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Dorota Rogala[1], Dorota Jachimowicz-Wołoszynek[1], Żaneta Skinder[1], Małgorzata Gierszewska[2]

THE USE OF INFORMATION SYSTEMS IN HEALTH CARE PRACTICE

WYKORZYSTANIE SYSTEMÓW INFORMACYJNYCH W PRAKTYCE JEDNOSTEK OPIEKI ZDROWOTNEJ

[1]Department of Organization and Management in Health Care UMK in Torun, Collegium Medicum of L. Rydygiera in Bydgoszcz
Leader: Dorothy Jachimowicz-Wołoszynek, PhD
[2]Department of Fundamentals of Obstetric Care in Torun, Nicolaus Copernicus University, Collegium Medicum of L. Rydygiera in Bydgoszcz
Leader: Margaret Gierszewska, PhD

S u m m a r y

Information systems are now the basis of the operation of each unit in health care. This paper describes the objectives and benefits of the introduction of new technologies in information systems and examples of practical use of the systems in Poland and worldwide. In the paper chosen programs used to monitor patient's health status and their usefulness to professionals have been described. The inherent savings, which are brought by the computerization of healthcare facilities, have been pointed out as well as the contribution of European Union funds in financing the programs.

S t r e s z c z e n i e

Systemy informacyjne stanowią obecnie podstawę funkcjonowania każdej jednostki w ochronie zdrowia. W pracy opisano cele i korzyści z wprowadzania nowych technologii w systemach informacyjnych oraz przykłady praktycznego wykorzystanie systemów w Polsce i na świecie. Opisano wybrane programy monitorujące stan zdrowia pacjenta oraz ich przydatność dla profesjonalistów. Wskazano na oszczędności, jakie niesie ze sobą informatyzacja placówek ochrony zdrowia oraz udział środków z Unii Europejskiej w finansowaniu programów.

Key words: information systems, telemedicine, computerization

Słowa kluczowe: systemy informacyjne, telemedycyna, informatyzacja

INTRODUCTION

Decision-making and management of healthcare units are largely determined by the information collected. The group of procedures consisting of collecting, processing, storing and transmitting information to support and facilitate the management can be defined as an information system [1]. Such a system is essential to normal/correct functioning of all organizations and companies, including facilities providing healthcare services. Today, healthcare institutions intending to gain a strong position in the evolving market of medical services are forced to carefully choose specific activities relevant to the management mechanisms of the information resources, so that they are appropriately used in order to increase

its chance to gain and maintain a permanent competitive predominance in the market environment.

In healthcare, the strategic and universal purpose of the development of information systems is to develop and improve the efficient use of existing resources of the information system, through the computerization of its various parts, standardization of structures, dictionaries, and communication protocols; additionally by improving the quality and credibility of information as well as the utilization of generated information [2].

The basic objectives of information systems in terms of the interests of health care are:

- providing the highest quality of services,
- efficient management of the unit in a competitive environment,
- facilitating the work of medical staff [1].

The modern health care system requires a high degree of computerization in institutions operating in the healthcare market, implementing of which has been greatly accelerated in recent years, for example, due to the necessity of carrying out settlements with the (tax)payer in the reformed health insurance system.

The compulsion to collect and transmit large amounts of data enforced the introduction of measures aimed at increasing a degree of computerization and it has improved information systems of these units [3,4]. The main disadvantage is the fact that the use of paper documents is time-consuming, and there are difficulties in obtaining quick access to data. The existence of electronic information flow enables to save time, and this, in turn, allows taking the effort to improve quality and productivity.

Experience shows, that the use of IT tools in the information process also removes the source of frustration and reduces the overall workload, which prevents the generation of conflict and stress reactions in employees [5].

The benefits of the implementation of information systems are multidimensional. The primary effects of computerization include:

- improving the effectiveness of personnel, through the rapid flow of information and better access to it,
- improving the quality of services, by providing tools to support medical staff in carrying out treatment and broadening the scope of information used in the treatment,
- greater control of sources of costs in the hospital,
- assistance in the management at higher levels, by allowing analysis of the data collected,
- reduction of costs associated with processing large amounts of information appearing in the treatment process [1].

COMPUTERIZATION IN HEALTH CARE

Every implemented system clearly defines the area of its influence. It should also be clearly aimed at one of the spheres of the covered project or to meet the selected need. The United States and Germany began work on a system dealing with financial issues. United Kingdom, Sweden, France and Japan realized it primarily on the patient. These are two different approaches, which at some point need to take account of and complement each other. Only equitable introduction of patient medical data correlated with their financial information allows looking at the overall hospital system [1]. Hospitals and medical centers are implementing systems, which are supportive for the management of so-called grey- administrative sphere and medical, so-called white.

Computerization can be complex or run in stages. In the event of a complex computerization in the hospital, systems and specialized software are integrated. An example of complex actions of computerization was the Oncology Centre in Bydgoszcz, where on the request of the Center, MEDINFO system was implemented to support part of the "white", some of the "grey" sphere and the settlement of the National Health Fund (NFZ). The system took almost all spheres of activities of the Centre, reducing the time of registration of patients and improving the quality of the service [6].

Computerization was carried out in stages in Kujawsko-Pomorskie Pulmonology Center in Bydgoszcz. In 2000, administrative system SKID (now Xpertis) was introduced, containing the following modules: HR - Payroll, Finance - Accountant, Cashier, Inventory, Fixed Assets, Homebanking. The system allows the preparation of financial statements, data analysis, planning and forecasting. In 2001, the medical computer system was implemented, which included most of the functionality of the medical aspects of hospital activities such as: Patient's movement (Admissions) (Admissions modules, Ward, Statistics), Pharmacy and Medication on the ward, (Medical, Clinical)Analytical Laboratory, Diagnostic Labs, the module of Bacteriology. Later, some new modules of the system were introduced: Pathology, Rehabilitation, Endoscopy, Outpatients Clinic and the

module, which was not integrated with the system, supporting the Laboratory of Respiratory Disorders during sleep. In 2007, the medical system was supplemented by a digital radiology system within the TELEMEDICINE program. The system allows the distribution of diagnostic images throughout the hospital's computer network at the indicated computer stations. [7] The current system Xpertis provides multi-variant reports with numerous levels of summation, simulation analysis. It allows comparing actual and forecasted results. Additionally, it gives a direct and immediate access to data collected in other modules of the system [8].

Already completed systems are naturally slower to respond to organizational and legal changes. Their implementation requires a large amount of time, and sometimes, it happens that quickly there is a need to make major modifications, replacement or introduction of a new system. In private clinics, information systems must take into account the specificity of their activities. Since the beginning of foundation (since the late 90), the Family Medicine Company SA has been creating on their own computer system. The work does a team of company analysts and programmers. The company has got 16 own medical clinics and includes 5 institutional clinics. In each of these, there is independent software operating on the principle client – server with central data synchronization on - line. The synchronization method is an own solution of IT specialists as well as analysts, and ensures sharing of information between providers in actual time. Currently, the system supports several areas of the company: managing the database of patients and their rights to services, customer management (contractors), including contracts with the NFZ, employers and insurers, work time management – the module of planning doctors' and other staff rota, booking patients visits, keeping records of services and electronic medical records. The system also has analytic functions, reporting modules, which provide the information management; therefore, it is possible to improve efficiency and service quality. The system is constantly being developed and implemented with new modules, including the run of treatment rooms, promotion of cooperation with suppliers of medical services (diagnostic imaging facilities, laboratories) and the stock management. This structure allows the system to quickly adjust to the constantly changing external and internal conditions. The company's experience shows that this kind of own system can successfully handle the smaller health care facilities [9].

Computerization of healthcare facilities is an expensive process. Introduction of modern solutions in many hospitals is possible thanks to funds acquired from the European Union.

By the end of 2011, the Regional Specialist Children's Hospital in Olsztyn is likely to complete a complex computerization, funded by the European Regional Development Fund (cost of the project was 3.9 million PLN). The project gives the patient the opportunity to register online and access to patient records at designated hospitals and clinics [10].

The county Hospital in Kedzierzyn-Koźle received 6.3 million PLN, funded by the European Union, to implement an integrated information system. After the introduction of the new system, the hospital predicts the growth of market position and the opportunity to compete with other commercial entities and to achieve benefits associated with obtaining savings in the operation by eliminating unnecessary expenditures incurred by operation activities [11].

In a similar manner, one of the largest psychiatric hospitals in Poland, Wolski Hospital in Warsaw, was computerized. The cost of the project, entitled 'E - Hospital - the creation of a digital information system of telemedicine, data collection, processing and archiving data for the Wolski Hospital SP Hospital in Warsaw', was approximately 4.2 million PLN. Half of the amount came from European Union funds within the Integrated Regional Operational Development Programme. The great importance to this institution was the introduction of electronic patient information flow - from admission to discharge, all the information are recorded at the so-called electronic patient record [12].

The introduction of information systems also translates into real savings. The University Hospital Aachen (Germany) is a hospital which employs over 5700 staff members and treats approximately 179 000 patients in the year. With the development of the facility, the list of used operating systems has grown. Integration and analysis of large amounts of data from different systems caused many difficulties. In early 2003, the hospital decided to implement SAS 9 software company SAS Institute across the organization. The implementation included such elements as: data integration, business intelligence (software for budgeting and analysis, supporting the decision-making processes), information portal, as well

as solutions for managing results. The biggest challenge before the implementation of SAS 9 was the integration of data from various systems including: Medico - Hospital Information System (3.4 million records are updated every day), Swisslab - Laboratory Information System (10 million records generated each year), ERP system used for hospital resources management. The benefits of the new system included increased income from reimbursement of medical costs, reduced operating time for the exchange of information within the organization and reduced costs of external services. Five years after the implementation of SAS 9, the return on investment after tax was estimated at 569% [13].

Norwegian Rikshospitalet University Hospital estimates that by introducing a comprehensive and modern information system, it reached annual savings of 66 million dollars, which represents 7% of the budget of the hospital [14].

THE USE OF INFORMATION SYSTEMS

Achievements in the development of modern medical technology have influenced the development of telemedicine, using technology for diagnosis, treatment, consultation and monitoring of the health status of patients. It gives a chance to reduce costs by allowing the treatment and care at the patient's home.

Televisits are particularly valued by chronically ill patients and those, who because of a long convalescence / stay at home for a long period of time. The audio-visual contact with a doctor or nurse improves patient's psychological comfort, despite the actual distance. Statistical data from the state of New York in the U.S. show that the use of telemedicine in home care resulted in reduction of the frequency of ambulance and emergency visits in the hospital among patients over 65 the age by approximately 70%. In the Netherlands, modern telemedicine devices (based on the model so-called Smart home) were used in seniors' home (nursing home/residential home) in Eindhoven, and in Finland, a project is being created to equip one of the villages with the home telecare system. In France, a project PROSAFE designed for people with memory loss including Alzheimer's disease was developed It monitors the health of patients in addition to their behavior, the cases of disappearance from the residence, falls, etc.

Telemedicine is also used to monitor the health status of patients in various types of diseases. MyCare program operating at Georgetown University Medical Center in Washington sends glucose measurements to the monitoring center from the miniature meters, which are provided for diabetic patients. At the same time, patients receive test results with recommendations on how to proceed. Thus, it is possible to prevent serious consequences resulting from the delayed implementation of therapy. At Vanderbilt University, USA, telemedicine is used to study the image of the eye of patients with diabetes. Also, the information is sent via the Internet to the monitoring center, where the information is analyzed for the diagnosis of complications associated with diabetes. This is particularly convenient for patients living in remote villages, because it eliminates the need for personal visits for diagnostic purposes. In the UK, the health of patients with asthma is monitored. The patient has a small mobile phone – computer that senses the deterioration of the patient's condition. The information is passed on automatically to the doctor, who takes the necessary actions. Similar pilot programs are applied in remote monitoring of patients with hypertension, suffering from cardiac arrhythmia. In Brazil, remote diagnoses were introduced in dermatology patients with suspicious skin changes [15].

In Poland, telemedicine 'crawls'. So far, there has been only a few interactive educational and training videoconferencing - such as the tripartite; one from Washington to Warsaw and Bielsko Biala or heart surgery at Children's Health Center in Warsaw. Local telemedicine networks are formed around large medical centers. They focus mainly on developing and implementation of systems to transmit ECG signals by telephone, and X-ray images, ultrasound, CT via the Internet and using the Intranet for consultation. Although, all Polish hospitals have access to the Internet, according to the report 'The study of the needs and potential opportunities in telemedicine in county hospitals,' which was developed in cooperation with the Department of Medical Informatics and Telemedicine Medical Academy in Warsaw and the Association of Polish Counties, only a few facilities have digital equipment to record test results. Ambulances, equipped with equipment that enables the electronic transfer of ECG results to the cardiac center on call, function only in 16% of hospitals. Even more rarely, consultations are carried out during the transport of the patient (11%). The telemedicine system in ambulances has been operating for several

years in Bydgoszcz. 16 rescue teams, including 5 specialist teams, are included in this system.

In the field of emergency medical service, Personal Digital Assistant (PDA) or personal digital assistant gives great opportunities to take advantage of. Already in 2007, the system was tested in the emergency stations in Katowice and Mikołów. The use of PDAs by procedures is following:

- the doctor gets a request on the PDA along with a map of directions to the patient,
- the software has also the option to fill the departure card,
- in module 'interview, examination, medical procedure " a description of the patient symptoms is filled out (in the electronic version of the card, a doctor does not have to enter it manually, but to record),
- the drug used does not have to be manually entered, but can be selected from the available database (this allows a statistical analysis of the drugs economy),
- when the crew returns to base, the doctor sends the contents of the PDAs to the server and signs the printed document [16].

The PDA is also used in telemedicine. Since 2004, one of U.S. companies has promoted its device, which, when connected to the PDA, allows the patient to observe own heartbeat. The data obtained can be sent to the doctor. At The College of Medicine in Texas use of information technology PDA in diabetes management by patients with type 2 diabetes in the ambulatory setting has been shown to improve self-care and glycemic control [17].

One of the pioneering activities of the PDA technology in Poland is the study of bronchial asthma and chronic obstructive pulmonary disease (COPD) within the COMPASS program, implemented by pulmonologists and clinical internists of Medical College in Krakow. The program allows registration of data of the disease, its course and treatment by hundreds of specialists from approximately 14 000 patients with COPD and asthma. Another research program, which uses the PDA, is OPTIMO, or 'optimal care of patients with diabetes in Poland.' This program is focused on populations with diabetes under the care of a specialist diabetes clinic. It provides information about the characteristics of the research population including diagnostic and therapeutic methods depending on the duration of illness, severity of complications or comorbidities. It is planned to use PDAs in the daily work of doctors. Using an electronic questionnaire, the results of the study, complications and treatment data will be entered. This will not only enable safe collection of the information of patients (without being able to identify the members of the public), but also will help physicians to care for patients through the use of clinical decision support system (CDSS - Clinical Decision Support System), developed on the basis of current Polish Diabetes Association guidelines. The program will remind to carry out tests provide information on current methods of action, criteria, definitions, classifications of complications, and the expected health effects in diabetes treatment. With OPTIMO a doctor will be able to quickly view the information about the methods used in the patient's treatment, the results of the patient's tests and the possible complications. Moreover, the program plays an educational role, because every month participating doctors will receive multimedia information materials as well as sets of questions, and educational points will be awarded for correct answers. The program OPTIMO undergoes further changes, because the incoming comments and suggestions from the physicians participating in the program are included in the modification of the electronic questionnaire and the clinical decision support system.

The PDA is also used in ECG and hearing screening tests, using objective and audiometric methods. Data is collected for 'Program of care for people with hearing impairment in Poland'[16].

The studies in Sweden revealed a positive attitude towards the PDA. The PDA seems to be a valuable tool for personnel and students in health care but there is a need for further intervention studies, randomized controlled trials and studies with various health care groups in order to identify its appropriate functions and software applications [18].

AUTOMATIC IDENTIFICATION OF PATIENT

In most European countries, the extensive use of automatic identification in healthcare is already a norm. In Poland, this solution is not yet widespread. For example, identification of the patient can be done by putting bands with a printed barcode on the wrist of a registered person.

In the U.S. there are even more advanced technologies, such as radio frequency identification, known as RFID tags. Patient information can be obtained using the identification numbers allocated to

them. The band put on the patient, contains both chip signal on a specific radio frequency and the barcode. By using such solutions the hospital staff has secure and virtually unlimited access to all data, including those from the laboratory and pharmaceutical information center. The system eliminated the need for paper documentation. The fact that the information is instantly updated in each place also reduced the number of errors in prescribing medicines. This system is particularly convenient when using shift work system, where the patient is looked after by more than one person and the instant sharing of information is more difficult. In addition, physicians and nurses using the wireless platform right at the bedside can order any necessary lab tests, write notes about patient care or update the order of the administration of medication. The extension of the functionality of the RFID for tracking blood for transfusion and monitoring of surgical instruments has been introduced [19].

An assessment RFID-enabled blood transfusion was conducted for two hospitals: the University of Iowa Hospital and Clinics (UIHC) and Mississippi Baptist Health System (MBHS). The study estimated that RFID technology could reduce morbidity and mortality effects substantially among patients receiving transfusions [20].

The RFID system has been also introduced in the University Hospital of Jena in Germany and designed to improve patient safety. A significant increase in the quality of medical services and virtually complete elimination of the risk of medication dispensing errors was observed. In addition to improved quality of treatment, the RFID infrastructure is helpful in the optimization of logistic processes. It allows management of drug supplies depending on demand, which reduces the amount of capital tied up in the stock of hospital pharmacies [21].

It is worth noting that for the security of distribution of blood, identification systems use mobile devices for printing labels on a regular basis. Such activities are aimed at reducing wrong-labeled samples of blood which, according to some studies, may be account for up to 5.8% of all containers [22].

In-patient and outpatient facilities systems are even less common.

RFID applications have the potential to increase the reliability of healthcare environments. RFID technology not only offers tracking capability to locate equipment, supplies and people in real time, but also provides efficient and accurate access to medical data for health professionals. However, the reality of RFID adoption in healthcare is far behind earlier expectations. Major barriers to adopt this technology include technological limitations, lack of global standards and secure authentication systems. In healthcare environments remains as a challenge the further use of this technology [23, 24, 25, 26].

SUMMARY

The examples of practical applications of modern systems confirm not only their multidimensional significance for the patient, but also for the management of health care institutions. Effective use of the system means not only improvement of administrative standards, but it provides savings in the form of reduced overall cost of treatment and care in our country.

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Address for correspondence:
Dorothy Rogala
85-830 Bydgoszcz
ul. Sandomierska 16
e-mail-dorotarogala@op.pl
telephone: 880 44 55 91

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