others, characterized by different values (Sherman, 1984, pp. 922-938; Linna, 1998, pp. 415-422; Biorn, Hagen, Iversen, Magnussen, 2003, pp. 271-283).

Nowadays its more common to consider efficiency through defining optimal relations between issues and effects. One of these methods is *Data Envelopment Analysis (DEA)* (Yang, Ma, Koike, 2009, p. 343-354). It lets to study efficiency of assumptions depending on sustained issues, its nonpatametrical method, based on linear programming. Efficiency in DEA method describes itself as quotient of sums considered issues and effects which we can describe as (Edirisinghe, Zhang, 2007, pp. 3311 - 3335; Nayar, Ozcan, 2008,

pp. 193–199; Cook, Liang, Zha, Zhu, 2009, pp. 276 – 281):

$$E = \frac{\sum_{k=1}^{p} \mu_k \, y_k}{\sum_{i=1}^{m} v_i \, x_i} \qquad (2)$$

where :

y_k - size of assumption;

μ_k – weight of certain assumption;

x_i – size of issue;

v_i – weight of certain assumption.

The oldest DEA model is CCR (*Charnes, Cooper, Rhodes*) its canonical model which is also a base for publications about DEA. Model CCR considers efficiency in Farrells sense. It is assumed there that change of efficiency means proportional changes in issues or proportional changes is results. Idea of estimation of efficiency of the object through CCR model focuses on estimating if in set A of projects, the right one is the one which implements tasks in the most efficient way (Cooper, Seiford, Tone, 2000, pp. 21 – 39; Ferrier, 2006, pp. 181 – 182; Jacobs, 2001, pp. 103 - 115).

In many researches from setting efficiency and CCR model, graphics is shown as the only method to solve it. This method it can be used when two issues is needed to get the results. In this case graphical picture pf a problem on the R^2 surface should be created (Yu, Lin, 2005; pp.1005 – 1017; Wen, Li, 2009, pp. 872–878).

Fig. 1. Graphical representation outlays in the analyzed points
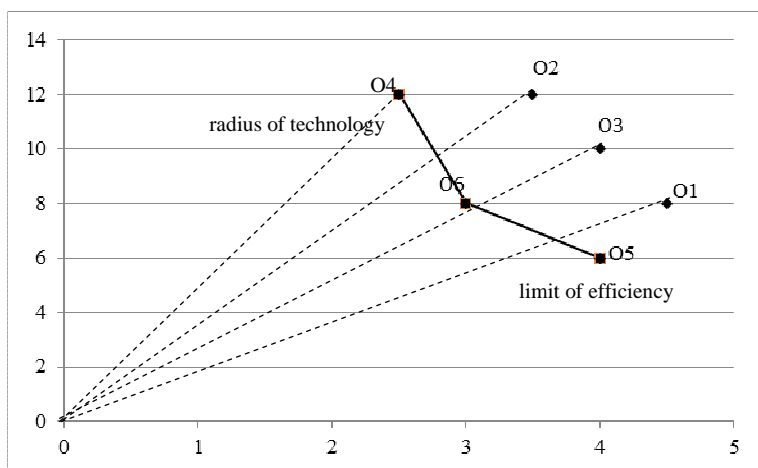
Source: own study.

The broken line in figure 1 is the border of efficiency on which there are all efficient points in Pareto sense (O'Neill, Rauner, Heidnberger, Kraus, 2008, pp. 158 – 189). For every object every evidence

of vector of empirical issues is not smaller than $x_{nj} \geq GE(x_j)$ for n=1,…, N; j=1,…,J.

Efficiency of object is quotient of distance of interaction point of technological radius j^{th} object and border of efficiency P_j from the beginning of

coordinate system and distance of certain object from coordinate system:

$$\frac{d(0, P_j)}{d(0, O_j)}$$

(3)

where distance between 2 points $A(x_A, y_A)$ i $B(x_B, y_B)$ can be counted by using this pattern:

$$d(A, B) = \sqrt{(x_A - x_B)^2 + (y_A - y_B)^2}.$$

(4)

Values that we've got from third pattern which are at least equal 1, are efficient and the ones that are smaller than 1 are inefficient.

Resources using efficiency in polish public hospitals can be also tested by the second degree polynomials (Krawczyk-Sołtys, 2013, pp. 194-212).

4. Results

Studying efficiency of using human resources in polish public hospitals has been made for 2007 and 2013. The data used in research is from statistical newsletter from Ministry of Health and from statistical years from Main Statistical Office .The information used in research were about employed doctors and nurses in polish hospitals and number of people cured in public hospitals in analyzed years.

Table 1. Number of doctors, nurses, patient in polish public hospital in 2007 and 2013

Voivodship	Code	number of doctors working in public hospitals per 100 thous. residents		number of nurses working in public hospitals per 100 thous. residents		number of patients hospitalized in public hospitals per 100 thous. residents	
		2007	2013	2007	2013	2007	2013
dolnośląskie	DSL	141,6	216,5	311,9	346,5	20012,5	22090,8
kujawsko-pomorskie	K-P	140,4	185,3	284,1	327,1	17177,1	19284,1
lubelskie	LBL	170,9	206,9	355,0	371,1	20099,0	22523,5
lubuskie	LBU	118,1	156,6	290,6	300,3	17170,8	19702,4
łódzkie	LDZ	189,6	259,6	326,4	363,9	20877,6	25996,2
małopolskie	MLP	164,3	199,5	301,0	332,5	16755,0	18703,7
mazowieckie	MAZ	196,1	262,6	326,6	375,6	18536,3	23532,9
opolskie	OPO	102,1	145,2	252,1	291,3	16265,3	18924,5
podkarpackie	PKR	114,9	152,1	316,7	345,9	18148,2	21504,5
podlaskie	PDL	181,8	229,7	345,7	347,4	20098,3	22057,2
pomorskie	POM	156,6	202,1	274,9	301,1	15383,1	18480,2
śląskie	SL	177,5	231,2	364,8	378,3	19116,1	21233,6
świętokrzyskie	SW	127,3	173,9	311,6	341,7	19757,8	24058,4
warmińsko-mazurskie	W-M	114,9	162,3	273,5	297,2	18483,8	19682,4
wielkopolskie	WLP	142,8	135,7	296,1	302,0	20837,9	22405,2
zachodniopomorskie	ZPM	141,2	199,4	283,3	315,0	18802,4	20591,5

Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny

The biggest amount of doctors working in public hospitals per 100 thous. residents has been noticed in 2007 in mazowieckie and łódzkie voivodeship. The average for Poland in 2007 was almost 148,8 doctors per 10 thous. residents but in 2013 it was 94,9 doctors. In 2007 in 9 voivodeships there worked less doctors than the average shown (opolskie, warmińsko-mazurskie, podkarpackie, lubuskie, świętokrzyskie, kujawsko-pomorskie, dolnośląskie oraz wielkopolskie). Than year (2007) it was possible to observe difference between opolskie (where the smallest number of doctors worked: 102,1 per 10

thous. residents) and mazowieckie (the biggest amount of doctors 196,1 per 10 thous. residents). In 2013 not much has changed even though the number of doctors working in hospitals has increased, opolskie still was one of voivodeships with the smallest amount of working doctors per 10 thous. residents when łódzkie and mazowieckie still were on top of the list with the biggest amount of employed doctors in public hospitals per 10 thous. residents. The biggest increase in employed doctors has been noticed in dolnośląskie – 52%; in order there was opolskie 42%. Only in case of wielkopolskie voivodeship has

been noticed – 5% decrease in number of doctors. In case of average medical staff – nurses working in public hospitals with the smallest amount of employees, the number of doctors in analogical. Opolskie and warmińsko-mazurskie voivodeship where places in which in 2007 has been noticed the smallest amount of nurses working in public hospitals per 10 thous. residents. It was in order: opolskie 252, warminsko-mazurskie 273. Analyzing coefficient of variation number of nurses working in voivodeships we could estimate that differentiation is not big, in 2007 dispersion was 10 % and in 2013 8,2%. In 2007-2013 a difference between voivodeships with the smallest and biggest amount of nurses employed in public hospitals has decreased by 33 %. Analyzing number of people with higher education (doctors,

specialist doctors) and medium one, we could say that the best situation is in these voivodeships where there are medical universities. Graduates of these places usually stay in cities, they finished their education at, to do internships and get more needed education. Average number of patient staying in public hospitals has increased from 18595,1 to 21298,2. The biggest number of patients has been noticed in łódzkie voivodeship where the biggest amount of medical staff has been employed. Level of differentiation of number of patient in researched time is equal, a noticed change from 9% level in 2007 to 10% in 2013. Opolskie, pomorskie and wielkopolskie voivodeships are the ones that had the smallest amount of patients cured in public hospitals (per 10 thous. residents).

Fig. 2. Relation: doctors – patients in 2007
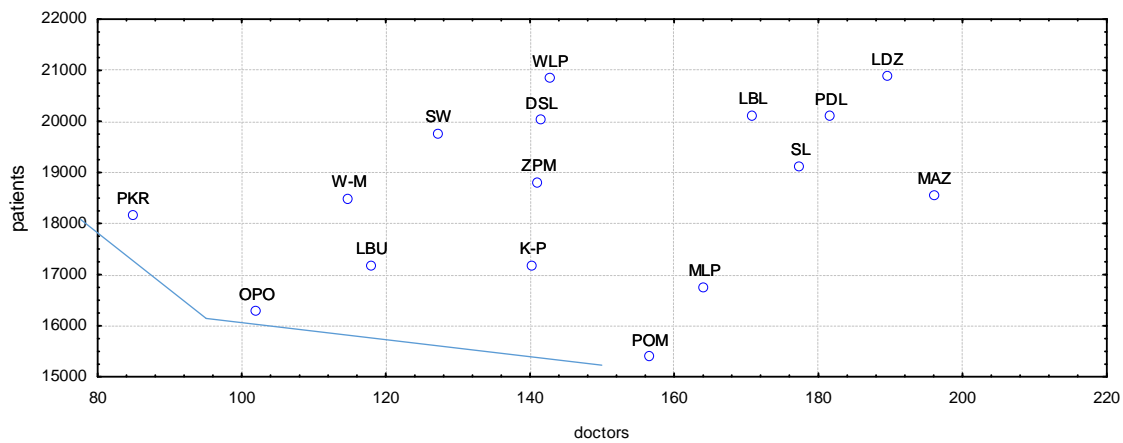
Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny
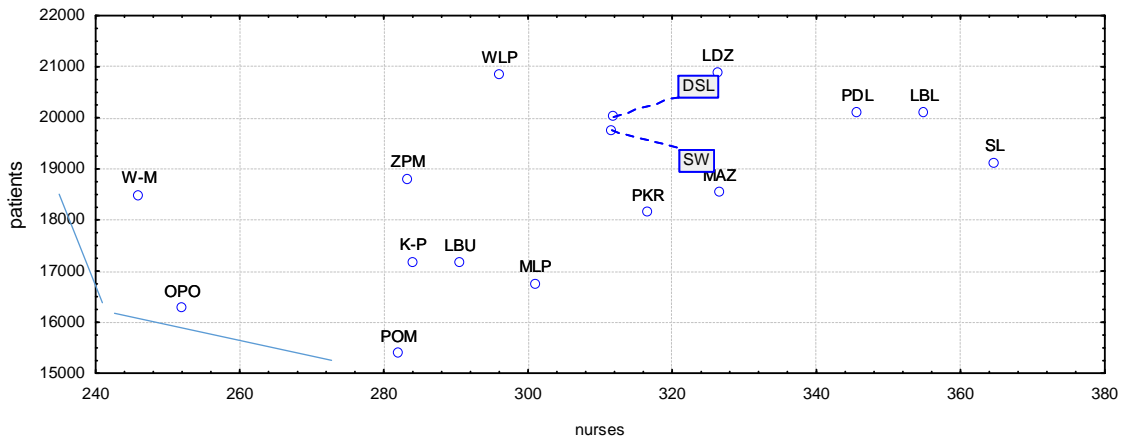
Fig. 3. Relation: doctors – patients in 2013
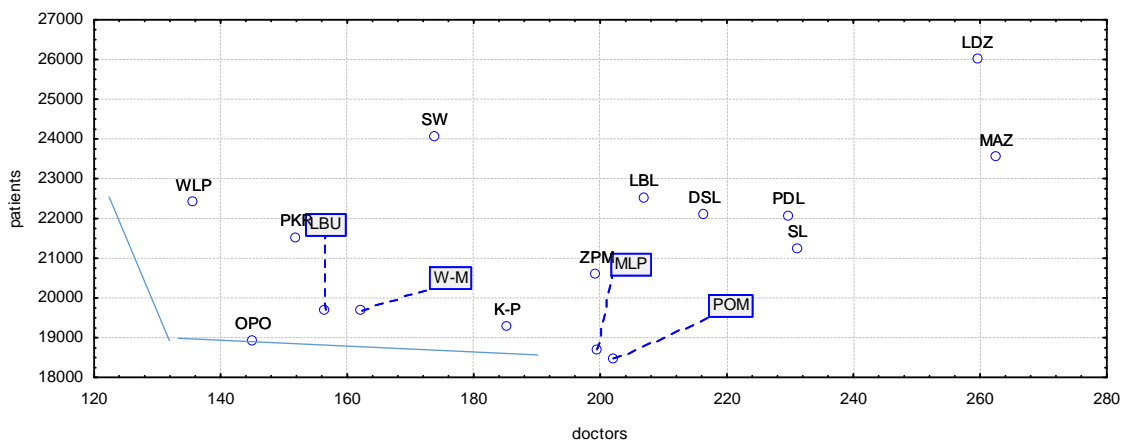
Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny

Figures 2-5 are graphical presentation of issues considered sources in public hospitals. Broken lines reflect borders of efficiency, based on them and datas in table 1, it was possible to describe efficiency of analyzed system of Nationl Health System through public hospitals. Voivodeships that are on the line picture border of the system in which national health system is efficient. This mean that the number of employees of medium and higher level is enough to provide good medical help for patients in public hospital. those voivodeships that distance from the beginning of coordinate system is the biggest, we can say that this system of health isn't efficient. On the border of efficiency there is always opolskie and pomorskie voivodeship where the number of staff employed is efficiently used according to number of patients cured in those hospitals.

Fig. 4. Relation: nurses – patients in 2007

Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny

Fig. 5. Relation: nurses – patients in 2013
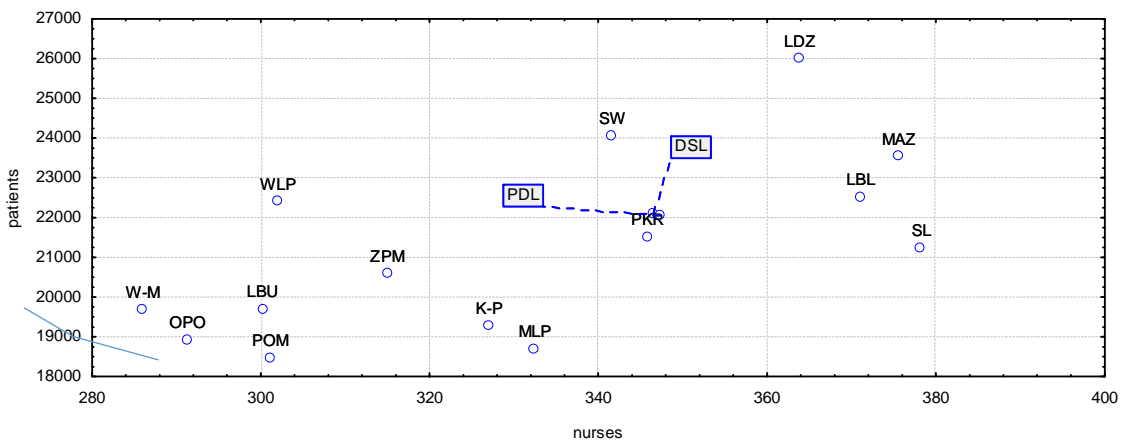
Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny

Using graphical interpretation and equation number 3 to measure efficiency we could say that in 2007 in issue expenditure doctor-patient: opolskie, pomorskie and podkarpackie were on the border of efficiency, but in 2013 it was opolskie, pomorskie and warmińsko-mazurskie (tab.2). It means that needs of patients had been pleased by certain amount of employees. Opolskie voivodeship is worth a little attention as despiting the smallest amount of employed doctors per 10 thous. residents got the title of place where health system is efficient. In ratio of issues nurse-patient in 2007 opolskie, pomorskie and wielkopolskie when in 2013 opolskie, pomorskie and warmińsko-mazurskie were on border of efficiency, they should be recognized as the ones where human resources are effectively used.

Table 2. Efficiency of public hospitals in 2007 and 2013.

Voivodship	Efficiency of hospitals based on relation: doctors – patients		Efficiency of hospitals based on relation: nurses – patients	
	2007	2013	2007	2013
Dolnośląskie	1,015	0,979	0,770	0,850
Kujawsko-pomorskie	0,835	1,154	0,897	0,942
Lubelskie	0,722	1,057	0,766	0,817
Lubuskie	1,127	1,518	0,897	0,967
Łódzkie	0,709	0,809	0,738	0,756
Małopolskie	0,906	1,023	0,918	0,951
Mazowieckie	0,842	0,763	0,830	0,792
Opolskie	1,000	1,000	1,000	1,000
Podkarpackie	1,000	0,901	0,848	0,864
Podlaskie	0,735	0,898	0,766	0,850
Pomorskie	1,000	1,000	1,000	1,000
Śląskie	0,780	0,876	0,804	0,837
Świętokrzyskie	0,888	0,789	0,780	0,812
Warmińsko-mazurskie	0,905	1,000	0,836	1,000
Wielkopolskie	0,924	2,198	1,000	0,923
Zachodniopomorskie	1,211	1,068	0,820	0,921

Source: own study based on Biuletyn Statystyczny Ministerstwa Zdrowia 2007, 2013; Centrum Systemów
Informacyjnych Ochrony Zdrowia, Warszawa, https://www.csioz.gov.pl/statystyka/biuletyn-statystyczny

Liders in rankings of efficiency are opolskie and pomorskie which should be recognized as highly efficient. Additionally we should mark lubuskie, wielkopolskie and zachodniopomorskie voivodeship which got more than one if scale of efficiency. It means that issues described in medical staff with higher education are higher than previous needs described in patients. It may indicate to losing potential of human resources in doctors in previously mentioned voivodeships and should be directed to different voivodeships in which there is lack of medical staff.

5. Conclusion

Research that has been made proves that DEA model even in the easiest version are good tool to study efficiency of polish health system. In next steps we should widen analysis through considering and taken attention to additional issues argumentative and/or financial.

Surely considering efficiency of health system only based of human resources (doctors, nurses) is not enough. In 2013 Information Agent Bloomberg has made ranking of efficiency of health system in the world. Measure has been made based on 3 things: expected length of life, cost of relative health insurance *per capita* and cost of absolute cost of health insurance *per capita*. Ranking has shown that efficiency of polish health system is not the worst. From 48 countries from research, Poland was on 21st place. Expected length of life was 76 years, on health system it was spent 7.1 % of PKB *per capita*. Our placing is decreased by absolute cost of health insurance which costs about 899 $ per year *per capita* (Baliszewski, 2013).

The issue of efficiency in health care is therefore particularly relevant. The constant shortage of funds needed to finance the system forces to special concerning about public hospitals efficiency. However, assessing the efficiency of these entities their specific social role concerning the most valuable good, which is humans health and life, should be pointed. For this reason, the dual view on such organizations is necessary, which include both economic and social results. It is therefore needful to take into account the multidimensional efficiency, doing analysis of many areas of activity, from the different perspective of system participants. This is a contribution to the further, in-depth research in this area.

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