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Evaluation of an Information System Model for Primary Health Care

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Abstract. Today, at the era of information technologies Bosnia and Herzegovina does not have organized action for creation of standardized Computer-Based Information Systems (CBISs) in health. These CBISs would enable collection of defined and comparable data and therefore ensure adequate analysis, observation and decision making on a local community level as well on the general level of health information system. Thanks to enthusiasts, local CBISs are created in health care facilities. Those individual local CBISs have similar solutions based on the experience of previous good functioning. Therefore, we can expect that a standardized state CBIS will be formed with the minimal focused action of people in charge. The Zavidovici Medical Center has a CBIS which has been working long enough so that we can analyze the results of usage of such an information system. The system has a modular character, oriented on analysis and documentation of data, and on support for management and decision-making functions. Analyzing the results reached by implementation of such a CBIS, we can conclude that we have achieved better results in patient administration and work organization and that we have less patients in dispensary of primary health care by 20%, shorter time in treatment of patients by 7%, reduced consumption of essential medicines by 8%, costs of treatment in medical facilities are down by 5% and patients have more a positive view toward the services provided now than they had earlier. Moreover, substantial savings in radio and laboratory diagnostics procedures have been achieved by reducing time for doing lab reports, savings in materials and through minimizing human error.

Keywords. CBIS, information system, primary health care

1. Introduction

Information systems as arranged techniques, processes and resources, shaped to assist in realization of aim [1], have existed in health care since the very beginning of an organized health service. The object of observations of the Information System (IS) is data or information operation. Target of every IS is to present true information in the right place, at the right time with minimal costs [2].

At time when computers were rare, primary data were collected, sorted, processed and delivered to stakeholders manually, and only secondary generated data were processed in information computer centers. Today, at the era of information technologies, computerized operation of health data begins right at the admission desk of medical clinics, so we have Computer-Based Information Systems (CBISs) in health

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centers. However, there is no organized action in Bosnia and Herzegovina to create standardized CBISs in health, but thanks to some enthusiasts CBISs have been created in several health care facilities [3], but they give different, unstandardised solutions and it is rather difficult to compare data or produce general conclusions on the level of a wider social community. A good thing is that, in the majority of such created CBISs, similar solutions are already observed, as a result of proper functioning. Therefore, we can expect that in foreseeable time a standardized state CBIS will be formed with the minimal focused action of people in charge.

The Zavidovici Medical Center has a CBIS, whose description, architecture, functioning and benefits will be the aim of this paper.

A CBIS health center in Zavidovici has modular character, oriented on analysis and documenting of data; it has support for decision making and management. It has four modules, open to other modules:

- Ambulatory module is used by health workers in the process of patient analysis. Apart from its own data this module uses data from modules for radio and laboratory diagnostics. It also produces data for all four modules.
- Module for radio diagnostics is used by health workers in process of radio diagnostics, digitalization and filing in of data. It uses data from ambulatory module, and produces data for business-informational and ambulatory modules.
- Module for laboratory diagnostics is used by health workers in the process of patient analysis, exchange of data between laboratory units and filing in of data. It uses data from ambulatory module, and produces data for business-informational and ambulatory modules.
- Business informational module is used by management of Medical center. Apart from its own data, it uses data from all three above-mentioned modules. It supports management and decision making. It analyzes input and output data of every process in individual modules and provides feedback information to the CBIS users.

All modules have a database based on the structured query language (SQL).NET platform, with separately created interface for every module. Database is set on HP Proliant ML 150 G3 server with Microsoft Windows 2003 server operational software. This server creates mirror data and two hours back up data. Apart from this server there is also a “no brand” server with the same operational software as the domain controller, which manages resources on the network and where authorizations on the network are defined. Local area network (LAN) has a star-like structure [4], partially connected with the cable (fast Ethernet), and partially is a wireless network.

The goal of this paper is to evaluate the effects of implementation of IT in Health Information System (HIS). We can assume that by connecting system components into a functional informational network, by introducing computer data processing, by creating a secure database and by archiving data, considerable benefits are created in administration of health care programs. Those benefits can be expressed as economic profit due to rational use of all resources in the health care system (material used, time spent in patient analysis, more effective diagnostics, less number of errors upon data manipulation, better control of processes, higher system permeability, enhanced satisfaction of patients, and lower consumption of medicines).

2. Materials and Methods

Materials for analysis are daily collected data in health care processes of before and during the implementation of IT in HIS.

Each module used the following data for analysis:

- Ambulatory module – data of monthly flow of patients in primary health care, average duration of treatment, consumption of essential medicines, reduction of treatment costs by both health care facilities and patients, and satisfaction of patients measured on a scale between 1 and 5.
- Radiological module – material savings due to digitalization of radiography, shorter time period for making diagnosis, number of visits per month, number of poor technical quality scans.
- Laboratory module – number of visits per month, number of errors during laboratory processes, shorter time period for diagnosis, reduction of manpower, decrease of dual requirements for the same tests.
- Business informational module – the number of reversible information, monthly expenses for all processes in health care (in laboratory and radio diagnostics, treatment costs, average expenses per location of consumption).

3. Results

All the parameters were observed within a three-month-period before and after the implementation of IT in HIS. For the period before the implementation of IT, data for March, April, and May 2001 were used, and for the period after the implementation of IT data for March, April and May 2008 were used.

By monitoring the number of the requests filed for health care services (average number of patients per month) it has been established that the number of the requests filed for health care services decreased by 20% after the implementation of the IT. The analysis of initial and repeated visits has shown that the reduction is mainly on the account of repeated visits. Average time of patient treatment is 7% shorter after the implementation of IT. Average decrease in the consumption of essential medicines is 8%. Having analyzed medical tests which have been run, the costs of patient analysis and costs of treatment, it has been shown that treatment costs for health care facility are 5% less after the implementation of the IT.

Analyzing the results of the survey carried out earlier in relation to patients' satisfaction [5] where they were asked to come forward with their impressions regarding their content or discontent with the provided health care services, the average grade was 3.6 and in the repeated survey that grade was 3.9 (see Table 1).

By digitalization of radiography and CT scans, by data filing and by creation of an available database, requirements for conventional roentgenogram scans have been reduced by 73%**,** which also brings similar savings in materials used (roentgenogram films, substances for developing scans, shorter time period for scan analysis by 20%, reduced number of poor technical quality scans by 15%), and decreased radiological diagnostics requirements by 4% (see Table 2).

The time period from the moment of request for laboratory tests until derivation of lab report decreased by 30%. Since the requests and scheduling of patients for laboratory tests have been moved to the primary health care clinic and since lab reports

are not distributed through printing material, two work places have been terminated (the number of work places in laboratory is less by 25%). After the implementation of the IT in CBIS there are no more errors due to data manipulation; earlier, there were 5% of human errors on average. Requests for laboratory tests have been reduced by 6% (see Table 3).

Business expenses are by 15% less (employees' salaries not included), employees who make decisions concerning spending of health resources now have the possibility of daily evaluation and they can correct their decisions. The Medical Center Management does weekly work analysis of every employee on all basic parameters in the process of health care providing and also issues a public electronic report with comments which is available to all employees. After the implementation of the IT, the management has considerably improved health care organization by eliminating certain problems, and through reinforcement of technical support in certain processes as well as by using human resources rationally.

Table 1. Comparative data for works in ambulance 2001 and 2008 years

	2001				2008			
	March	April	May	Average	March	April	May	Average
Nr. of visits of patients	24,824	21,722	22,361	22,969	19,352	18,101	17,653	18,368
Average time for treatment (days)	25.2	21.3	22.7	23.07	22.76	20.34	20.73	21.28
Cost of essential medicines (KM*)	98,000	96,500	97,300	97,266	95,000	88,000	86,000	89,666
Cost of treatment for institution (KM*)	132,000	124,000	122,000	126,000	125,000	119,000	117,000	120,333
Satisfaction of patients (scale 1–5)	3.6				3.9			

*KM = 0.51 €

Table 2. Comparative data for works in radio diagnostics 2001 and 2008 years

	2001				2008			
	March	April	May	Average	March	April	May	Average
Nr. of X-ray films	892	922	1,064	959	253	274	261	263
Time from order to diagnosis (days)	2	1.6	1	1.5	1.1	1.2	1.1	1.13
Nr. of technically poor X-ray films	16	17	14	16	2	3	2	2
Radiography per month	1,182	972	1,064	1,073	1,043	1,056	989	1,029

Table 3. Comparative data for works in laboratory diagnostics 2001 and 2008 years

	2001				2008			
	March	April	May	Average	March	April	May	Average
Nr. of tests per month	11,504	10,963	10,621	11,029	10,812	10,474	9,756	10,347
Time from order to diagnosis (days)	1.1	2	1.3	1	1.1	1	1	1.03
Nr. of employees in lab	8	8	8	8	6	6	6	6
Nr. human errors	7	4	6	6	1	0	0	0.33

4. Conclusions

The introduction of computers in HIS is not readily accepted, particularly by the older fellow physicians, which has not been evaluated in this paper, but has been duly noted. As older colleagues work in specialists' services, their non-acceptance of the IT can significantly influence the effects of computerization of HIS. Feature like this is not typical only of our country; in the paper of Anderson and Balas [6] it has been said that in the USA's primary health care only 20–25% of physicians use computers in their work. The adequate approach and wider social action can create motivating factors [7] for acceptance of computers in HIS.

The results indicate significant achievements after the implementation of the IT into the HIS of the Medical Center. The number of patient visits has considerably decreased on the account of repeated visits, when patients bring lab reports, for prescription of medicines or for control examinations. With the help of IT there is simple and fast access to data from diagnostics modules, to the archive of each patient or to the data from the second level health care. It all gives an active insight to all proceedings, and therefore unnecessary scheduling of patients is avoided [8]. Analysis of economic effects of implementation of the IT shows 5% decrease. These results have been achieved with rational politics of medicine prescription, rational administration of patient treatment, which decreased time period for treatment, and avoided unnecessary visits of patients. Patients are not frustrated; there is no more extensive waiting period, or dissatisfaction which causes tension between patients and health professionals. Services are faster, cheaper and of a higher quality, patients are more satisfied. Shorter time for discovering their health status contributes to satisfaction of patients with received health care.

Beneficial economic effects are achieved with use of diagnostic modules, because demands for used materials, human resources and human errors are decreased.

We can conclude that implementation of IT in HIS gives significantly beneficial effects for health care. Those effects are complex and interlaced, but it can be said that significant results on economic and professional level have been achieved, with a higher quality health care and a higher level of patient's content.

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