



# Application of the health information system in the Health Center Niš

## Primena zdravstveno informacionog sistema u Domu zdravlja Niš

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### Abstract

Medical informatics is the science that studies the creating, transmitting, processing and using information, data and knowledge to solve medical problems. It is medical technology due to participation in the process of formal medical decision making. The first step in the development of health information systems in Serbia is the adoption of a national “Strategy for the Development of the Information Society in the Republic of Serbia by 2020”.

The aim of this paper is to consider the advantages of using information technologies in the process of health care provision in health care institutions in comparison to the previous, classical way of collecting, analyzing and interpreting data in the example of primary health care institutions.

The methodology is a retrospective study of the presentation of implementation in information technologies on the example of the Health Center Niš for the period from 2004. to 2019. and presentation of the computer equipment status.

The implementation of the health information system will enable: better and more efficient access to patient information, faster diagnostics, faster and more reliable selection of medicines, greater patient safety, more time for health care employees, better and more complete health-statistical reporting and faster transfer of biomedical knowledge. The introduction of a health information system will allow the creation of an electronic health record and electronic medical history.

In 2011, the Health Center Niš became a user of the medical information system MEDIS.NET, which was realized in the Laboratory for Medical Informatics of the Faculty of Electronic Engineering in Niš. The Adult Health Service and the Child and School Health Services were the first to use electronic records.

**Key words:** medical informatics, health information system, primary health care, secondary health care

### Apstrakt

Medicinska informatika je nauka koja izučava zakonitosti stvaranja, prenosa, obrade i korišćenja informacija, podataka i znanja u cilju rešavanja medicinskih problema. Ona je medicinska tehnologija jer učestvuje u procesu formalnog medicinskog odlučivanja. Prvi korak u razvoju informacionih sistema u zdravstvu u Srbiji je usvajanje nacionalne „Strategije razvoja informacionog društva u Republici Srbiji do 2020. godine”.

Cilj ovog rada je sagledavanje prednosti upotrebe informacionih tehnologija u procesu pružanja zdravstvene zaštite u zdravstvenim ustanovama u odnosu na dosadašnji, klasičan način prikupljanja, analize i interpretacije podataka o korisnicima zdravstvene zaštite prikazane na primeru ustanova primarne zdravstvene zaštite.

Metoda rada je retrospektivna studija prikaza etapne implementacije informacionih tehnologija na primeru Doma zdravlja u Nišu za period od 2004. do 2019. godine.

Primena zdravstvenog informacionog sistema omogućice: kvalitetniji i efikasniji pristup informacijama o bolesniku, bržu dijagnostiku, brži i pouzdaniji izbor lekova, veću bezbednost bolesnika, više vremena za zaposlene u pružanju zdravstvene zaštite, kvalitetnije i kompletnije zdravstveno-statističko izveštavanje i brži prenos biomedicinskog znanja. Uvođenje zdravstvenog informacionog sistema omogućice kreiranje elektronske zdravstvene knjižice, elektronskog zdravstvenog kartona i elektronske istorije bolesti.

Dom zdravlja u Nišu je 2011. godine postao korisnik medicinskog informacionog sistema MEDIS.NET, koji je realizovan u Laboratoriji za medicinsku informatiku Elektronskog fakulteta u Nišu. Služba za zdravstvenu zaštitu odraslih i Služba za zdravstvenu zaštitu dece i školske dece, prve su krenule sa primenom elektronskog kartona.

**Ključne reči:** medicinska informatika, zdravstveni informacioni sistem, primarna zdravstvena zaštita, sekundarna zdravstvena zaštita



## Introduction

Medical informatics is the science that studies the laws of creating, transmitting, processing and using information, data and knowledge to solve medical problems. Its origin and development are due to the results of the work of Leibnitz and Bula (Gottfried Wilhelm von Leibnitz, physicist and mathematician, and George Boole, mathematician and logician).

In the biomedical sciences, informatics began to be used with Holerit (Herman Hollerit, 1890) punch cards in epidemiological and public health research. The first scientific paper in the field of medical informatics was published in 1959 in the journal *Science*. The number of published papers in this field has increased significantly since 1992.

Medical informatics is nowadays accepted as basic medical science, characterized by designing experiments, performing analyzes, and using the results in the daily provision of health care. Informatics participates in the process of formal medical decision-making, therefore, we can also define it as medical technology (1).

The 1960s were marked by efforts, first of all, in automated data processing. Medical equipment combined with computers was developed for the first time, new diagnostic methods (computed tomography) and therapeutic procedures are emerging, as well as the first prototype of the hospital information system (Technicon Medical Information System-TMIS).

The number of hospital information systems grew rapidly in the 1970s. The first approach to their realization is the concept of a centralized, integrated, closed system, which relied on large computers. Then the first personal computer-PCs appeared on the market. With the introduction of system and software usage as well as microprocessors, personal computers have enabled widespread use in medicine.

The development of artificial intelligence was very prevalent in the 1980s and its integration process in the 1990s. The health information system is being integrated with formation of medical databases and administrative data.

The main feature of information systems intended to support the provision of health care is the desire to automate the technology of work processes in healthcare institutions with the aim of providing support in medical decision-making and providing conditions for managing the health system (2).

## Application of informatics in healthcare

The health information system is tasked with using the information that is produced and transmitted to:

1. *Keeping medical records* - the number of data recorded in healthcare facilities is large. Health care delivery is extremely specific and complex, and characterized by an abundance and variety of data and information.

2. *Medical diagnostics* - computers in medical diagnostics are used for processing and analysis of biophysical signals (electrocardiography, electroencephalography, electromyography, blood pressure measurement), also for processing and analysis of medical images in the procedures of computerized tomography - CT, then images obtained from MR, for processing and analysis of clinical and laboratory measurements.
3. *Therapy and rehabilitation* - the beginning of the use of computers in medicine is related to the programs of planning radiation (dose calculation, size of the field). These methods are widely used today and it is practically impossible to imagine without a computer.
4. *Health care organization* - scheduling patient visits, prescriptions, admissions, sick leave and health records.
5. *Medical research* - the use of computers in medical research is very important, and unimaginable without informatics. In addition to data analysis, research work is increasingly being enhanced by computerized medical literature monitoring systems.
6. *Medical Education* - Educational materials are increasingly distributed online (1,3).

## The health information system

The health information system can be divided into:

1. public health information system,
2. primary health care information system,
3. hospital information system,
4. pharmaceutical information system,
5. health insurance information system.

The implementation of information systems is more prevalent in secondary and tertiary health care institutions than in primary health care, which is probably due to the way in which it is financed and organized (4).

A significant contribution of ZIS is the development of telemedicine, which encompasses a set of procedures and the use of information technology in the provision of long-distance healthcare. The transmission of health information is not affected by the distance between the doctor and the patient, nor the destination of the provider or equipment, provided that the patient can be connected to the Internet.

## Development of health information systems in Serbia

Until recently, the Serbian health system relied primarily on outdated paperwork. The first step in the development of health information systems in Serbia is the adoption of a national strategy for the development of ICT in health care, defined in the document „*Strategy for the development of the information society in the Republic of Serbia until 2020*”.

The project „Health development of Serbia - additional financing” is a continuation of the project „Health development of Serbia”, which was implemented in the period 2003-2009. The introduction of a central information service, a database of health insurers, information and communication network of the Republican Health Insurance Fund of Serbia, information systems in primary health care institutions (DILS project), hospital information systems for four general hospitals that were included in the year project (Zrenjanin, Valjevo, Kraljevo and Vranje).

In 2011, 100 servers and 1,600 personal computers were provided for 20 hospitals in Serbia. The European Union has equipped 19 hospitals with information systems through the IPA program, and six have been equipped with investment through projects of the Ministry of Health and the World Bank.

### Information system in primary health care

At the end of 2014, with the efforts of employees and investments of Serbian citizens, and with the assistance of the World Bank, the Republican Health Insurance Fund planned to introduce an electronic health record, electronic prescription, electronic scheduling of examinations and consultations at all primary health care institutions.

It was planned that 8,000 primary care physicians and 1,000 pharmacies would be connected to the electronic prescription system. It is planned that over 60 million paper recipes will be replaced by electronic ones, and where this is not possible or difficult, they will remain paper until they are someday replaced. This would save over 100 tonnes of specialty paper and around 2 million euros for the production and printing of recipes. An electronic card that will become the golden key to entering the health information system.

Introducing the appointment of an examination, as well as personally by patients through computers and mobile phones, will prevent the wandering and the search for an adequate medical doctor or specialist. It will save time and respect the dignity of patients and policyholders.

The introduction of an electronic doctor consultation provides a better quality of protection for every citizen: the possibility of obtaining the opinion of top consultants by e-mail or SMS; electronic information on each drug and its dosage, or a warning not to be taken without re-consulting the selected physician; warnings about interactions and ineligibility of taking various medicines together (5). The introduction of an electronic health record by the end of 2015 would provide a database of all insured health data in one place! Well-protected information will only be available to an authorized doctor and no one else.

## Security and data protection in medical information systems

Electronic medical records (electronic health records) contain sensitive personal information that can be easily misused (6-8).

*Data privacy* refers to an individual's desire to control the disclosure of personal health and other information. *Confidentiality* refers to an individual's ability to control the way a healthcare provider uses personal information, as well as to further disseminate that information. Protection enables privacy and confidentiality to be secured through a choice of protection strategies, procedures and mechanisms.

*IT security* is defined as „... a set of technical and administrative procedures established for the purpose of protecting information from unauthorized or unintentional insight and alienation, alteration or destruction, as well as to protect the functionality of the information system itself” (8,13).

HIPAA document (Health Insurance Portability and Accountability Act 1996) from 1996. regulates data protection in a certain way, balancing data protection and confidentiality (9).

### Legal aspects of managing electronic health data and information

The prerequisites for processing personal data within the electronic health records system are:

- adopting regulations on keeping electronic health records,
- adoption of regulations on the protection of personal data.

Until the electronic health records are maintained, they will be a burden to healthcare providers as much as a relief.

**The aim** of this paper is to consider the advantages of using information technologies in the process of health care provision in health care institutions in comparison to the previous, classical way of collecting, analyzing and interpreting data in the example of primary health care institutions.

### Methodology

The methods used to evaluate health information systems are typically borrowed from several fields, including cognitive psychology, computer science, systems engineering, and fields of applied engineering.

The method of direct observation was used to present the existing information system as a starting platform for the development of the information system of the Health Center in Niš.

The source of data for the preparation of this paper are used paper and electronic documentation

from the Department of Information System of the Department of Social Medicine with statistics and informatics in the Health Center in Niš.

## Results

In 2011, the Health Center in Niš became a user of the medical information system MEDIS.NET, which was realized in the Laboratory for Medical Informatics of the Faculty of Electronic Engineering in Niš. The Adult Health Service and the Child and School Health Services were the first to use electronic records.

As a participant in the pilot program, Health Center Niš was among the first to integrate the existing MEDIS.NET program into IZIS (Integrated Information System). It is a project of the Ministry of Health of the Republic of Serbia, which covers all health care institutions, both primary, secondary and tertiary institutions, as well as pharmacies that will be integrated into the IZIS system. Thanks to the software developer from the Faculty of Electronic Engineering in Nis, seamless integration of the software with minimal modifications is enabled. The official start of the system is March 28, 2016. Each user of the system was given a username and password and thus certain authorizations and access. Due to the integration of MEDIS.NET software into IZIS, it was necessary to retrieve outdated equipment, computers that were more than 10 years old. New computers and printers were purchased from our own funds for the needs of the Specialty Consulting Services. The speed of internet access in both the central facility and remote locations has been increased.

The Population Diabetes Registry has been implemented within the MEDIS.NET information system and is a core part of any diabetes control program. It involves the organized collection, entry, storage, analysis and interpretation of data on people with diabetes.

This kind of monitoring allows:

- Assessing the burden on society of diabetes
- Analysis of weather trends
- Determining patient survival rates
- Quality analysis of diabetes health care
- Determination of direct and indirect costs
- Evaluation of the implementation of preventive measures
- Planning of health care of residents, equipment, staff
- Develop prevention strategies and programs to prevent diabetes and its complications
- Clinical and epidemiological studies

The registry contains documented personal and medical records of people with diabetes, as well as information about a health care facility where diabetes is diagnosed and treated. These data are collected systematically and continuously from healthcare facilities that provide health care for people with diabetes at all levels of health care.

The great value of the registry is that children will not only be categorized by diagnosis, but by functionality.

At the moment, no one knows the exact number of children with disabilities in our country. World Health Organization statistics show that 3 -22% of children in the world have some form of disability.

## Discussion

The information system consists of personnel, resources (Software, Hardware) and organization. These elements are closely related, so the design of the information system must include all the elements. It must fulfill the following:

- Does not change the organization of the institution, but fully supports it, with the characteristic of flexibility, ie. possibility to adjust the system according to changes in the organization of work.
- Does not change the methodology of work, which is primarily related to data flows and data processing in individual organizational units of the institution - the schedule and type of activities are fully supported, with the possibility of change, depending on the need.
- The concept of the software enables the further development of the software in accordance with the existing health care reform and requirements of the Ministry of Health of the Republic of Serbia and the Health Insurance Fund.

The use of the information system in health care will contribute to the quality of health care delivery. Instead of painstakingly searching through paper records and deciphering manuscripts and abbreviations, information will be readily available and reliable. This does not mean that the information system will replace the work of doctors and nurses, but will only increase the quality of medical decisions made. Practice data will be better structured and new evidence may be introduced more quickly into everyday practice. The information system will be an instrument that will allow practice to be guided by the principles of evidence-based medicine (10).

The introduction of an information system leads to improvements in work organization, work discipline, logistics and overall management of the health center. The most significant changes that occur after the full implementation of information technology are:

1. medical records will be entered directly by medical doctors and nurses;
2. provides insight into previous diagnostic results, radiological reports, discharge lists and other previously collected clinical data;
3. medical records will be typed instead of handwritten and paper documents will be printed;
4. easier and better to schedule appointments and diagnostic procedures;
5. an electronic prescription has reduced the number of patients, because chronic patients should not come to their therapy or prescriptions monthly (11).

## Barriers to the implementation of electronic health records

The implementation of electronic health records is hindered by a number of reasons. Many of them were also recognized at the Health Center Niš and could be a serious threat to the implementation of the project of introducing electronic health records. The most common reasons cited in the literature as a barrier to the implementation of electronic health records are:

- Technical issues - uncertainty about application quality, functionality, ease of use, ability to integrate with other applications,
- Financial issues - initial costs for hardware and software, maintenance,
- Resource issue - training and retraining of staff, resistance from potential users, default mode changes,
- Certification, security and confidentiality of information, ethical issues,
- A potential problem is a possible "system crash" that can completely block the work of the institution (12, 13).

In 2011, the Health Center Niš became a user of the medical information system MEDIS.NET, which was implemented in the Laboratory for Medical Informatics of the Faculty of Electronic Engineering in Niš. Since the introduction of the information system, an electronic health record has been implemented and used in all services. The aforementioned file offers an integrated and clear view of health information, including those collected by individuals, such as symptoms, diagnosis, test results and medications.

At the same time, due to legal regulations, both printed and electronic records were kept. After that, all services started to apply electronic card. This was preceded by employee training and hardware support. Continuous work with electronic records has enabled the presentation of data that is invaluable for providing better health care and analyzing the use of software in order to create new versions of software and better use in healthcare institutions.

After the full implementation of the electronic health record, IZIS (Integrated Information System) program has began. IZIS is a project of the Ministry of Health of the Republic of Serbia that covers all health care institutions at all levels of health care and pharmacy provision. In order to improve the quality of health care and the implementation of new information technology programs for the needs of employees of the Health Center, new equipment was purchased. The equipment was purchased not only for the central facility but also for all ambulances, and at the same time the speed of internet access was increased. The Call Center's work has been improved and adjusted to IZIS and cooperation with the Clinical Center Nis in the part of scheduling appointments for examinations.

The introduction of e-Prescriptions has especially improved the quality of healthcare delivery. The num-

ber of patients receiving therapy is reduced and they do not have to visit their chosen doctor every month. This created the assumption that less elected physicians would be burdened.

The laboratory information system has further facilitated the work of medical doctors. Through the software-Medis, a direct referral to the laboratory is forwarded and the doctor receives the result the same way. The chosen physician becomes more familiar with the results of the required analyzes.

The implementation of the Diabetes Population Registry is an organized collection, entry, storage and analysis of data on people with diabetes.

The disadvantages of implementing the information system in the Health Center Niš are:

1. Lack of electronic signature, and therefore paper documents are kept in parallel;
2. It is not possible to refer patients electronically for further diagnostics or consultative examinations because not all levels of healthcare are networked and affiliated with CIS;
3. Lack of ONLINE communication with the Republican Health Insurance Fund in order to have instant information on the insured.

## Conclusions

1. The introduction of ZIS is very significant, the potential is better quality health care delivery. Further development of ZIS involves the introduction of new modules and their integration into the information system. The strategy of ZIS upgrading by adding new applications is the path to realizing the potential that information technologies provide.
2. The implementation of the health information system will enable: better and more efficient access to patient information, faster diagnostics, faster and more reliable choice of medicines, better patient safety, more time for health care employees, better and more complete health-statistical reporting and faster transfer of biomedical knowledge. With the introduction of the health information system, an electronic health record and electronic prescription were created.
3. It is desirable to implement the introduction of an electronic health book in parallel with the introduction of an electronic identity card. A database with the health and personal information of each person can be integrated on the same chip. This would completely eliminate the problem of losing the medical record, the problem of illegible handwriting, possible physical damage to the paper, wasting time to find the medical record in a huge file.
4. An electronic data reader is expected to be introduced in the near future, which would allow the patient of the Health Center to insert an electronic health book into the reader in the waiting room, and the data will automatically appear on the com-

puter of the doctor of medicine. The time elapsed from inserting the card in the waiting room to receiving the patient is indicated by the waiting time in the queue. This would significantly reduce administrative responsibilities, especially nurses, which would focus on the health care delivery process itself.

The elimination of dual records and the reduction of administrative activities are the ultimate benefits of

implementing the ZIS. The proposed improvements will allow the elimination of paper documents, with the possibility that the information required to be submitted in paper form to certain competent authorities may be created in the information system. The prerequisite for the implementation of the proposed measures is the continuity in the design and construction of the integrated information system of Serbia, which should not depend on personnel changes at any level of the health system.

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