Interest of the Population in Electronic Communication in the Health Services Provision – Research Results

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The subject of this paper is to present the results of the implementation of electronic communications in one segment of the electronic health system that is currently under development in the Republic of Serbia. For an insight into the readiness of the Serbian population to adopt the electronic communication between doctors and patients, a research was conducted at the Center for testing hemostatic disorders, Blood Transfusion Institute of Serbia, in patients who were administered an oral anticoagulation therapy. The survey was conducted on the basis of data collected on patient health, using application solution that is made specifically for this study. The collected data were analyzed and presented in statistical control charts. The introduction of electronic health systems is a long and arduous task, aimed at creating a functional and modern health care system that will contribute to „improving the health of the population".

1. Introduction

The electronic health-care system comprises the implementation of information and communication technologies, especially the Internet, for the purpose of improving and ensuring health, on one hand, and the health-care system, on the other [1]. It can be described as a system that is complementary to the traditional system of health services delivery; it eliminates paper as a medium and ensures that all the data on the patient and his/her health status are recorded in an electronic format and are accessed promptly and efficiently via a computer network – the Internet [2] [3].

2. nformation and communication technology implementation in communication in the provision of health services

Information and communication technologies offer great opportunities and have an impact upon national economies and the global competition. Originally, they served as support to administrative activities (personnel, payroll, material and financial affairs, warehouse maintenance) and the activities in statistical reporting (health status assessment, work of health-care centres, data from the research of concern for the country, the region, and the like), however, the implementation of information technologies in the segment of support to its core activity significantly lags behind.

The potentials the information and communication technologies have in the health-care system can be employed to help citizens and health-care workers ensure a safer, higher-quality, more rational and better integrated health-care. Information and communication technology is a means to achieve strategic goals in the health-care system [4], namely:

- development and improvement of management in all the elements of the system through decision making based on the facts provided by health-care workers, users, mediators and politicians;
- providing conditions for sustainable financing of the health-care system;
- measuring the key dimensions of the health-care system, such as availability, equality, quality, efficiency and sustainability.

In planning and implementation of information and communication technology solutions into health-care we have to bear in mind the intersts of: citizrns, health-care workers and any other social concern. The basic principles of information and communication technologies are:

- preservation of privacy and confidentiality of the data on the health status of an individual;
- efficiency and usability of the health-care information system;
- promotion of an optimal usage of health status data; and
- high quality of health-care related information.

3. Research into the implementation of application solution in the health-care system

The health-care system is one of the most complex systems in a state. Due to its importance and its impact upon the health status of the population of each state, as well as due to its relevant economic influence, the state implements a large number of measures in health-care system planning and management in order to ensure steady financing and a rational and quality health-care

system, with an intention to ensure the basic health protection to its citizens within the available resources [7].

3.1. Subject and goals of implementation of application solutions

When seeking the necessary information, the user becomes aware that the weaknesses in the health-care system are many and he/she wastes a lot of time to find and organize information. The basic data can be found in paper documentation, however, they are not easily accessible, nor are they included into an integrated format so that a general insight into the treatment and care of the patient can be obtained.

This weakness concerning the accessibility of information is rather widespread. It often happens that health-care centres have to deliver a health service to an individual without knowing what has been previously done; thus the patient may receive the treatment that is not necessary, effective, or that may even endanger his/her health.

The lack of accessibility of all the information on the patient, e.g., laboratory findings, may result into medical errors or into an unnecessary repetition of laboratory tests. This problem can be easily solved by using information systems that can communicate.

It is for these reasons that a research has been conducted into the willingness of the Serbian population to adopt an electronic type of communication between the physician and the patient. The research was based on an application solution of the health-care system segment meant for the patients receiving an anticoagulant therapy.

The anticoagulant therapy is a medicament therapy that is meant to prevent forming and/or activity of thrombin and thus block the coagulant cascade. The treatment of such patients reaquires a timely measurement of INR (*International Normalised Ratio*) values in the blood, which is the ratio between the patient prothrombin period and the prothrombin control time.

The application solution devised for this research was designed in accordance with the basic model of the health-care system. The solution is based on the establishment of electronic communication between the physician and the patient.

The goal of the application solution implementation is to collect and analyse the data on the patients and on the extent to which they implement the application. The method used in data collection is the implementation of information and communication technologies such as web applications and SMS services. The implementation of these helps obtain the following [8]:

- a better and more direct exchange of knowledge and information between physicians, on the basis of patients' electronic medical records;
- a more easily accessible patient-physician communication;
- a mass and interactive education of citizens in the field of desease prevention and treatment of patients;
- a more rational employment of capacities and a higher efficiency of use of equipment and technical resources through an automated integration of diagnostic and therapy information in the patient's electronic medical record.

The gathered data were submitted to analysis on the basis of the statistical process control.

The idea was to use a relevant number of service users that implement the application and find the percentage of users that adopt the electronic health-care system as a novel method of health-care service delivery. The solution to the application can be implemented in all medical facilities whose core activity is medical care provision.

The precondition for a fruitful physician-patient communication is the identification system. The solution proposed means that basic parametres have to be defined to identify the target group of users, and these are:

- unified patient identifier;
- unified physician identifier; and
- unified health-care centre identifier.

The unified patient identifier serves to link data, regardless of where they are stored, on which locations, i.e., on different media. The unified physician identifier allows for a unified identification of medical workers in the health-care system as well as records of their treatment related to individual patient and his/her health problem. The unified health-care centre identifier serves to unambiguously identify the existing operating state and private health-care institutions.

3.2. Functional organization of data flow in the application solution

The key precondition for this application solution is the data flow organization. The data flow organization architecture is built on the needs of the basic categories of system users (physicians and patients) and provides the exchange, processing, storage and use of the data. The data flow organization architecture is presented in Figure 1.

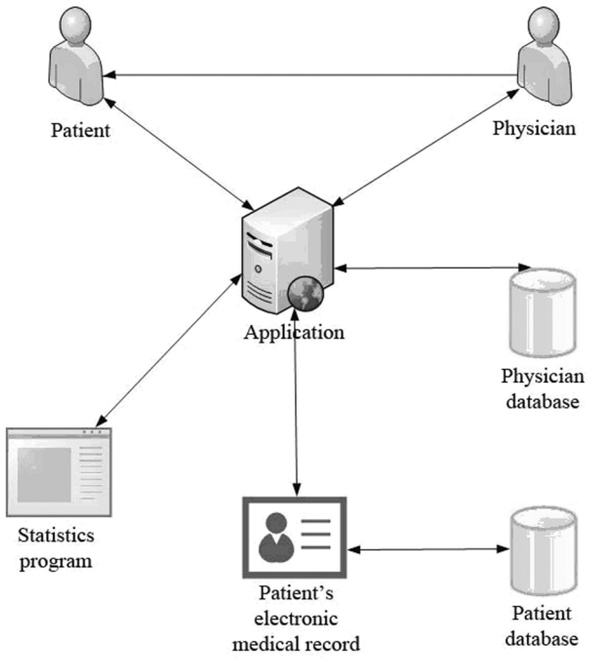


Figure 1. *Data flow organization architecture*

In the application solution the communication starts from the patient. The patient first has to register with the system and then enter the data into the application. The system receives the data and enters the identified patient into the documentation. The data are then recorded into the electronic medical record as well as into the patient data base. The physician also accesses the application. He checks the entered data on the patient and makes sure that the medication dose is adequate. In case of emergency, he has to contact the patient by phone.

The communication in the model is two-way – the user and the system exchange the data in both directions. The data are transferred via the web service or via the mobile phone. The information and the functions of the system are accessible only to authorised and authenticised individuals that function in the roles of the authorised physician and the patient.

The application solution allows for a statistical tracking of data that make an individual and group observation of patients, controlled by the observation period and the values of the parametre observed. The application contains a database with the data entered:

- textual data – basic data on the patient;
- numerical data – laboratory values.

The application solution is characterised by three stadia in the so-called diagnostic-therapy cycle: observation, diagnosis, therapy. The patient sends data, the data are entered into his database and the decision is made as to the further therapy for the patient.

With the implementation of this data flow organization the following is achieved:

- entry of system users' data;
- data exchange between the system users;
- physician's insight into the consistency of data entry;
- entry of data on the patient's health status into the electronic medical records;
- statistical processing of relevant parametres that are observed.

The sequence of the activities in the application solution implementation is presented in Figure 2.

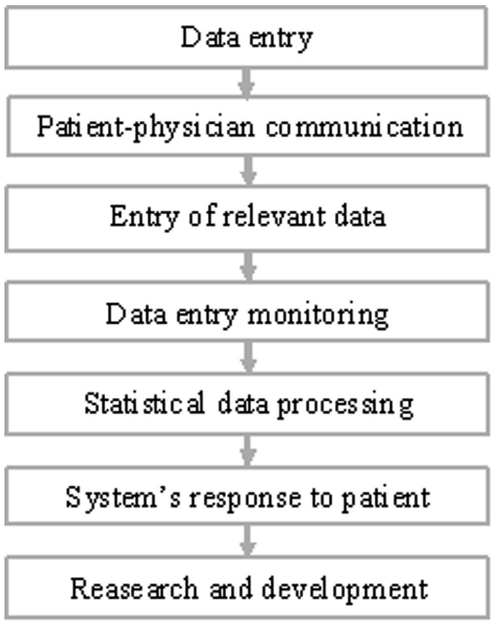


Figure 2. *The sequence of activities in application solution implementation*

4. Research findings and analysis

The research was conducted in accordance with the 1975 Declaration of Helsinki revised in 1983 with the approval of the Ethical Committee of the Blood Transfusion Institure of Serbia where the oral anticoagulant therapy is administered.

The sample included 116 male patients and 84 females 20 to 82 years of age (the median was 61 years of age). The criterion observed in including the respondents into the research process was that the patient receives a permanent anticoagulant therapy, that is, in the INR therapy span of the last three months. The research methodology is shown in Table 1.

Realization period	Research was conducted from September 2009 until September 2010
Sample size	200 patients
Target population	Patients receiving anticoagulant therapy
Research field	Beograd

Table 1. *Research methodology*

Over a period of one year, patients were asked to record the INR values on a fortnight basis. Several points in time period were observed within the study analysis – after one month, after 4 months, after 6 months, after 10 months and after 12 months.

The respondents accessed the application via the web or the mobile phone. They entered the measured values of INR in blood. On access to application, each patient was asked if they would agree to receive electronic mail, i.e., an SMS to remind them to timely measure the INR values in blood. A too early or a delayed sample of blood may reduce the effects of the therapy and cause grave health problems. The mandatory frames on the screen format of the application are: patient identifier, the results of the laboratory analysis of blood, date and time.

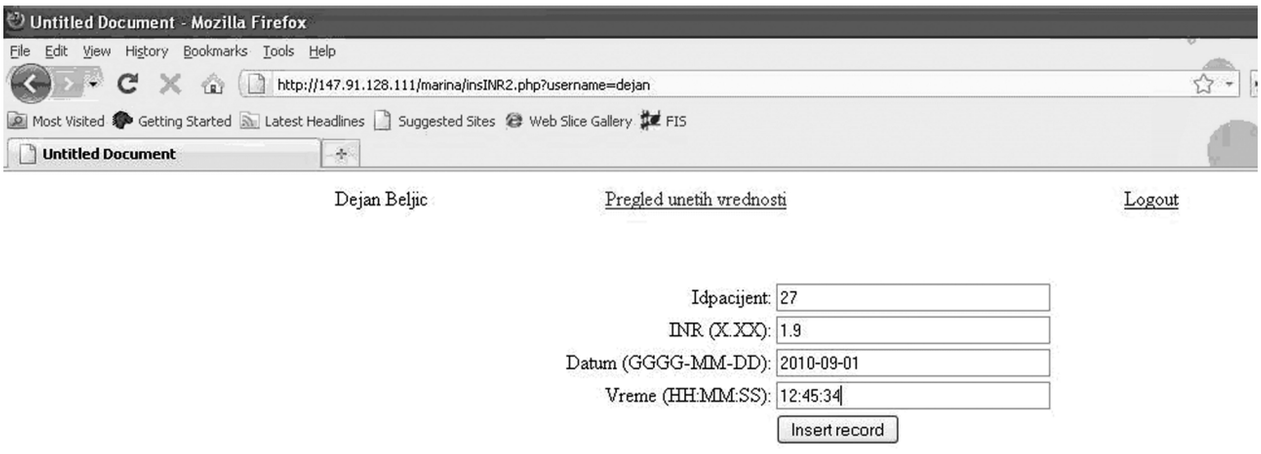


Figure 3. *The application site for recording the measured INR values*

This type of organization serves to avoid that the patients often add the analysis results, and the records of doctor's order and diagnoses reduced entering unidentified or doubbled analyses to a considerable extent. If necessary, the laboratory findings can always be printed on a local printer.

The possible INR values are classified into 7 categories. Hence the recommendation to the patient as regards the therapy differs in accordance to the category. The possible values are the following [9]:

- when the INR value is lower than 1, it is necessary that the patient should see the physician.
- when the INR value is between 1 and 2, it is necessary that the weekly dose be encreased by 5-20%.
- when the INR value is between 3 and 3.5, it is necessary that the weekly dose be reduced by 5-15%.
- when the INR value is between 3.6 and 4, it is necessary that one dose be skipped and the weekly dose be reduced by 10-15%.
- when the INR value is between 4 and 5, it is necessary that one dose be skipped and the weekly dose be reduced by 10-20%.
- when the INR value exceeds 5, it is necessary that the patient should see the physician.
- the referent INR value is between 2.0 and 3.0.

In case the INR values do not correspond to the above described values, the system automatically notifies the physician of the emergency of the case.

On the basis of the enetered values a control card of numerical characteristics is obtained. The green zone shows that the INR values are within normal values, the yellow zone is the action zone, whereas the red zone is the alarm zone. The system displays a control card for each patient, showing whether the values vary in predicted or in unpredicted ranges, and also when the deviation is high enough to call for a corrective action.

The following graph presents the control card with INR values of blood, entered by the patient. The entered data are automatically transferred into the patient's electronic medical record.

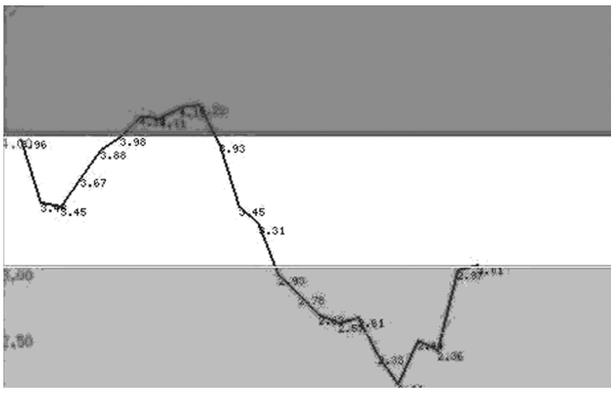


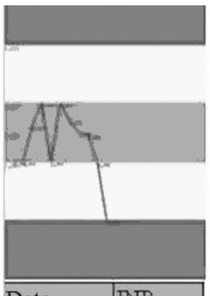
Figure 4. *The chart of entered patient's INR values*

The expert system compares the entered values and makes a decision as to the next step concerning the dosage of the medicine the patient is to be administered in order that his/her health should be stabilized.

Table 2 presents the number of entries of INR values for a given patient as regards five time points. It is clear from the table that throughout the research period (one year) the patient checked his health status via the electronic communication with the physician.

Table 2. The number of entered INR values as regards five points in time

Time period	Total entries made by the patient	%
After one month	2	100%
After four months	8	100%
After six months	12	100%
After ten months	20	100%
After one year	24	100%



Date	INR
10/1/2009	2
10/15/2009	2
11/1/2009	2.6
11/15/2009	3
12/1/2009	2
12/15/2009	3
1/1/2010	2.7
1/14/2010	2.5
2/1/2010	2.45
2/15/2010	1.98
3/1/2010	1

Not all patients, however, were active in entering the INR values into the system during the one year period. The following example illustrates that the patient discontinued recording the data into the application. Figure 5 indicates that the patient accessed the application 11 times and recorded the INR values.

Figure 5.
A review of INR values and a graph for a patient that discontinued recording after 6 months.

In this case, the physician could see in the application that the patient does not access the system, therefore the physician contacted the patient in person. The treatment and the control continued in a traditional way, namely, the patient went to the health-care centre to see his doctor.

Generally, after a year of entering the iNR values into the application, the following conclusions could be drawn. At the beginning of the research, the patients included in the study adopted the new way of control of their health status. A number of patients, however, discontinued accessing the application over time (chart 1).

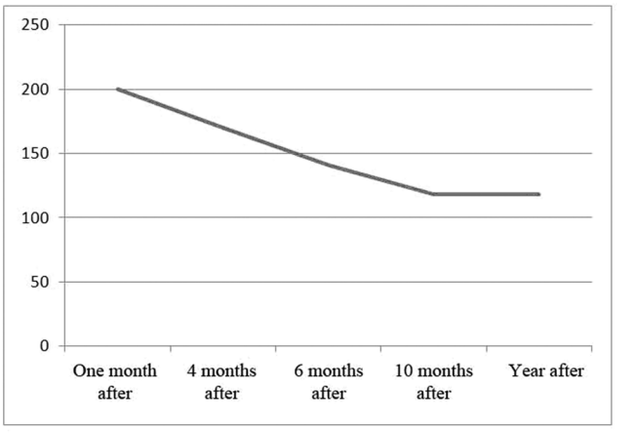


Chart 1. *Number of patients who entered INR values as regards time*

Table 3 illustrates the percentage of patients who eneterd the iNR values as regards the five time points.

Table 3. *Number of patients who entered INR values*

	Total number of patients who entered data monthly	%
	200	100%
	170	85%
	141	70,3%
	118	59,26%
	118	59,26%

Upon the completion of the research, the conclusion is drawn that 118 patients have continually controlled their INR values and regularly entered them into the application, which makes up 59.26% of respondents. The percentage is very high, from the aspect of the patients' age, since the age median is 61 years of age.

Given that the access to the application is possible from the computer or via the mobile phone, the research has shown that a majority of INR value entries was via the SMSs. This is evident from the fact that the use of the mobile phone to access the application is easier for several reasons:

- access to application is possible right in time;
- access to application is possible regardless of the patient's actual location;
- 82.7% of population use the mobile phone [10].

Table 4 presents the percentage of patients who used the computer, or mobile phone to enter the INR values as regards the five time points.

Table 4. *The percentage of patients who used the computer, or mobile phone to enter the INR values*

Time period	Number of patients who entered data monthly	Data entry via computer		Data entry via mobile phone	
		Number of patients	%	Number of patients	%
After one month	200	98	49%	102	51%
After four months	170	75	44%	95	56%
After six months	141	57	40%	84	60%
After ten months	118	49	41%	69	59%
After one year	118	49	41%	69	59%

The percentage of use of the computer and the mobile phone to enter the INR values is shown in chart 2.

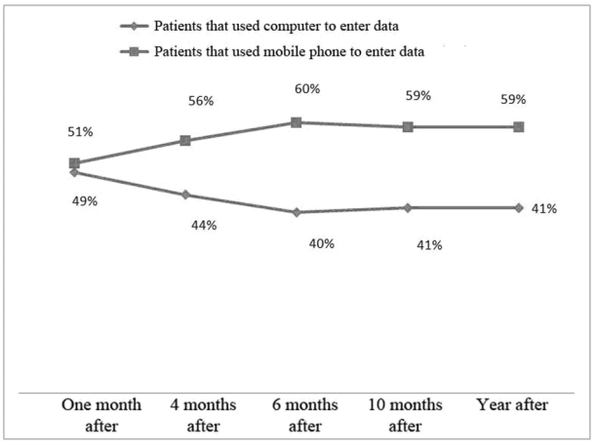


Chart 2. *The chart showing the percentage of use of the computer and the mobile phone to enter the INR values*

Conclusion

The research conducted shows that the population is interested and that their attitude to the introduction of the electronic health-care system is positive. This attitude results from the fact that the implementation of technology in everyday activities is increasing.

The findings of the research show that the majority of people are in favour of improving the quality of health-care services on the local level, using the information and communication technologies. These results demonstrate that it is necessary that a decision should be made on the level of the Republic of Serbia that lectures should be delivered in which the citizens would learn about the basics and the possibilities to use the ICT in health-care services. This would raise awareness about the need to improve the delivery of health-care services and create a positive general attitude on the establishment of an electronic health-care system.

The research gives basis to a conclusion that the citizens of the Republic of Serbia are willing to adopt the electronic health-care system which will ensure that the treatment process remains the same, however, the method of treatment will be easier and more efficient.

The pace in the development and expansion of the electronic health-care system worldwide shows that its implementation in this country is not the issue of necessity and profitability, but only a question of time.

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