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# Efficiency of day surgery in Slovak regions during the years 2009-2014

**Abstract.** The paper deals with CCR, BCC and FDH efficiency analyses results of valid available indicators of eight Slovak regions with one day surgery facilities both for adult and paediatric patients in the period of 2009-2014, where the input is the number of beds and the output is the number of patients. In 2014, Banska Bystrica region was efficient from the viewpoint of CCR model of paediatric patients. According to the BCC model, there were four efficient cases: Trnava - in 2009, Banska Bystrica - in 2014 and Presov - two years running (2013 and 2014). In the case of CCR model regarding adult patients, Zilina region was efficient in 2009. On the basis of the BCC DEA model, six efficient cases have been determined: Trnava and Zilina regions - in 2009, Zilina region - in 2010, Banska Bystrica - in 2012 and Bratislava region - in 2012 and 2014. The results of the analysis present a valuable platform for the creators of health and social policies as well as for other stakeholders of health system in Slovakia that will transform into correct stabilization and regulatory mechanisms of health and social policies.
**Keywords:** Day Surgery; Hospital; Efficiency; Healthcare; Data Envelopment Analysis; Slovakia
**JEL Classification:** H51; C61
***Acknowledgement.*** *The work was supported by the VEGA Project No. 1/0986/15 «Proposal of the dimensional models of the management effectiveness of ICT and information systems in health facilities in Slovakia and the economic-financial quantification of their effects on the health system in Slovakia».*
*Our thanks go to the National Health Information Center of Slovakia (http://www.nczisk.sk) for providing the Slovak day surgery database, as well as for a long-term support of our research activities within health policy.*
**DOI:** http://dx.doi.org/10.21003/ea.V159-17

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**Ефективність відділень денної хірургії в регіонах Словацької Республіки в період 2009–2014 років**
**Анотація.** У статті розглядаються CCR, BCC та FDH моделі аналізу середовища функціонування (АСФ, англ. мовою – Data Envelopment Analysis (DEA)), побудовані на основі використання наявних достовірних показників, що характеризують відділення денної хірургії для дорослих та дітей у восьми регіонах Словацької Республіки в 2009–2014 рр. У якості вхідної змінної був обраний показник «кількість ліжок», а в якості вихідної – «чисельність пацієнтів». З огляду на CCR модель, педіатричні відділення регіону Банська Бистриця були ефективними у 2014 році. За результатами застосування BCC моделі було виділено чотири випадки ефективності відділень: в регіоні Трнава – у 2009 році, у регіоні Банська Бистриця – у 2014 році, а також у регіоні Прешов протягом 2013 та 2014 років. У випадку CCR моделі, яка застосовувалася для визначення ефективності відділень для дорослих пацієнтів, ефективними були відділення в регіоні Жиліна в 2009 році. На основі моделі BCC було отримано шість випадків ефективності відділень: у регіонах Трнава та Жиліна – у 2009 році, у регіоні Жиліна – у 2010 році, у регіоні Банська Бистриця – у 2012 році та в Братиславському регіоні у 2012 та 2014 роках. Результати проведеного аналізу є платформою для розробки політики охорони здоров'я та соціального захисту в Словаччині, формуючи основу для створення ефективних механізмів стабілізації та регулювання у цих сферах.
**Ключові слова:** відділення денної хірургії; ефективність; охорона здоров'я; аналіз середовища функціонування.

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**Эффективность отделений дневной хирургии в регионах Словацкой Республики в период 2009–2014 годов**
**Аннотация.** В статье рассматриваются CCR, BCC и FDH модели анализа среды функционирования (АСФ, на англ. языке – Data Envelopment Analysis (DEA)), построенные на основе использования имеющихся достоверных показателей, характеризующих отделения дневной хирургии для взрослых и детей в восьми регионах Словакии в период 2009–2014 гг. В качестве входной переменной был выбран показатель «количество коек», а в качестве выходной – «численность пациентов». С точки зрения модели CCR, педиатрические отделения Банскобыстрицкого региона были эффективными в 2014 году. По результатам применения модели BCC были выделены четыре случая эффективности отделений: в регионе Трнава – в 2009 году, в регионе Банска Быстрица – в 2014 году, а также в регионе Прешов на протяжении 2013 и 2014 годов. В случае с моделью CCR, которая применялась для отделений взрослых пациентов, были эффективны отделения в Жилинском регионе в 2009 году. На основе модели BCC DEA было определено шесть случаев эффективности отделений: в регионах Трнава и Жилина – в 2009 году, в Жилинском регионе – в 2010 году, в регионе Банска Быстрица – в 2012 году, а также в Братиславском регионе – в 2012 и в 2014 годах. Результаты проведенного анализа представляют собой ценную платформу для разработки политики здравоохранения и социальной защиты в Словакии, формируя основу для создания корректных механизмов стабилизации и регулирования в этих сферах.
**Ключевые слова:** отделения дневной хирургии; эффективность; здравоохранение; анализ среды функционирования.

**1. Introduction & Brief Literature Review**

In Slovakia, day surgery has been developing since 2000. Its development is connected with a formation of the Slovak Association of Day Surgery that supported the formation of a legal framework to create day surgery workplaces. However, the ratio of day surgery (approximately 7% out of the total number of realised surgeries in comparison to 40-70% ratio abroad) is very low in spite of the fact that the Ministry of Health of the Slovak Republic supports it significantly (Gavurova & Hyranek, 2013; Gavurova et al., 2014) [1-2]. Day surgery has been operating successfully abroad for decades and it has also been used by older patients as it is interconnected with subsequent nursing care in many countries.

The fundamental characteristic of day surgery operation states that it is an operation, which is relatively patient-friendly with regard to the patient's body and it does not represent any extremely high post-operative burden for the patient's body (Jarrett & Staniszewski, 2006)[3]. It is also necessary to take into consideration the level of operational invasiveness, the relevant complications, the risk of blood loss, the estimated post-operative pain or the time which is necessary to perform day surgery operations (Kroneman, 2001; Soltes et al., 2011a; Soltes & Gavurova, 2014) [4-6]. Threrefore, minimally invasive procedures, particularly in general surgery, represent a viable option (Soltes et al., 2010) [7]. Furthermore, there are also patients' characteristics that may promote or prohibit day surgery preference for the given procedure (Soltes & Radonak, 2014; Popa et al., 2015) [8-9]. Day surgery decreases a risk of nosocomial infections that extend the treatment period and increases treatment costs. Day surgery differs within each country. This may be caused by many reasons of both economic and non-economic character (Soltes, 2011b; Szabo & Sidor, 2014; Szczygiel et al., 2014) [10-12]. Reimbursement mechanisms represent an important aspect in the individual countries (Soltes & Gavurova, 2015; Bem et al., 2014; Bem & Michalski, 2015) [13-15].

In the context of the given facts, this article provides another partial view of health system efficiency by using a chosen method of evaluating the day surgery efficiency in Slovakia. We obtained the data on the basis of contractual cooperation with the National Health Information Center.

**2. Purpose**

The main purpose of our paper was to do day surgery efficiency analyses in the Slovak regions (NUTS III level) in the period of 2009-2014 (the relevant day surgery data have been collected on the basis of the Ministry of Health of the Slovak Republic Guidelines since 2009). Our main analytical methods were DEA (CCR, BCC and FDH) input oriented models. We assume that the number of patients is already defined and it is not rational to increase it due to different medical, personal and technological requirements of day surgery therapy patients.

**3. Data and Research Methods**

«The Annual Report of Day Healthcare» is the data source for our DEA analysis of day surgery healthcare efficiency (The Ministry of Health of the Slovak Republic). It was offered to us by the National Health Information Center of Slovakia.

Slovak regions with day surgery facilities are our research objects. We have analysed suitable available indicators of day surgery efficiency during the years 2009-2014. The number of day surgery patients in two age groups (paediatric patients under 18 years old and adult patients of 19 or more years old) was the output. The corresponding number of both paediatric and adult beds was used as the input.

Besides descriptive statistics, we have used three input oriented DEA models (CCR, BCC a FDH) (Cooper et al., 2007) [16]. The CCR model with constant returns to scale was the first DEA model (Charnes et al., 1978) [17]. The BCC model with variable returns to scale was published later (Banker et al., 1984) [18]. The linear combination of units (in our case the units are Slovak regions in corresponding years) is used to compute optimum values of inputs and outputs in the DEA models. It evokes the question of reality of such «regions» in our case.

DEA is a non-parametric approach for frontier estimation. Basic models are discussed in works of many authors and applied in different areas. In the Slovak Republic, the DEA models have been used to measure the efficiency of financial institutions (Kocisova, 2012) [19] or the efficiency of the agricultural sector (Kocisova, 2015) [20].

A different approach to the problem of efficiency was published in 1984 (Deprins et al., 1984; Cooper et al., 2007) [16-17]. It does not require the basic classic condition for the production models - convexity of production sets. Another important difference in comparison with other DEA models is that evaluated units are compared only to real efficient units, not to their linear combinations. Optimal (dominant) units are on the so-called Free Disposal Hull (FDH) of production set. Its definition is very simple:

$$FDH(x_0, y_0) = \{(x, y) : x \geq x_0; y \leq y_0\}. \quad (1)$$

Production units are compared with optimum units on FDH in such a way that none of the units has a smaller input and a larger output. Then, for all $(x, y) \in FDH(x_0, y_0)$ at least one of the three conditions is valid $x > x_0, y = y_0; x = x_0, y < y_0; x > x_0, y < y_0$. The optimal unit produces the same output by a smaller input or a larger output by the same input or a larger output by a smaller input. Input oriented FDH model is then defined by:

$$\min \theta, X\lambda \leq \theta x_0, Y\lambda \geq y_0, e\lambda = 1, \lambda \in \{0,1\}, \quad (2)$$

where $\theta$ is the input efficiency, $X$ and $Y$ are input and output matrices and $\lambda$ is the Boolean variable with values 0 or 1. Computational simplicity is an advantage of the FDH method. It is not necessary to use optimisation programming methods. Only pair-wise comparisons of units are needed. Possible existence of so-called slacks is a disadvantage of the FDH. However, it is also the problem of the classic radial CCR and BCC DEA models. In our case of one input and one output, the existence of possible slacks can be easily controlled visually. For statistical and graphical analyses, we have used the statistical system SPSS version 19. The software DEA solver was used to conduct the DEA analyses (Cooper et al., 2007) [10]. In next part, we briefly present statistical parameters of the analysed variables (day surgery indicators).

**4. Results**

*a) Descriptive statistics results*

There are eight self-government regions in Slovakia (NUTS III level). In the paper, we use their abbreviations from National Health Information Center of Slovakia: Banska Bystrica (BC), Bratislava (BL), Kosice (KI), Nitra (NI), Presov (PV), Trnava (TA), Trencin (TC) and Zilina (ZI). The available data cover a period of five years: 2009-2014 (then, for example, the case of Trencin region in 2012 is marked as TC12). Basic statistical parameters of examined available variables (the number of day surgery paediatric patients, the number of day surgery adult patients, the number of day surgery paediatric beds, the number of day surgery adult beds) are shown in Table 1. We used them in the efficiency analysis of Slovak regions (Mean = arithmetic mean, Std. Dev = standard deviation. The number of cases is 48 (eight Slovak regions in the period of six years).

The mean number of day surgery paediatric patients is 1,463. The minimum number (201) was in Trencin region in 2009, whereas the maximum number (3,377) was in Presov region in 2014.

The number of day surgery adult patients has a mean value of 15,410. The minimum number (4,233) was in Trnava region in 2009, whereas the maximum number (33,049) was in Bratislava region in 2014.

Tab. 1: **Statistical parameters of day surgery in Slovak regions during the years 2009-2014**

| Variable | Mean | Std. Dev. | Minimum | Region | Maximum | Region |
|---|---|---|---|---|---|---|
| No. of paediatric patients | 1,463 | 961.1 | 201 | TC9 | 3,377 | PV14 |
| No. of adult patients | 15,410 | 7,357.8 | 4,233 | TA9 | 33,049 | BL14 |
| No. of paediatric beds | 43 | 30.2 | 5 | TA9 | 173 | NI14 |
| No. of adult beds | 172 | 86.1 | 30 | TA9 | 439 | BL14 |

Source: Own calculations

The mean number of day surgery paediatric beds is 43 ranging from the minimum value of 5 in Trnava region in 2009 to the maximum value of 173 in Nitra region in 2014.

The mean number of day surgery beds for adults is 172 with their minimum number of 30 in Trnava region in 2009 and their maximum number of 439in Bratislava region in 2014. In the next part of this paper, we present the results of the application of the DEA methods to calculate the available day surgery indicators.

*b) DEA analyses results*

We have a production dependence with one input (the number of day surgery beds) and one output (the number of day surgery patients). It is easy to depict it in the common scatter-plot where we can see relative positions of Slovak regions during the analysed time period in production possibility set between the number of day surgery patients (the vertical axis) and the corresponding number of day surgery beds (the horizontal axis). Figure 1 is shows a production set of paediatric day surgery efficiency problem with the CCR (constant returns to scale) and the BCC (variable returns to scale) production frontiers. The FDH production frontier is not depicted because the relevant software was unavailable we have not got software for it. From the viewpoint of the CCR model of paediatric day surgery, is efficient Banska Bystrica region was efficient in 2014 (BC14). A line from the point (0.0) goes through it and determines the CCR efficient production frontier. Other Slovak regions should shift to the CCR production frontier in the horizontal direction to the left to become input efficient. The BCC production frontier is piecewise linear function which goes through four BCC efficient cases.

An overview of the results of DEA analyses for paediatric day surgery is reflected in Table 2 which contains CCR, BCC and FDH efficiency scores. A reduction of day surgery beds that is needed for Slovak regions (with day surgery facilities) to become efficient is computed easily from efficiency scores, e.g. if efficiency is 0.7, then the relative reduction is 1 - 0.7 = 0.3 (30%). Of course, the efficient units have a 0% reduction. The most conservative is the CCR (with constant returns to scale) model. Usually, only one unit is efficient in its case. Then follows the BCC model (with variable returns to scale) with more than one efficient unit. The FDH model is the least conservative. It has even a larger proportion of efficient units.

Then, three regions follow, namely Zilina in 2014 (ZI14), Banska Bystrica in 2013 (BC13) and Kosice in 2012 (KI12) with almost the same reduction just above 50%. Nitra was relatively the «worst» region in 2014 (NI14) with its necessary bed reduction of large proportion equal to 96% (from 173 beds to only 6 beds). It is also clear from Figure 1. The region is in the lower right corner of production set and falls far behind the other regions. Furthermore, Nitra region has been at the end of the list of rank order through all the years.

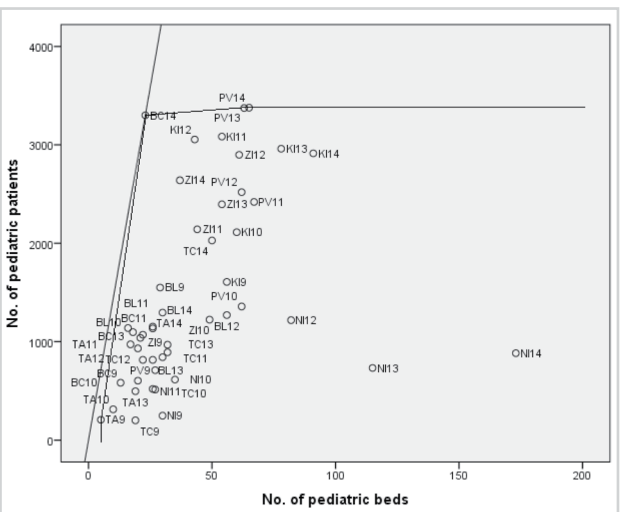


Fig. 1: **Production set of number of day surgery paediatric patients vs the number of day surgery paediatric beds with corresponding CCR and BCC DEA frontiers**
Source: Own construction

Tab. 2: **Results of input oriented CCR, BCC a FDH DEA efficiency analyses of paediatric day surgery in Slovak regions in the period of 2009-2014**

| Rank | Region | CCR eff. | Region | BCC eff. | Region | FDH eff. |
|---|---|---|---|---|---|---|
| 1 | BC14 | 1 | TA9 | 1 | PV14 | 1 |
| 2 | ZI14 | 0.497 | BC14 | 1 | BC14 | 1 |
| 3 | BC13 | 0.496 | PV13 | 1 | PV13 | 1 |
| 4 | KI12 | 0.495 | PV14 | 1 | BC13 | 1 |
| 5 | BL10 | 0.424 | BC13 | 0.651 | TA10 | 1 |
| 6 | TA11 | 0.399 | BL10 | 0.565 | BC10 | 1 |
| 7 | KI11 | 0.398 | TA10 | 0.562 | TA9 | 1 |
| 8 | PV13 | 0.373 | TA11 | 0.556 | TA11 | 0.941 |
| 9 | BL9 | 0.373 | BC10 | 0.553 | BL10 | 0.889 |
| 10 | PV14 | 0.362 | ZI14 | 0.518 | BL11 | 0.885 |
| 11 | BC12 | 0.345 | KI12 | 0.502 | BC9 | 0.800 |
| 12 | ZI11 | 0.339 | BC12 | 0.468 | TA12 | 0.800 |
| 13 | BC11 | 0.339 | TA12 | 0.461 | BL9 | 0.793 |
| 14 | ZI12 | 0.331 | BC11 | 0.456 | BL14 | 0.767 |
| 15 | TA12 | 0.325 | BL9 | 0.442 | BC12 | 0.762 |
| 16 | BC10 | 0.313 | BL11 | 0.404 | TC12 | 0.727 |
| 17 | ZI13 | 0.309 | KI11 | 0.403 | BC11 | 0.727 |
| 18 | BL11 | 0.309 | TA14 | 0.400 | TA13 | 0.684 |
| 19 | TA14 | 0.304 | TC12 | 0.388 | ZI14 | 0.622 |
| 20 | BL14 | 0.301 | BL14 | 0.378 | TA14 | 0.615 |
| 21 | TA9 | 0.289 | ZI11 | 0.370 | BL13 | 0.615 |
| 22 | PV12 | 0.283 | BC9 | 0.366 | PV9 | 0.593 |
| 23 | TC14 | 0.283 | TA13 | 0.352 | KI12 | 0.535 |
| 24 | KI13 | 0.265 | ZI12 | 0.339 | TC11 | 0.533 |
| 25 | TC12 | 0.259 | BL13 | 0.329 | ZI11 | 0.523 |
| 26 | PV11 | 0.252 | ZI13 | 0.329 | ZI9 | 0.500 |
| 27 | KI10 | 0.245 | TC14 | 0.312 | TC13 | 0.500 |
| 28 | KI14 | 0.223 | PV12 | 0.298 | TC10 | 0.500 |
| 29 | BL13 | 0.219 | TC13 | 0.295 | NI11 | 0.481 |
| 30 | TA10 | 0.218 | PV9 | 0.294 | ZI10 | 0.469 |
| 31 | TC13 | 0.211 | TC11 | 0.290 | TC14 | 0.460 |
| 32 | BC9 | 0.211 | ZI9 | 0.281 | NI10 | 0.457 |
| 33 | KI9 | 0.200 | KI13 | 0.270 | KI11 | 0.426 |
| 34 | TC11 | 0.196 | KI10 | 0.268 | ZI13 | 0.426 |
| 35 | ZI9 | 0.195 | PV11 | 0.267 | BL12 | 0.411 |
| 36 | PV9 | 0.184 | TC9 | 0.263 | KI9 | 0.411 |
| 37 | TA13 | 0.182 | TC10 | 0.262 | KI10 | 0.383 |
| 38 | ZI10 | 0.174 | NI11 | 0.251 | ZI12 | 0.377 |
| 39 | BL12 | 0.158 | KI9 | 0.235 | PV12 | 0.371 |
| 40 | PV10 | 0.153 | KI14 | 0.228 | PV10 | 0.371 |
| 41 | TC10 | 0.139 | ZI10 | 0.223 | PV11 | 0.343 |
| 42 | NI11 | 0.133 | NI10 | 0.211 | NI9 | 0.333 |
| 43 | NI10 | 0.123 | BL12 | 0.200 | KI13 | 0.295 |
| 44 | NI12 | 0.104 | PV10 | 0.189 | NI12 | 0.280 |
| 45 | TC9 | 0.074 | NI9 | 0.175 | TC9 | 0.263 |
| 46 | NI9 | 0.058 | NI12 | 0.133 | KI14 | 0.253 |
| 47 | NI13 | 0.045 | NI13 | 0.070 | NI13 | 0.139 |
| 48 | NI14 | 0.036 | NI14 | 0.052 | NI14 | 0.092 |

Source: Own calculations

Four cases are efficient according to the BCC model: Trnava - in 2009 (TA9), Banska Bystrica - in 2014 (BC14) and Presov two years running in 2013 and 2014 (PV13 and PV14). To gain input efficiency it is necessary for inefficient regions to shift horizontally to the BCC production frontier. For example, Bratislava region in 2009 (BL9) should move to the line between points of Trnava region in 2009 (TA9) and of Banska Bystrica region in 2014 (BC14). The first inefficient region after the efficient regions is Banska Bystrica region in 2013 with a 34.9% input reduction. Once again, Nitra region was the last one in 2014 (NI14) with a slightly smaller input reduction 94.8% in comparison with the CCR model required reduction. As we have already mentioned, the FDH model is even more free. In our case seven regions are FDH efficient. In the year 2009, there was one efficient region: Trnava (TA9). Two regions were efficient in 2010: Banska Bystrica (BC10) and Trnava (TA10). In 2013 and 2014 other two regions were FDH efficient: Banska Bystrica (BC13, BC14) and Presov (PV13, PV14). The first inefficient region was Trnava in 2011, which has a reduction of only 5.9%. The last region in 2014 was Nitra with a reduction of 90.8%. The most frequent peer was Banska Bystrica region in 2013 (17 times); in 2014 (21 times) and in 2010 (4 times). Its proportion is 87.5%. If we take the criterion of 50% or more in the necessary reduction of beds as useless surplus of beds, then among the worst regions are: Nitra region (in all the analysed years from 2009 to 2014 it had double the required beds), Kosice - during five years, Presov and Zilina - during three years. In figure 2 are depicted The CCR and BCC production frontiers

with Slovak regions in the period of 2009-2014 for adult day surgery are depicted in Figure 2.

In Table 3, there is an overview of corresponding DEA results analyses.

Now, from the viewpoint of the CCR model, Zilina region was efficient in 2009 (ZI9) (see also Figure 2). The second region is Zilina region in 2010 (ZI10) with a small 1.7 % reduction. Thus, Zilina region was almost efficient in 2010. The last region was Presov in 2011 (PV11) with a large necessary input reduction of 80.8 %.

On the basis of the BCC model, there are six efficient cases: Trnava and Zilina regions in 2009 (TA9 and ZI9), Zilina region in 2010 (ZI10), Banska Bystrica in 2012 (BC12) and Bratislava region in 2012 and in 2014 (BL12 and BL14). The first inefficient region was Kosice region in 2013 with a 3.5% input reduction. The last one is again Presov region in 2011 (PV11), with its slightly smaller input reduction (80.1%), was the last one.

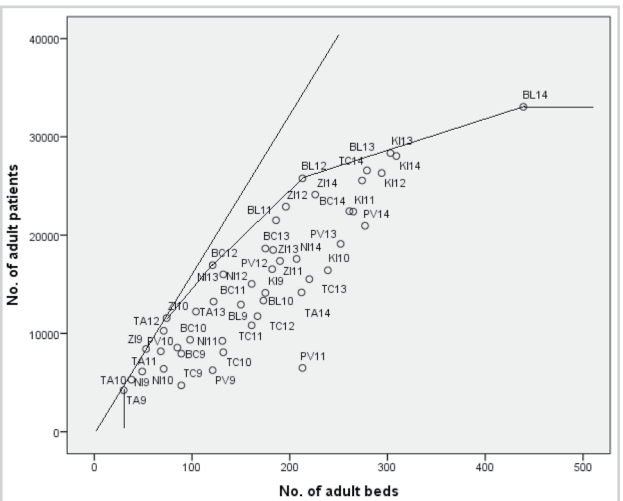


Fig. 2: **Production set of number of day surgery adult patients vs the number of day surgery adult beds with corresponding CCR and BCC DEA frontiers**
Source: Own construction

Fifteen cases are efficient according to FDH model. In the year 2009, there were three efficient regions: Nitra (NI9), Trnava (TA9) and Zilina (ZI9). Two regions were efficient in 2010: Trnava (TA10) and Zilina (ZI10). In 2011, only Bratislava region (BL11) was FDH efficient. Four regions were efficient in 2012: Banska Bystrica (BC12), Bratislava (BL12), Trnava (TA12) and Zilina (ZI12). Three regions were efficient in the year 2013: Banska Bystrica (BC13), Kosice (KI13) and Trnava (TA13). In 2014, two regions, namely Bratislava (BL14) and Trencin (TC14), were efficient. The first inefficient region was Banska Bystrica in 2011 with an input reduction of only 0.8%. The last region was Presov in 2011 (PV11) with a reduction of 75.1%. The most frequent peers are Banska Bystrica in 2012 (11 times) and in 2013 (4 times), Zilina in 2009 (7 times) and Trnava in 2012 (4 times). Their proportion is 54.2%. Surplus beds are not so frequent as in the case of paediatric day surgery. More than 50% reduction is needed only in two regions: Presov (2009 and 2011) and Trencin (2009, 2010 and 2011).

Now we can make some summary evaluations. is An overview of the FDH efficiency results of Slovak regions in the period of six analysed years is shown in Table 4.

Banska Bystrica was relatively the best region in the field of paediatric day surgery. It was efficient three times: in 2010, 2013 and 2014. Two regions were efficient during two years: Presov (in 2013 and 2014) and Trnava (in 2009 and in 2010). All the other regions were not efficient at all during six years interval.

A different situation is in the field of adult day surgery where Trnava, which was FDH efficient during four years (2009, 2010, 2012 and 2013), is relatively the best region. The second place is held by two regions: Bratislava (2011, 2012 and 2014) and Zilina (2009, 2010 and 2012) with three efficient years. Banska Bystrica region follows with two efficient periods (2012 and 2013). Three regions were efficient once: Kosice (2013), Nitra (2009) and Trencin (2014). Presov region was not efficient during 2009-2014.

Tab. 3: **Results of input oriented CCR, BCC a FDH DEA efficiency analyses of adult day surgery in Slovak regions in the period of 2009-2014**

| Rank | Regions | CCR eff. | Regions | BCC eff. | Regions | FDH eff. |
|---|---|---|---|---|---|---|
| 1 | ZI9 | 1 | TA9 | 1 | TC14 | 1 |
| 2 | ZI10 | 0.983 | ZI9 | 1 | BL14 | 1 |
| 3 | TA12 | 0.909 | ZI10 | 1 | TA13 | 1 |
| 4 | TA9 | 0.887 | BC12 | 1 | KI13 | 1 |
| 5 | BC12 | 0.881 | BL12 | 1 | NI9 | 1 |
| 6 | TA10 | 0.878 | BL14 | 1 | BC13 | 1 |
| 7 | NI9 | 0.788 | KI13 | 0.965 | TA9 | 1 |
| 8 | NI13 | 0.762 | TA10 | 0.944 | ZI12 | 1 |
| 9 | BL12 | 0.761 | ZI12 | 0.933 | ZI9 | 1 |
| 10 | TA11 | 0.757 | TA12 | 0.920 | TA12 | 1 |
| 11 | TA13 | 0.739 | KI14 | 0.916 | BL12 | 1 |
| 12 | ZI12 | 0.735 | BL11 | 0.907 | BC12 | 1 |
| 13 | BL11 | 0.728 | ZI14 | 0.866 | BL11 | 1 |
| 14 | BC11 | 0.683 | NI13 | 0.854 | ZI10 | 1 |
| 15 | ZI14 | 0.671 | TC14 | 0.853 | TA10 | 1 |
| 16 | BC13 | 0.670 | NI9 | 0.826 | BC11 | 0.992 |
| 17 | ZI13 | 0.636 | BC13 | 0.792 | KI14 | 0.981 |
| 18 | PV10 | 0.634 | KI12 | 0.781 | ZI13 | 0.956 |
| 19 | BC10 | 0.601 | BL13 | 0.769 | KI12 | 0.949 |
| 20 | TC14 | 0.599 | TA13 | 0.767 | ZI14 | 0.942 |
| 21 | KI13 | 0.588 | TA11 | 0.760 | ZI11 | 0.921 |
| 22 | NI12 | 0.587 | ZI13 | 0.749 | NI13 | 0.917 |
| 23 | BL13 | 0.587 | BC11 | 0.727 | NI14 | 0.845 |
| 24 | ZI11 | 0.575 | BC14 | 0.683 | PV10 | 0.835 |
| 25 | PV12 | 0.572 | KI11 | 0.671 | BL9 | 0.807 |
| 26 | KI14 | 0.571 | ZI11 | 0.660 | TA11 | 0.779 |
| 27 | NI10 | 0.568 | NI12 | 0.648 | BL13 | 0.777 |
| 28 | KI12 | 0.563 | PV12 | 0.645 | NI12 | 0.752 |
| 29 | BC9 | 0.562 | PV10 | 0.635 | BC14 | 0.751 |
| 30 | BL9 | 0.542 | NI14 | 0.616 | NI10 | 0.746 |
| 31 | BC14 | 0.541 | BC10 | 0.604 | KI11 | 0.740 |
| 32 | NI14 | 0.534 | NI10 | 0.591 | PV13 | 0.738 |
| 33 | KI11 | 0.531 | PV14 | 0.588 | BC10 | 0.724 |
| 34 | KI9 | 0.508 | BL9 | 0.573 | BL10 | 0.699 |
| 35 | BL10 | 0.485 | PV13 | 0.570 | KI9 | 0.691 |
| 36 | PV13 | 0.477 | BC9 | 0.566 | PV14 | 0.671 |
| 37 | PV14 | 0.476 | KI9 | 0.551 | PV12 | 0.665 |
| 38 | BL14 | 0.473 | BL10 | 0.518 | TC12 | 0.623 |
| 39 | NI11 | 0.444 | TC13 | 0.494 | BC9 | 0.596 |
| 40 | TC13 | 0.444 | KI10 | 0.487 | TA14 | 0.571 |
| 41 | TC12 | 0.443 | TA14 | 0.456 | TC13 | 0.550 |
| 42 | KI10 | 0.432 | TC12 | 0.453 | NI11 | 0.542 |
| 43 | TC11 | 0.423 | NI11 | 0.447 | KI10 | 0.506 |
| 44 | TA14 | 0.420 | TC11 | 0.429 | TC11 | 0.460 |
| 45 | TC10 | 0.386 | TC10 | 0.388 | PV9 | 0.438 |
| 46 | TC9 | 0.334 | TC9 | 0.368 | TC9 | 0.427 |
| 47 | PV9 | 0.326 | PV9 | 0.340 | TC10 | 0.402 |
| 48 | PV11 | 0.192 | PV11 | 0.199 | PV11 | 0.249 |

Source: Own calculations

Tab. 4: **FDH efficient cases of day surgery in Slovak regions in the period of 2009-2014**

| Group | Paediatric day surgery | | | | | |
|---|---|---|---|---|---|---|
| Region/Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Banska Bystrica | | + | | | + | + |
| Bratislava | | | | | | |
| Kosice | | | | | | |
| Nitra | | | | | | |
| Presov | | | | | + | + |
| Trnava | + | + | | | | |
| Trencin | | | | | | |
| Zilina | | | | | | |
| Group | Adult day surgery | | | | | |
| Region/Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Banska Bystrica | | | | + | + | |
| Bratislava | | | + | + | | + |
| Kosice | | | | | + | |
| Nitra | + | | | | | |
| Presov | | | | | | |
| Trnava | + | + | | + | + | |
| Trencin | | | | | | + |
| Zilina | + | + | | + | | |

Source: Own calculations

If we put together the results from both groups of day surgery, then Trnava, which was efficient six times during 12 evaluated cases (regions and years), is relatively the best region. The second place is held by Banska Bystrica which was efficient for five times. Two regions were efficient three times: Bratislava and Zilina.

We have found out the differences in the efficiency of units that were performing day surgery separately for children and adult patients in the individual regions of Slovakia by means of the analysis. It is very complex to form particular reasons of given differences. The deliberate use of own reporting methods in the given health facilities represents one of those reasons. It is caused by the present price strategies of health insurance companies. They influence day surgery availability by concluding the contracts with healthcare providers and setting financial limits. This leads to a deliberate transformation of procedures from day surgery group procedures to a separately reimbursed group of procedures by many healthcare providers (the patient is discharged within 72 hours – a 3-day procedure). This becomes financially more advantageous. If a healthcare provider performs the procedure that is already recorded as a one-day procedure without stating adequate reasons by means of a traditional hospitalization form, he receives a payment in the amount of a day surgery procedure from his/her health insurance company. It is related to deeper system issues that are connected with pricing policies of health insurance companies, short-term period of contractual relationships between healthcare providers and health insurance companies, as well as with other issues (legal, procedural, etc.).

## 5. Conclusions

The article deals with the issue of day surgery efficiency in Slovakia. It is part of health system and is not very highlighted. Thus, the development of day surgery in Slovakia has been stagnating for a long period of time. This may be proved by a minimum rate of day surgery procedures within the total amount of procedures. We have chosen a methodology that corresponds to the structure of available data, as well as to the given research target to evaluate the level of day surgery efficiency with regard to the individual regions of Slovakia.

We have conducted input oriented CCR, BCC a FDH DEA efficiency analyses of day surgery in Slovak regions (NUTS III level) in the period of 2009-2014 on basis of data offered to us by the National Health Information Center. From the available indicators, we have used the number of beds as the input. The number of day surgery patients was the output.

In case of paediatric day surgery, the most frequent peer was Banska Bystrica region in 2013 (17 times), in 2014 (21 times) and in 2010 (4 times) according to the FDH model. Its proportion is 87.5%. If we take the criterion of 50% or more in the necessary reduction of beds as useless surplus of beds, then among the worst regions are: Nitra region (in all the analysed years from 2009 to 2014 it had double the required beds), Kosice - during five years and Presov and Zilina - during three years.

In the field of adult day surgery, the most frequent peers are: Banska Bystrica in 2012 (11 times) and in 2013 (4 times), Zilina in 2009 (7 times) and Trnava in 2012 (4 times). Their proportion is 54.2%. Surplus beds are not as frequent as in the case of paediatric day surgery. More than a 50% reduction was needed only in two regions: Presov (2009 and 2011) and Trencin (2009, 2010 and 2011).

Significant differences were found on the basis of efficiency analysis of facilities that provide day surgery for child and adult patients in individual regions. It is an important result for those who will form health and social policies in Slovakia and for those who will form a strategic framework as well as for health legislation experts. The submitted analysis contains valuable information related to the specialisation of day surgery clinics. Day surgery will provide many options to increase health system efficiency, which is connected with bed reduction, cutting the hospitalisation time, elimination of waiting list periods for individual procedures, as well as making efficient a complex planning system. Its procedural and system consistency, together with the allocation of the present healthcare providers' network, will support the efficiency processes in Slovakia, as well as the contentment on the side of patients, healthcare providers, health insurance companies, the Ministry of Health of the Slovak Republic and other stakeholders.

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*Received 23.03.2016*