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Economic Aspects of a Health System Electronization

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ABSTRACT: it has been found significant disparities among the health needs of citizens and the financial resources of the health care system. Limitations of the inputs to growth of the health systems are primarily due to fiscal constraints, the demographic crisis, the degree of competitiveness of the EU, as well as the willingness of citizens to bear some degree of the tax burden. The costs of providing health care can be reduced by the proper implementation of eHealth project, as is evidenced by the analysis of the costs and benefits of successful implementation abroad. The aim of this paper is to evaluate the use of information and communication technologies (ICT) in medical institutions, in Slovakia, as the basis of effective strategic management, influencing the positive and negative changes in their external environment. In addition, the chapter focuses on investments in technological innovation, its determinants, and specification of the effects of the use of IS and IT in healthcare facilities. Finally, it reflects the partial outputs of the first international research GESITY/Hospitals 2011-2012 conducted in partnership with Slovakia and Brazil, in connection with the objectives of the implementation of an eHealth program in Slovakia.

INTRODUCTION - As the population ages, higher incidence of chronic diseases and financial cost of the new procedures are global trends that cause increase of expenditures in health care. Together with the growing demands of patients, it is clear that for achievement of long-term sustainability of the system is needed an efficient and stable system of financing. The volume of resources in the Slovak healthcare is determined by two factors. First is the development of macro-economic situation, which is not directly influenced by government with direct state intervention through different social, fiscal and other policies. Exactly in these interventions we can find an explanation for the lack of money in the system. The Government through the tax-contributions policy determines the amount of health insurance contributions, which constitute the most important component of income. While the economically active population has to pay 14% of their salary, the State pays for a defined group of people (pensioners and unemployed) only 4% of the minimum wage. The number of subsidized persons is increasing due to population aging, and older people need financially demanding health care services. The State low fixed rate contributes significantly to the formation of the deficit in finance sector. Slovak health expenditures are represented with an estimate 8% of GDP, which is in percentage and per capita more than the other V4 countries (WHO, 2011). The larger amount of money in the system is not reflected in higher wages, quality or lower price of medicinal products. Compared to the average of OECD country, Slovakia spends 13% more of medical products (OECD, 2010), while staff salaries are still
lower than in neighbouring countries (Morvay, 2009; Romanová et al., 2013). The health status of the population in Slovakia is significantly worse in many parameters compared to more developed countries of the European Union (EU). In Slovakia, health needs of the population are not yet mapped properly. If we add the lower cost of hospital treatment (WHO, 2011) and a lower quality of service than in the Czech Republic, Poland and surroundings (Szalay, 2009) it is clear that the Slovak health system has significant problems with the allocation and efficient transformation of resources (Harkovotová, 2011). This fact was also confirmed by several studies (Balloni, 2011; Soltes et al. 2012). Estimates show that health expenditures (20 to 50%) are spent inefficiently (WHO, 2010; Harkovotová, 2011; PWC, 2010). The most important factors that reduce the effectiveness of the Slovak health care are demotivated staff, inefficient use of beds and staff, unnecessary prescription of antibiotics, lack of generic medical products, corruption, lack of transparency, overpriced purchases and administrative complexity. These problems are a reflection of many systematic errors which should be changed. One of them is the weak flow of information.

Particularly, in Slovakia, there is no single system that collects information about patients. This deficit of information allows and often causes duplication of diagnostics and prescription of medical products that affect the resource usage efficiency. Problematic is the lack of information flow in the relation to health care providers. Lack of communication is weakening the negotiating power of hospitals with health insurance companies and thus reduces their attractiveness from the perspective of the private sector. Therefore, the flow of information is a critical factor influencing the efficiency of the whole system. Solving this problem will help to create an online eHealth platform that will work on European basis (PWC, 2011; PWC, 2010). This will allow a higher level of specialization and use of beds and thereby supporting the reduction of the average cost of treatment. Assumptions for further development of Slovak Health to 2020 are affected by an aging population, increasing incidence of difficult diagnoses, shortening of the medicinal products life cycle, increasing expenditures in the sector by 30% - 70%. Therefore, necessary priority will be to focus on the following aspects: pressure for effective treatment, elimination of inadequate flow of information and the creation of a vision and strategy for Slovak healthcare.

**BACKGROUND** - The changing paradigm of healthcare, as well as the new challenges, requires constant updating of state health policy. This should reflect the economic status of the country based on the challenges for the healthcare, current data of the population’s health status as well as providers of health care (Benčo - Kuvíková, 2011; Klepáková, 2010). It has to clearly define the vision, strategic targets, priorities and methods to achieve those objectives and regulatory instruments and position of the state. Its update should be based on the current information on the population’s health status and its trends (Nemec et al. 2008). It is the primary role of the eHealth program, which lag behind leading countries in the eHealth program in the EU about ten years. Slovakia has in a time of fiscal crisis problems to ensure adequate resources for eHealth; therefore, our country takes the risk that the expected benefits will to be reached (Janke and Prídavok, 2012; Závadská et al., 2013). It is important to ensure the partial resources in the state budget and strict prioritization in eHealth for the potential of health and economic benefits. Table 1 declares SWOT analysis of eHealth in Slovak healthcare.

*Table 1 SWOT analysis of eHealth in Slovakia based on Health System Electronization*
Draft version- 1.3 – Final Version published by Hershey, PA: IGI Global: 


<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>- eHealth Support from Government.</td>
<td>- Scepticism of the public towards eHealth based on past results.</td>
</tr>
<tr>
<td>- eHealth Support from the Ministry of Health.</td>
<td>- Lack of successful pilot eHealth applications.</td>
</tr>
<tr>
<td>- Good availability and quality of Internet connection.</td>
<td>- Minimum investment in existing eHealth.</td>
</tr>
<tr>
<td>- Interest in technologies and information technologies in healthcare.</td>
<td>- Failure to meet existing plans and tasks in eHealth.</td>
</tr>
<tr>
<td>- The high number of good quality infrastructure suppliers, HW and SW.</td>
<td>- Inadequate legislative support.</td>
</tr>
<tr>
<td>- Reasonable price level of available HW and SW.</td>
<td>- Low rate of connection to Internet in ambulances.</td>
</tr>
<tr>
<td>- The completed first phase of building IS in most hospitals.</td>
<td>- Underdeveloped secured infrastructure.</td>
</tr>
<tr>
<td>- Computerisation of all ambulances of general practitioners - secure collection of health care data from all citizens,</td>
<td>- Lack of eHealth standards (for EHR, EDS...)</td>
</tr>
<tr>
<td>- Introduction of modern hospital IS.</td>
<td>- Limited interoperability of systems.</td>
</tr>
<tr>
<td>- The existence of medical records.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Reduce healthcare costs by increasing efficiency, removing duplicates, errors and their impacts.</td>
<td>- Failure to provide adequate financial coverage of infrastructure and eHealth projects.</td>
</tr>
<tr>
<td>- Reduce the cost in healthcare by inserting data into system in the place where a data (digital) picture emerges.</td>
<td>- Improperly designed infrastructure.</td>
</tr>
<tr>
<td>- Increase the interest of citizens in care of their health.</td>
<td>- Inefficient use of funds for eHealth.</td>
</tr>
<tr>
<td>- Increase the awareness of all participants of health care through the National Health Portal.</td>
<td>- Underestimating the legislative and standardization process.</td>
</tr>
<tr>
<td>- More effective pressure of public healthcare on citizens, especially in the field of prevention of civilization diseases.</td>
<td>- Underestimating the importance of data collection in already built infrastructure of general physicians.</td>
</tr>
<tr>
<td>- Restrict the use of the older generation of medical systems and implement the latest technology.</td>
<td>- Incompleteness architecture of eHealth and data model for inclusion of infrastructure of general practitioners.</td>
</tr>
<tr>
<td>- Increase the attractiveness of provided health care in the SR and for the citizens from other EU countries and thus obtain additional funding.</td>
<td>- Underdeveloped secured infrastructure.</td>
</tr>
<tr>
<td>- Active participation in EU initiatives in eHealth.</td>
<td>- Lack of eHealth standards (for EHR, EDS...)</td>
</tr>
<tr>
<td>The possibility to use EU funds for eHealth.</td>
<td>- Limited interoperability of healthcare IS with the EU due to missing required standards.</td>
</tr>
<tr>
<td>Mobility of health care in the SR and the EU.</td>
<td>- Reduced effectiveness of some activities by their inconsistent informatization.</td>
</tr>
<tr>
<td>- The introduction of an electronic identifier for the policyholders and health care professionals.</td>
<td>- Dehumanization of health care.</td>
</tr>
<tr>
<td>- The possibility to provide new medical services.</td>
<td>- Excessive unfulfilled expectations of public from eHealth.</td>
</tr>
<tr>
<td>- The ability to create active and dynamic real-time changing picture of the health status of the population.</td>
<td>- The risk of corruption by entities participating in the allocation and use of resources for eHealth.</td>
</tr>
<tr>
<td>- Ensuring input data in real time and by natural form in the first contact places with the patient and establish traceability of dynamic data at all levels of the proposed data model and all cooperating components in real time, not only in time-delayed statistics evaluations.</td>
<td>-</td>
</tr>
</tbody>
</table>
Economic and social determinants of the development of pan European area of healthcare

The European Union has pushed for the emergence of a Pan European area of healthcare, which brings many opportunities, but also potential risks. We can mention a potential financial collapse in the public health insurance system because of the lack of regulation resulting from the wide use of healthcare abroad. Also, citizens of other member countries which are using our healthcare can due to low prices and state subsidies to healthcare cause deepening of the financial problems. Last but not least there is a major obstacle to the development of Pan European area of healthcare; language skills and absent semantic interoperability. Document of the World Economic Forum (Global Risk Report, 2010) specifies a group of global risks that can occur and can cause a phase transition in the form of disasters, of unforeseeable great impact on the society and at the same time on the health system, not only within the country, but in the EU or all over the world. The on-going destabilization of the euro area, followed by economic and political as well as the social impact on Slovakia and its economy is another actual risk of the EU. Moreover, the disruption of the economies of neighbouring countries should have on our export-oriented economy a negative influence (Szabo et al., 2013; Hejduková and Klepáková, 2013), which would have a direct negative impact on the decrease of funds in the healthcare system. Other facts are the negative effects of climate change, which may cause a short-term negative trajectory of rising food prices, through the risk and unmanageable mass migration from the worst affected countries into the EU, followed by socio-economic as well as significant health impact (Ivančík, 2012; Janke and Prídavok, 2012). The above mentioned unfavourable findings with impact on the healthcare system are not depleted; it is only the most visible calculation. In this conceptual framework and intentions of globalization with an emphasis on ensuring the function healthcare system in Slovakia is necessary:

- stop the growth of hidden debt due to obsolescent infrastructure
- promote energy efficient and cost-effective areas to invest in it and
- correctly set the minimum network of PZS in terms of ownership (State vs. private sector), forms (stock company, contributory company, non-profit company) and structure (hospital, clinic, primary health care, laboratories, ADOS, etc.) (Danilák, 2011)

Figure 1 declares selected economic and social determinants impacting with a significant extent on the health system in Slovakia.
An important instrument to eliminate the negative effects of the mentioned economic and social determinants is quality monitoring with exact outcomes from analyses and effective feedback, essential for the design and implementation of systemic measures in the State Health Policy. Important position in creating a Pan European area in health care also plays an eHealth implementation. Its development and using are in individual countries very different, caused by many socio-economic, political and cultural determinants. Mapping its specifics, as the basis of comparison of the IT and IS systems platforms in individual countries was the main ambition of the international research. We present the partial results in the following subsections.

**Specification of the effects from the use of IS and IT**

Effects of the use of IS and IT can be viewed from its content, divided into several groups, respectively types of effects. Each of these groups is suitable for different size and orientation of health care provider. In this subchapter, we focus more on economic effects, customer effects, effects from increased procedural efficiency of the health care provider, effects from increased analytical performance and quality management and personnel effects.

**Economic effects** of informatics could be understood as differences in current economic indicators of the organization, resulting from the application of information technologies. Those are

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**Economic and social Determinants**

- Low-income groups: problem with financial support - deferring health issues.
- Socially inadaptable groups (for example Roma settlements) significantly distinct effects of negative social environment.
- The influence of social pressure and fashion trends (anorexia, denouncing of old age, decay of generational solidarity in health insurance, etc.). The economic model of woman - growth of genetic risk.
- Strong faith of citizens in the achievements of medicine - less interested in keeping health at the highest level, insouciance towards its damage.
- Underestimation of treatment at a time of rising unemployment, tolerance to addictive substances, drugs with negative implications.

**Required Monitoring**

- Exact outputs of analysis: assessing the impact of health determinants on various socio-economically defined groups and their connection with statistical databases.
- Prediction and modelling of impacts on public health depending on changes in the economic performance of the economy, income of population and social impact.

**Figure 1** Selected Economic and Social Determinants of Healthcare System in the Slovak Republic

*Source: own elaboration*

Fig. 1 Selected Economic and Social Determinants of Healthcare System in the Slovak Republic - *Source: own elaboration*
monitored in its natural or financial terms, and they reflect the differences in indicators before the introduction of appropriate application or service and after its introduction. The examples are cost indicators, indicators of the labour productivity and so on. The problem in this group of effects represents how exactly determine whether the effect (i.e. positive difference in the values of the monitored variable) was achieved by the given informatics application, service, or other organizational and personal factors, by environmental factors change, or in a shift in demand of customers, or by the changes in offer of competition.

**Custom effects** - customer orientation and most accurate knowledge of all customer needs, analysis of the activities and interests of customers (e.g. communication with business websites) are currently the focus of attention of many organizations in a competitive environment. It also documents the use of specialized applications for customer relationship management (CRM - Customer Relationship Management, CLTV - Customer Life Time Value, etc.). Customer effects are currently mainly linked to the specific types of applications and technologies, and therefore their detection is easier and more accurate than in other groups of effects.

**Improving operational performance of the organization** - it can be generally seen as reducing the time and financial difficulties of the processes in the organization and also increases its flexibility – i.e. flexible responses to customer - patient conditions. Among the important characteristics of this group of effects can be included the reduction of waiting times, reducing length of health care, etc. A prerequisite for achieving effects in process performance is providing more comprehensive reengineering projects in the organization. Interest in shortening the intermediate times of processes in the organization is changing the approaches and priorities of organization management in the management and application of information technologies. This reinforces the expansion of applications and technologies for managing organizational performance (CPM - Corporate Performance Management).

**Increasing analytical performance and quality management** - we can state it as a working title for the overall improvement of the quality and accuracy of decision-making processes, for determining and achieving an effective number and structure parameters for analysis, planning and other managerial activities and in particular to provide the necessary number and internal structure (dimensions), on the basis of which it is possible to analyse individual variables and plan. Currently, the main carriers of these effects are applications and Business Intelligence technologies. These applications bring other effects, as they ensure the evaluation of monitored hospital indicators; they analyse these indicators under different dimensions and combinations; they monitor developments over time; this means they create time series and different types of indexes, they provide analysis, reports and overviews on a consolidated basis, without duplicities and differences in the various reports of organisation and so on.

**Personal effects** - for example include increasing the skill level of employees thanks to the use of computer applications based on the latest management techniques and economic models, enhancing the level of formal internal communication and communication with the external partners. A specific indicator of this group is like in the customer group, the level of customer satisfaction. This is followed by internal surveys among users and user departments on the basis of a defined range of values and usually focuses on the quality of the provided functionality of the applications, the availability of technical resources and other resources of information technology resources and so on.
The objective of the international research "An Evaluation of the Management of the Information Systems (IS) and technology (IT) in Hospitals" (GESITI-Hospitals) in the Slovak Republic was to map management information systems (IS) and information technologies (IT) in hospitals in Slovakia, analyse and evaluate their current situation and thus identify the specific needs and requirements for development of the region's hospitals. Research was conducted on the basis of cooperation agreements between the Center of information technologies in Brazil with the Faculty of Economics, the Technical University of Kosice, as the only participant from Slovakia. The outcome of the research is the Integrated Research Report (IRR), which should help managers of hospitals to support decision-making processes and increase their competitiveness. To obtain the data, we used a form of personal interviews through a structured questionnaire "Prospective Questionnaire" (PQ) containing more than 200 open and closed questions. The research questionnaire was divided into several strategic areas: "Human Resources, Strategic Management, Research and Development and Technology innovation, Competitiveness of hospitals, Availability of information technologies, Electronic commerce, Telemedicine, Access to the clients, Rapid prototyping of health, Waste management." (Balloni, 2011). The project is emphasizing several main directions: "knowledge society", "the challenges and considerations" and research and dissemination of best management practices". Currently the outputs of the project in Slovakia acquire an importance in connection with accepting a special law no. 153/2013 about the National Health Information System (NHIS), which regulates the status, rights and obligations defined by the National Health Information Center (NHIC) as its operator, the rights and obligations of other entities in relation to NHIC.

The data basis and used methods

Consequently, the next subchapter proposes partial results of the research that are oriented on development of innovation potential in the medical institutions on the basis of the research outputs. Our researched sample represents approximately 50% of all the hospitals in a given area (ŠÚ SR, 2009). Twelve (12) of these hospitals are situated in the Košice region, and eight (8) of these hospitals are in the Prešov region. Figure 2 illustrates the structure of researched sample of the hospitals on the basis of their law status (in the left) and according to their ownership form (in the right).

![Figure 2. Analyzed hospitals according to the law form (in the left) and according to the ownership form (in the right)](image)

**Source:** own elaboration

Fig. 2 Analyzed hospitals according to the law form (in the left) and according to the ownership form (in the right) - Source: **own elaboration**

We used statistical methods except of descriptive statistics and graphic illustrations to evaluate the data. We also used the analysis of variance (ANOVA) in order to compare the specifications of various types of hospitals from the point of view of their legal and ownership status. The core of the ANOVA method is a reduction of total sum of square variances (SS) to two components – sum of...
Squares of inner-level (residual) variances (SSE) and sum of squares of semi-level variances (SST). In addition, we used contingency coefficients as well as other statistical characteristics by using the SAS software in order to analyse the qualitative variables. Their importance is in determining the strength of association of row and column variables in contingency tables.

**Solutions and Recommendations**

In the following subchapters, we focus on partial results of the research, while prior orientation was on aspects of computing equipment use (PC) in the hospitals as well as their use of technological innovations.

**PC equipment use**

The number of computers that are used in hospitals depends on their size and structure according to the results of the survey. Seventy five percent (75%) of all the computers have access to the Internet and almost ninety five percent (95%) of computers have access to the LAN network (Table 2).

*Table 2 Descriptive statistics of pc and printers.*

<table>
<thead>
<tr>
<th></th>
<th>Middle value</th>
<th>Standard variance</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC number</td>
<td>262</td>
<td>334.8</td>
<td>5</td>
<td>1350</td>
</tr>
<tr>
<td>PC number with access to the</td>
<td>197</td>
<td>197.2</td>
<td>4</td>
<td>770</td>
</tr>
<tr>
<td>Number of PC with access to LAN</td>
<td>251</td>
<td>287.4</td>
<td>0</td>
<td>1100</td>
</tr>
<tr>
<td>Number of LaserJets</td>
<td>155</td>
<td>149.1</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Number of InkJets</td>
<td>13</td>
<td>14.6</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>Number of dot printers</td>
<td>23</td>
<td>71.7</td>
<td>0</td>
<td>315</td>
</tr>
<tr>
<td>PC number with multimedia</td>
<td>86.2632</td>
<td>131.40</td>
<td>0</td>
<td>500</td>
</tr>
</tbody>
</table>

*Source: own elaboration*

We found out that the standard deviation is significantly higher than the middle value in case of the number of PCs. This indicates the fact that there exist clear differences between hospitals, where hospitals with a low number of computers occur similarly as hospitals, which have a higher number of computers. Hospitals with a minimum number of computers include only 5 computers. On the other hand, the largest hospital has had 1350 computers. We may conclude that most of the computers are connected to LAN network.

The possible relation between the number of PCs in the hospital and law status or ownership status of a hospital (19 hospitals provided relevant data) was analysed by means of ANOVA. The fundamental assumption of ANOVA method shows dispersion homogeneity. The results proposed in Table 2 show that zero hypotheses may be accepted, and ANOVA may be used. This indicates that the dispersion of individual groups is the same. It means that the dispersion sizes within individual groups are approximately the same. However, it does not evoke error occurrence in calculations of the ANOVA method. We did not observe any statistical differences, while observing the hospitals from the point of view of private/public/university ownership. We deepened the analysis of differences among hospitals of different legal status by the Bonferroni test, which confirmed the significant differences between state allowance organizations and other legal status. Table 4 illustrates that the largest differences are especially against the allowance organizations. State contributory organizations own more computers than other legal forms hospitals. However, it should be noted that the sample included only two contributory organizations. These hospitals are the biggest hospitals in the analyzed region considering the number of doctors and beds. Therefore we expect that the number of computers
will be primarily concerned with the size of hospitals and not with their legal form. This fact about the sample size of contributory organizations clearly contributed to the accuracy of measurement, but due to the low proportion of contributory organizations between hospitals in analyzed region we cannot assume that we could reach their higher number. If we focus on the form of ownership, we find out that the problem of the comparison arises in university hospitals, where we have identified only two hospitals. It justifies the fact that between the university hospitals may also be classified also smaller hospitals and therefore were not get to significant differentiation by computers. An important part of hardware architecture is the printer. The laser printers are the most frequently used printers (Table 1 – mean maximum value). Ink Jets are used to a limited extent in spite of the fact that they are the most frequent types of printers in the world. The use of printers is significantly related to the bureaucratic system of hospital management. We estimated that dot printers are used to a lesser extent due to the absence of graphic pictures in printing. It especially includes the patient’s statements that exclusively consist of texts. Laser printers are used in outputs, where graphics occur without graphics resolution. There need of graphics resolution is rarely indicated. We also identified during this research that a part of outputs are given to compact discs that significantly decrease the costs for result illustration. It especially includes the results of computer tomography examinations (CT) and magnetic resonance (MR). In this case, the electronic version is preferred as it is easily readable, and also other doctors may use it. The previously used prints and outputs given in roentgen films are not used anymore. Forty percent (40%) of analyzed hospitals consider the need to invest in technical equipment and tools the next two years, fifty five percent (55%) of hospitals consider this fact as a medium importance fact. Consequently, IT innovation is very important for them. The next section presents a detailed view on investments in technological innovation.

**Investments in technological innovation**

It is important to follow the capacity of investments, which is a critical factor in the process of implementation of technological innovation besides the assumed impact and income from of the implementation from technological innovations. Considering the financial resources of medical institutions, it is not possible to predict their positive access to the implementation of innovation as a lump sum. The necessity and planning of innovation primarily lead strategic planning. In several organizations, we encountered an issue that, in planning, it is speculating to implement innovation and technological innovation. However, not speculating means a release or provision of sufficient amount of financial resources for its coverage. In that respect, we decided to focus on discovering this concordance.

Figure 3 shows that only in a single hospital, they could not answer whether they are or are not considering in their strategic planning the investments in technological innovation. However, the rest of the hospitals declare that the strategic plan contains besides interest in innovation also proper planning of investments that are necessary for implementation and provision of innovation.
Within the questionnaire, focus was put on the investments of hospitals into the sphere of ICT during the past three years as well as in the future. First of all, each of analyzed hospitals had included the intention to invest in innovation technologies into their strategic and business plan. Within the past three years, only one hospital has invested more than 4% of revenues, 35% of hospitals invested between 3-4% of revenues and one hospital invested between 2-3% and 1-2%, and the rest of hospitals invested less than 1% (Figure 4). Significant association was found by Fisher exact test \( (p=0.011) \) among aggregated relative volumes (up to 3% and more than 3%) of innovation investments and hospital legal forms. Cause of significance is in difference between shares of non-profit and private limited companies legal forms.

We used the Chi-square test, while observing the statistic dependence of this answer of the type of hospital from the point of view of its property (private, public, university). In this case, we identified that the dependency was not confirmed on the level of 5% importance, as we could not reject the zero
hypothesis of non-dependency of these variables (p-value 0.3762) and therefore with probability of 37.62% we would permit a mistake of rejecting a true hypothesis. Hence, we consider the zero hypotheses $H_0 : \rho = 0$ for true and, therefore, we cannot consider the existence of dependency between these variables (Table 3).

![Table 3 Output of SAS Software – type of hospital vs. investment capacity](image)

<table>
<thead>
<tr>
<th>Statistic</th>
<th>DF</th>
<th>Value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>8</td>
<td>8.6111</td>
<td>0.3762</td>
</tr>
<tr>
<td>Likelihood Ratio Chi-Square</td>
<td>8</td>
<td>9.3227</td>
<td>0.3158</td>
</tr>
<tr>
<td>Mantel-Haenszel Chi-Square</td>
<td>1</td>
<td>0.0246</td>
<td>0.8754</td>
</tr>
<tr>
<td>Phi Coefficient</td>
<td></td>
<td>0.6562</td>
<td></td>
</tr>
<tr>
<td>Contingency Coefficient</td>
<td></td>
<td>0.5486</td>
<td></td>
</tr>
<tr>
<td>Cramer's V</td>
<td></td>
<td>0.4640</td>
<td></td>
</tr>
</tbody>
</table>

Source: own elaboration

Subsequently, we decided to analyse the structure of hospitals according to their answers in this question. The result is shown through the following categories. We found out that, in the group of hospitals that marked the amount of investments on the level of 1%, we could see that both university hospitals are there. Private hospitals are investing more in technology investment. Three to four percent share of investment in innovative technologies is not indicated any University Hospital (Figure 5). We may assume that the private hospitals are more oriented on investments than public ones.

![Figure 5 MI according to their ownership and volume of investments in innovation technologies](image)

Source: own elaboration

Fig. 5 MI according to their ownership and volume of investments in innovation technologies

Larger hospitals are primarily represented by public hospitals (Table 4). On the basis of the average number of personnel, the divergence between private and public hospitals is not so notable. It is confirmed by the result of the t-test, comparing the average number of personnel (Table 5).
Table 4: Output of SAS Software – average number of employees according to a hospital type

<table>
<thead>
<tr>
<th>Analysis Variable : A12</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>private hospitals</td>
<td>247.22</td>
<td>107.22</td>
<td>33.00</td>
<td>379.00</td>
<td>9</td>
</tr>
<tr>
<td>public hospitals</td>
<td>348.78</td>
<td>378.37</td>
<td>55.00</td>
<td>1248.00</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: own elaboration

Table 5: Output of SAS Software – t-test comparisons of medium values of the employees’ number

<table>
<thead>
<tr>
<th>T-Tests</th>
<th>Method</th>
<th>Variances</th>
<th>DF</th>
<th>t Value</th>
<th>Pr &gt;</th>
<th>t</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Pooled</td>
<td>Equal</td>
<td>8</td>
<td>-0.76</td>
<td>0.4665</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Satterthwaite</td>
<td>Unequal</td>
<td>4.86</td>
<td>-0.76</td>
<td>0.4800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equality of Variances

<table>
<thead>
<tr>
<th>Variable</th>
<th>Method</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Folded</td>
<td>4</td>
<td>4</td>
<td>9.18</td>
<td>0.0541</td>
</tr>
</tbody>
</table>

Source: own elaboration

We cannot reject the zero hypothesis, which assumes that the average number of personnel in private or public hospitals has statistically distinguished p-values which is 0.4665, significantly higher than 0.05. We determine that the p-value of the consonance dissipation test is 0.0541, and hence we cannot dismiss the zero hypotheses about the dissipation agreement of primary files \( H_0 : \sigma_1^2 = \sigma_2^2 \).

We also considered the “Pooled” test to verify the zero hypotheses \( H_0 : \mu_1 = \mu_2 \). Therefore, we could evaluate the portion of investments as comparable. We may state that, for private hospitals, the investments are reasonably important which had not been confirmed. It could be also caused by the fact that these hospitals are not bounded on budget of other organizations, and hence a potential negative financial result is not able to be compensated from external sources that are on the other hand, possible in cases of public hospitals. In present economic situation, we may not clearly expect this kind of behaviour from the side of the founder even though this kind of action occurred in the past by upraising of financial problems directly or through transmission of a given facility to another organization.

In the last verification of dependency existence, we measured the relation between portion of the capacity investments that was measured through the questions E11 and also by the amount of personnel in a hospital. We found out that the dependency is not statistically important even though the correlation coefficient reaches the value of -0.46. In a given sample, we had identified a negative dependency when, in increasing number of personnel, a decreasing portion of investments is recorded. In this case, we may predict that the capacity of investments is not developing linearly according to the number of personnel, which reflects a negative dependency and hence the relative capacity of investments is decreasing. By monitoring the capacity of investments in absolute formulation, we should be able to record a dependency as the rising amount of personnel probably leads to growth of capacity of investments in an absolute formulation.
Technological innovation use

Healthcare infrastructure of the Slovak hospitals is technically, economically and operationally outdated, which significantly affects the efficiency of its management. The average age of Slovak hospitals is 34.5 years. The layout of the hospitals is characterized by the distribution of multiple objects within the complex. General hospitals have an average of 30 buildings in one hospital; some hospitals have up to 81 buildings. Table 6 indicates the number of health care providers, the number of professional services and the corresponding number of beds.

Table 6 Bedspread of health care facilities for 2009

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of health care providers</th>
<th>Number of Professional service units</th>
<th>Number of beds up to 31.12.2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovak republic</td>
<td>147</td>
<td>1345</td>
<td>35520</td>
</tr>
<tr>
<td>Bratislava region</td>
<td>24</td>
<td>148</td>
<td>5294</td>
</tr>
<tr>
<td>Trnava region</td>
<td>9</td>
<td>95</td>
<td>2568</td>
</tr>
<tr>
<td>Trenčín region</td>
<td>12</td>
<td>125</td>
<td>3135</td>
</tr>
<tr>
<td>Nitra region</td>
<td>16</td>
<td>141</td>
<td>4154</td>
</tr>
<tr>
<td>Žilina region</td>
<td>13</td>
<td>162</td>
<td>4276</td>
</tr>
<tr>
<td>Banská Bystrica region</td>
<td>25</td>
<td>193</td>
<td>4376</td>
</tr>
<tr>
<td>Prešov region</td>
<td>25</td>
<td>215</td>
<td>5998</td>
</tr>
<tr>
<td>Košice region</td>
<td>23</td>
<td>226</td>
<td>5729</td>
</tr>
</tbody>
</table>

Source: National Centre for Health Information, 2010

The use of technological innovations concerning the knowledge of many authors may be considered as a significant element that encourages the development of individual procedures. In the field of a health system, we may improve the procedures and processes in the medical institutions within this process. Significance of technological innovations affects all spheres of economy and especially producers. The implementation of new technologies represents a possibility of improving the present state and identification of improvements that form better assumptions for high-grade service provision. The medical institution may achieve a competitive advantage towards other subjects on the market of healthcare providers by means of new technologies.
Fig. 6 Reasons of technological innovation implementation. Source: own elaboration

We have identified the medical institutions knowledge on the basis of realized research towards other reasons of technological innovation implementation. In this case, we may observe that the highest number of reasons of technological innovation implementation is due to quality improvement (Figure 6). Seven medical institutions presented costs reduction as the main reason of technological innovation implementation. Image improvement is also very important for health a facility that is connected with doctor’s free choice and also with the rise of competition among individual medical institutions. In this case, the patient may decide which medical institution s/he chooses. This is connected with the possible decrease of performances and also with lower transaction from the health insurance companies’ side. Therefore, the medical institutions struggle for the improvement of their image by means of examination and operation activities provision, while using the up-to-date technologies and technical equipment. This may be related to subsequent shortening of recovery length, which has a positive influence on other costs of health insurance companies, but also employees, or their employers.

Productivity increase is closely connected with modern technology use as well as costs reduction. In this case, it is the realization of the higher number of performances (analyses) during certain observed time interval, or lower need of corrections or technical layoffs after a chosen number of repetitions. The representatives of the medical institution consider this result differently from the possibility of costs reduction.

We found out that this division does not have the essential influence on perception of technological innovation contribution. It was found out on the basis of given data from the point of view of the medical institutions (public, private, university). Similarly, we found out that, in all cases, we did not refuse the non-existence of a relation between indication of given option (to choose a given contribution) and medical institutions type, while analysing. In the case of productivity increase, we have determined the p-value of 0.7090.

A similar result was noticed in the case of the second option, i.e. “quality improvement”. In this case, we observed that the p-value is lower; however, it is always relatively distant from the 0.05 level under which the zero hypotheses have been refused. Therefore, the probability of zero hypothesis refusals is higher; however, there is always a risk of true hypothesis refusal error that is even higher than the boundary of accepted 5%. In the case of image improvement analysis, we found out that there exists a possible relation between the hospital type and perception of the contribution of the technological innovation implementation, which is the lowest. The given result is confirmed by the p-value of Chi-Square test of independence that has a value of 0.7287.
In this case, it may be considered as a fact that some hospitals are situated in the regions, where there is no existing competition. As a result, they are not forced to primarily observe their image, and so this factor does not represent a motive force that would force them to implement the technological innovations.

We may not draw a conclusion from the given data that hospitals which represent the only providers of healthcare in the region have not been focusing on technological innovations. However, image improvement does not represent a sufficient motivation of such implementation for them. In this case, there prevail economic factors that especially include costs savings, productivity increase of work or quality improvement. These factors reach minimum downtimes and reduction of costs pursuing or material consumption. All these aspects are reflected in economic indicators that are for hospitals, business subjects, a very important issue. Even the public medical institutions are forced to behave as business subjects, as they do not have any unlimited budget for their existence. In such a case, the medical institution is established and financed by means of towns’ or municipalities’ budgets. These subjects do not have a good financial situation concerning insufficient amount of tax incomes and, therefore, they limit their financial fees for these organization in their founder’s competency.

We also found out, on the basis of the given analyses that contributions of technological innovation implementation do not differ in the hospital type. We may not assume that the private medical institution was more focused on contribution achievement in the field of cost reduction by means of technological innovation implementation, or image improvement. Also, other aspects of technological innovation implementation, such as quality improvement, or productivity increase are common for all three types of hospitals that are analyzed in this research. In the next research, it would be possible to focus on individual aspects of these innovations and to analyse contributions of individual areas of economic and operating hospitals activities. On the other hand, we may assume that the influence may also be observed in the field of management types, which is possible to be determined in the analysis of hospital management or analysis of a strategy of given medical institution.

CONCLUSION: The health system in Slovakia is marked by permanent indebtedness, while in this sector it is not possible to accurately quantify the extent of structural debt. This includes the current problems related to the project realization of changing the system of public health insurance, problems associated with reducing the volume of purchased care from health insurance companies with an unchanged demand, thereby reaching to a difficult moral dilemma when health care facilities reach the limits. This caused many negative subsequent processes, such as doctors leaving abroad, waiting for the realization of performance, growth of corruption, increasing dissatisfaction of medical staff and patients, unwillingness to accept over-limit. As well as results from a recent research Gavurová et al. (2013) it is urgently necessary to define the price of performance for hospitals, because price lists of performance not correspond to reality, and it is also fundamental system source, which is one of the aspects of indebtedness. Effective implementation of eHealth in close cooperation with health insurance companies, as well as representatives of primary health care and focus on areas with defined potential high benefits should be examined. Informatization in this process reaches a crucial position and influences the strategy for hospitals. The form and content of hospitals strategy significantly depends on the type and ownership. As shown by research results, the most important barrier to the adoption of technological innovations in hospitals is the lack of financial and personnel resources. This is also reflected in the inadequate use of e-commerce, which is not determined by the price of the product or the size of the hospital, but with the skills of responsible managers decides to invest in projects of implementation and use of e-commerce. From the analysed hospitals, only one currently uses telemedicine and eight other hospitals are planning using it in the near future. Hospitals invest most resources into informatization of economic and management processes and to health information systems, which is related to the requirements of current legislation and the objectives of the project eHealth. International research outputs from which the chapter presents only partial findings, provide
a valuable platform for national and international benchmarking of informatization development in healthcare facilities, allow identifying potential development opportunities of healthcare facilities and flexibly respond to the challenges of Project 2020 and the opportunity to complementary adapt the strategy programs to eHealth.

Based on the results of the research in 20 Slovak hospitals, we can conclude that the use of ICT is very diverse and inadequate. As declared by the results for investments in ICT, only in one hospital they exceed 4% of their income, in half of the analyzed hospitals it is under 1%. Their investments are directed primarily to management processes and information systems, which helps to adapt to the rapid pace of IT development. Another negative fact is that the systems dealing with human resource management, ERP systems, logistics and application solutions, solutions for process management (BPM), as well as systems for customer relationship management (CRM), are in our health care facilities used minimally. This greatly affects the efficiency of management, as well as limits the successful implementation of eHealth. Slovak hospitals must primarily move from rigid, long-existing organizational structures and norms of behaviour towards to flexible and easily changeable forms and the integrating and interconnected networks. If the growth in the quantity and quality of interaction processes of the hospital would not be regulated and controlled, it would cause the intensive chaos in the processes.

REFERENCES


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KEY TERMS & DEFINITIONS

Efficiency: known as effectiveness or productivity, generally refers to the efficiency of the used resources and the utility obtained by them. It is a ratio of inputs and outputs of an activity or a system. In terms of organizational management, it is a ratio of quantity or quality of final products and the amount of the resources invested into the production process. Thus it is the use of such resources, which is to maximize the volume and quality of the services.

eHealth/Electronic Healthcare: through information and communication technologies is to provide the right information at the right time in the right place in all phases and processes of healthcare, which will significantly contribute to improving health care and thus to improve the quality of life of citizens.
Strategic management: is a management field focusing on long-term planning and the direction of the organization. Strategic management in an organization ensures that things do not happen randomly but according to pre-planned, long-term plans. It serves, on one hand, the transmission of the owners’ requirements to the management of the organization, and on the other hand, the organizational management for the organization, unification and direction the behaviour of all people in all parts of the organization. It formulates operating rules, priorities and direction in the long term, including the direction the organization wants to go.

Informatics and ICT management: is an area that includes, in practice, all management methods and analytical techniques, whose subject is information, data or information and communication technologies management, thus their day to day operations, development, implementation of new information technologies, data security and information, and software development. Partially it extends into knowledge management. Informatics in the enterprise cannot be separated from the overall organizational architecture and its needs - it must be measurable costs and benefits (utility) for the customer and for the functioning of the organization.

Innovation management: contains thematically all that is related to innovation in organizations and businesses. Summarized below are the various management methods and analytical techniques, whose subject is innovation. Without innovation, business, organization or company does not develop forward. The ability to manage innovation is a natural ability which helps to introduce new or improved goods, services, processes, procedures and other things. Innovation is closely linked to quality management, because quality improvement also brings innovation and therefore the mentioned methods overlap each other considerably.

Healthcare: is defined as a social set of professional knowledge institutions, establishments and authorities, workers and their corresponding activities, serving specifically to providing health care with an appropriate order to promote, preserve and restore health.

Health Care: is a range of activities and measures leading to prolong and sustain life of individuals, to improve quality of life and its protection, the promotion, strengthening, improving, restoring health, alleviation of suffering or health assessment of natural person associated with disease or disease state, and directed to better health for future generations.

System of Health Care: we understood it as provision of health services. Is one component of health care and health policy is determined by the state. Health care system consists of all individuals and organizations, from all tangible and intangible property and any company activities, which contribute to improving the health of its members, what is the main objective of health care.