MODERN INFORMATION TECHNOLOGY IN MEDICINE

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Abstract. The application of modern information technologies in daily work significantly facilitates the collection, analysis of data and interpretation of results in a graphical environment. Scientific works, especially in the field of medicine, involve the collection and analysis of various types of data, on the basis of which pre-set hypotheses are accepted or rejected. They often contain many other interesting indicators, such as unrecognizable hidden dependencies, cause-and-effect relationships, mutual relationships, etc. Thus, the need to use modern concepts, as well as all modern analytical-statistical tools, was imposed. they must be of interest to experts in the subject areas, especially when it comes to scientific papers in the field of medicine. In particular, modern medical information systems should be highlighted. They are used to maintain a computerized clinical history and classification system of terms, diseases and drugs. They also allow creating electronic queues that are much more comfortable for patients. The modern conception of information systems is the consolidation of electronic records of patients with an archive of medical and financial information, data from medical devices and modern means of information exchange. Thus, the medical information system is a combination of hardware, software and a database intended for the automation of various processes in the health care system.
Keywords: *information technologies, database, medical informatics, information systems*

Introduction

Introducing health information technology (IT) within a complex adaptive health system has the potential to improve care, but it also introduces unintended consequences and new challenges (Ash et al., 2004). Ensuring the security of health IT and its use in the clinical environment has emerged as a key challenge. The scientific community is trying to better understand the complex interactions between people, processes, environments and technologies as they strive to safely develop, implement and maintain new digital infrastructure. While recent evidence from the hospital environment shows that health IT can make care safer, it can also create new security problems, some of which manifest long after the technology has been implemented (Brenner et al., 2016). Medical informatics is a huge branch of the interdisciplinary field at the intersection of informatics and medicine, which, interestingly, is very large both from the point of view of informaticists and from the point of view of medical specialists. The most general definition that can be given is the processing of data obtained as a result of medical activities and support of any health processes. At the same time, healthcare itself is a

huge field and it is necessary to understand what place medical informatics occupies in it. Medical informatics and its development are inextricably linked to evidence-based medicine. In principle, informatics as such could develop together with medicine when we had an evidence-based medicine methodology. From the history of evidence-based medicine, we see that it is inextricably linked to data processing and medical statistics.

Evidence-based medicine is medicine that produces any effects on the patient only when there are preliminary reasons to believe that it will be beneficial, and these grounds are obtained by scientific methods (Bhandari and Giannoudis, 2006). The scientific method uses statistics to make verifiable and repeatable judgments. Hence, in medicine, we achieve desacralization, repetition, and study it statistically. The process of statistical research consists first of all in controlled randomized trials, that is, in proving on large samples that some effect is better or at least not worse than another. The respective methodology is called superiority study and non-inferiority study. Once we realize that we need statistics, we have to work with raw data and processed data. This is what lies at the heart of medical informatics. The question immediately arises: where does the data that tells us that something is better and something worse come from? We need objective diagnostics, which is a separate subfield. After the diagnosis, we receive a huge amount of raw data that needs to be converted into other data, connected to the patient, taking medical history and so on. And this is another sub-area. As a result, today it is considered that medical informatics is divided into clinical informatics, i.e. the actual support of informatics to the treatment process itself in the clinic, i.e., it is, in fact, standard office work and life cycle management of patients, life cycle management of operations, etc.

Discussion

Modern information system as a prerequisite for successful management in the health system

In the effort to modernize information management and information handling in the healthcare sector, the focus is almost always on technologies and conceptual issues such as coding and language (Khan, 2018). However, without competent and therefore secure users, this important investment in modern information systems will at best not achieve its full potential, and at worst may lead to service deterioration. If it is accepted that the main goal of the system is to improve and preserve people's health, then it is almost pointless to discuss/discuss whether it is needed. It is probably more adequate to conclude, not only that it is needed, but that it is necessary for modern society and the people in it, because its good work, that is, good functioning, can significantly improve the health of the people. But in addition to its main overall goal, improving and preserving people's health, it has two other goals that are also important for its contribution to the overall goal, namely: suitability (responsibility) and fairness. Eligibility (responsibility) refers to meeting what people expect from him, and fairness means his equally good/adequate response to everyone, without discrimination, with a fair/fair financial contribution. In other words, the health system is necessary for the preservation and improvement of people's health (physical, psychological and social), but no less for the responsibility for meeting the demands for health care of people, as well as its fairness in financing and meeting the health needs of all, without discrimination.

The efficiency of the health care system represents the optimal use of available resources to achieve the greatest benefits or results (Jacobs et al., 2006). It refers to the system's ability to function with minimal costs without reducing achievable and desirable results. Efficiency targets refer to the percentage of national resources dedicated to health. Macro efficiency refers to the ability to use those resources in such a way as to maximize outcomes within the health care system. The application of information technologies in healthcare can significantly influence the increase of this significant dimension of the quality of healthcare. In general, primary health care, as well as other levels of health care, use extremely inefficient procedures to support various activities and processes. There are many issues that occur every day when working with patients, from the format of medical records to specialist instructions and prescriptions. Patient data is not updated and available from one place to anyone authorized to access it. It is very important to emphasize that health systems are very expensive and inefficient to a large extent due to not using the opportunities provided by modern information technologies. The health information system represents one of the basic factors for ensuring health care, which is centered on patients. The introduction of integrated health care information systems (Integrated Health Care Information System-IHCIS) can greatly increase the efficiency of the overall health care system, as well as the efficiency of individual health care institutions from the network of health care institutions (Hollingsworth and Peacock, 2008).

The solutions provided by the integrated health information system benefit all interested parties (Ministry of Health, health institutions - state and private, public health institutes, pharmacy institutions and pharmacies - state and private, institutions dealing with health insurance, citizens): (1) transparent access to medical and administrative data about the patient; (2) high-quality management of patient data and information; (3) effective collection of medical information for planning and optimization of business processes in healthcare; (4) optimization of the price-effectiveness ratio in healthcare practice; (5) exchange of knowledge based on best practice and scientific knowledge; (6) an open platform that can be integrated and enable cooperation between interested parties in healthcare; (7) active participation of patients in healthcare processes; (8) improving the quality of ongoing health business processes; and (9) security and confidentiality of medical data and information. Application of modern information technologies in the implementation of management information systems is to support business systems (medical and non-medical affairs) of health institutions. There is also a large lack of computers and certain associated equipment in health institutions. For the most part, health institutions, both state-owned and privately owned, are left to their own devices and in them the problem of providing health services is treated mainly as an evidence-based problem (scheduling examinations, receiving patients, specialist examinations, making laboratory findings, specialized diagnostics, treating patients, invoicing health services, archiving medical documentation), and not as a patient management problem that ultimately must: (1) be based on the network of processes in the health institution; and (2) fulfill certain requirements of modern integrated management and data, identification and traceability of services.

The main contribution of the Project should be the introduction of a standardized system of electronic health records (EZD) into the Health Information System. Electronic health documentation represents a set of information about the health of each individual patient in electronic form, over a continuous period of time "from the cradle

to the grave". The concept of developing electronic health documentation is in accordance with European standards in the field of health primarily oriented towards improving the health of each individual. Data for electronic health documentation is provided by health professionals at the point of provision of health services, using modern information and communication technologies. Electronic health documentation is available to all users of the system, regardless of location, and access to information is strictly controlled by the application of standards for privacy and security of information, modern technological solutions and rules established by law. The electronic health documentation system is an integrative factor for the entire social information system. Its introduction should speed up the organized and synchronized computerization of health institutions, in accordance with the standards and adopted rules.

Modern directions and perspectives of use of medical information systems

The information system represents a set of data, processes, people, material resources and information technology that in mutual interaction collect, process, store and provide the necessary information in order to support an organization. Information technology (IT) is a modern term that describes the synergy of computer technology (hardware and software) with data and telecommunications technology. Information technology is a component of any information system. Within a healthcare institution, the information system and information technology includes a wide range of applications and products that are used by different types of users, which can be: healthcare workers, support staff, human resources, patients, scientific workers, government, ministries, institutes, etc. One of the most important areas of application of information systems is medicine, i.e. health care. Medical Information System (MIS) is an information system that is applied in the field of healthcare within a healthcare institution. There are two primary parts within the medical information system: the administrative part and the medical part (Littlejohns et al., 2003). The administrative part of the medical information system is responsible for supporting the work of the financial service and providing support to the management of the health organization (eg human resources management, public procurement management, materials and medication management, accounting, working time records, billing for services provided to patients, etc.). On the other hand, the medical part of the medical information system enables medical support during the establishment of diagnoses, keeping records of patient treatment, monitoring the health of a patient (curative and preventive), the entire family and a population.

Development of medical information systems from 1960 until today

The development of the first medical information systems (the first information systems were created in the United States of America) went from the simple recording of billing for the provided medical service, and that only in larger health institutions, through the system for scheduling and verifying examinations, the implementation of the electronic patient record, the use of mobile phones medical applications, until today when: significantly intensified use of deep learning and other artificial intelligence algorithms for diagnosing diseases and processing medical data, advanced integration with smart city services, intensive use of open data, etc. The medical information system of a health institution usually consists of several smaller information systems, tightly connected to each other, which are used at the level of a department and usually

include: Laboratory Information System (LIS), Radiological Information System (RIS), Electronic Patient Record (EKP), Pharmacy Information System (ISA), Information System for Decision Making, Information System for Documentation and Document Storage, Information System for Telemedicine, etc.

Data flow in the medical information system

A central part of a medical information system is also a database for storing medical and demographic data of patients from which relevant data can be extracted and manipulated to create various displays and reports for specific purposes.

Architecture and key features of a medical information system

The central part of any medical information system is the electronic patient record. The patient's electronic record contains all medical and demographic data related to diagnosing the disease, establishing therapy and treating the patient. It includes medical data entered during examinations at various services (organizational units) of the health institution and after examinations using various diagnostic methods. The goal is to have a centralized electronic record of every patient at the level of one state, from which up-to-date medical and demographic data will be available to all health institutions upon request from local medical information systems. In that case, there must be two-way communication between the local medical information systems and the centralized electronic patient record.

Information systems used in healthcare institutions

Healthcare facilities are constantly looking for new ways to improve patient outcomes and create an efficient facility. Electronic records are transforming healthcare operations by digitally storing all patient records, providing instant access to medical staff and improving doctor-patient interactions. Since everything is done electronically, it is important to access that information in multiple areas of the hospital. One way hospitals access health information is by having computerized medical carts. This cart can travel between rooms and store information necessary for the proper functioning of the hospital in accordance with the law.

Characteristics of health information systems

A health information system (HIS) manages data collected and stored in a health facility. This includes doctors' offices, private and public clinics and hospitals. These institutions collect, store, manage and send electronic medical records of patients. Digital health systems improve patient care with the latest available patient data. Patient data is very sensitive, so any health information system used must ensure the accuracy of data collected and patient confidentiality. Other uses of patient data beyond individual client treatment include medical research, policy data, revenue cycle analysis, and decision-making information. Health information systems routinely access, process or store large amounts of sensitive patient data. As a result, the security of computer systems is crucial.

Advantages of health information systems

Health information systems tend to target efficiency and data management. The main drivers of health information systems are: (1) Data Analytics: The healthcare industry is constantly producing data. Health information systems help collect, collate, and analyze health data to help manage population health and reduce health care costs. Then the analysis of health data can improve patient care; (2) Collaborative care: Patients often need treatment from different healthcare providers. Health information systems-such as health information exchanges (HIEs)-allow healthcare facilities to access shared health records; (3) Cost Control: Using digital networks to share health data creates efficiencies and cost savings. When regional marketplaces use health information exchanges to share data, healthcare providers see cost reductions. On a smaller scale, hospitals are aiming for the same efficiency with electronic health records; and (4) Population health management: Health information systems can aggregate patient data, analyze it, and identify population trends. The technology also works in reverse. Clinical decision support systems can use big data to help diagnose and treat individual patients.

Health information management affects the quality of patient care

Helping Patients Access Their Records: An estimated 50 percent of providers still use paper charts in some way. As providers move to electronic files, health informaticists are proposing-and often implementing-new programs that not only improve record keeping but also give patients access to their records online for the first time in American history.

Keeping Private Patient Data Safe: Think about how much personal data healthcare professionals collect. From addresses to recipes, the amount of sensitive information being exchanged is daunting. The Health Informatics Service is the custodian of this information, protecting it from unauthorized personnel and security breaches.

HIPAA Compliance: Health IT professionals ensure compliance with HIPPA regulations. The Health Insurance Portability and Accountability Act provides for specific data security measures, including data encryption, data disclosure policies, and breach notification plans. Health IT professionals ensure that providers follow these complex rules and keep patient information under lock and key.

Data Mining to Improve Patient Safety: Health informatics scientists analyze data to find ways to improve patient safety. For example, an informatics scientist might analyze trends in healthcare-related infections or falls so healthcare professionals can create solutions to those problems.

Health Record Accuracy Analysis: The health information management team's job is to examine electronic records for errors or incomplete information. For the highest level of care, records must contain up-to-date information about the patient.

Creating a Standard Language: Health informatics translate clinical data into information useful to everyone from home health aides to insurers. Patient safety is enhanced through a universal nomenclature that maintains accuracy and provides essential, easy-to-use information to those who need it (Chen et al., 2013).

Improving Care through Better Coordination: With knowledge and skills in electronic record keeping, health informatics professionals help providers coordinate patient care. Electronic records provide a broad view of the patient, with real-time information that can be accessed by any doctor, nurse or physical therapist who interacts with the patient.

Communication with healthcare staff: Healthcare informaticians are the custodians of information, which is why they work closely with a wide range of healthcare professionals and support staff. They bridge the gap between administrators and those who work one-on-one with patients to provide care. Bridging this gap ensures that patient data is not lost, misplaced or mishandled.

Providing Financial Information: Health informatics integrates clinical care data with financial data. Using these statistics, managers can make decisions that improve patient services and quality of care.

Improving Health Literacy: A growing number of health informaticists are devising strategies to help patients navigate common problems, including complicated discharge instructions and code-heavy insurance bills. By improving health literacy, informaticists remove obstacles to quality care.

New technology in health care

Health care is changing dramatically due to technological developments, from anesthetics and antibiotics to MRI scanners and radiotherapy. Future technological innovations will continue to transform healthcare, but while technologies (new drugs and treatments, new devices, new social media support for healthcare, etc.) will drive innovation, the human factor will remain one of the stable constraints on discovery. The World Health Organization defines health technology as "The application of organized knowledge and skills in the form of devices, drugs, vaccines, procedures and systems developed to solve health problems and improve the quality of life." This includes pharmaceutical products, devices, procedures and organizational systems used in healthcare. Technology is driving healthcare more than any other force, and it will continue to evolve in dramatic ways in the future. While we can see and debate the details of future trends in health care, we need to be clear about the drivers so that we can align with them and actively work to ensure the best outcomes for society as a whole

Advances in medical technology

In today's world, technology plays an important role in every industry as well as in our personal lives. Of all the industries where technology plays a key role, healthcare is definitely one of the most important. This merger is responsible for improving and saving countless lives around the world. Advances in medical technology have enabled physicians to better diagnose and treat their patients since the beginning of professional medical practice. Thanks to the continuous development of technology in the field of medicine, countless lives have been saved, and the overall quality of life continues to improve over time. Medical technology is a broad field where innovation plays a key role in maintaining health. Fields such as biotechnology, pharmaceuticals, information technology, the development of medical devices and equipment, and more have made significant contributions to the improvement of human health around the world. From "small" innovations like adhesive bandages and ankle braces, to larger, more complex technologies like MRI machines, artificial organs and robotic prosthetic limbs, technology has undoubtedly made an incredible impact on medicine. In the healthcare industry, the dependence on medical technology cannot be overstated, and as a result of the development of these brilliant innovations, healthcare professionals can continue to

find ways to improve their practice from better diagnosis, surgical procedures and improved patient care.

Information technologies and medicine

Information technology has made a significant contribution to our world, specifically in the medical industry. With the increased use of electronic medical records (EMRs), telehealth services, and mobile technologies such as tablets and smartphones, both physicians and patients are seeing the benefits of these new medical technologies. What is health information technology? Medical technology has evolved from introducing doctors to new equipment for use in private practices and hospitals to connecting patients and doctors thousands of miles away through telecommunications (Berg and Goorman, 1999). It is not uncommon in today's world for patients to hold video conferences with doctors to save time and money usually spent on traveling to another geographical location or to instantly send health information to any specialist or doctor in the world. With more and more hospitals and practices using medical technology such as mobile devices at work, doctors can now access any type of information they need-from drug information, research and studies, patient histories or records, and more a lot-within seconds. And, with the ability to effortlessly carry these mobile devices with them throughout the day, they're never far from the information they need. Applications that help identify potential health threats and examine digital information such as X-rays and CT scans also contribute to the benefits that information technology brings to medicine.

Medical equipment technology

Improving the quality of life is one of the main benefits of integrating new innovations into medicine. Medical technologies such as minimally invasive surgery, better monitoring systems and more comfortable scanning equipment allow patients to spend less time recovering and more time enjoying a healthy life. The integration of medical equipment technology and telehealth has also created robotic surgeries, where in some cases doctors don't even need to be in the operating room with the patient when the surgery is being performed. Instead, surgeons can work out of their "home base," and patients can have the procedure done at a hospital or clinic close to their hometown, eliminating the hassle and stress of health-related travel. In other robotic surgeries, the surgeon is still in the room, operating the robotic devices, but the technology allows for a minimally invasive procedure that leaves patients with less scarring and significantly shorter recovery times.

Expected effects and contribution of health information systems

Healthcare is one of today's most knowledge-driven industries. It is an evolving sector where the quality of patient care relies on the tools, support and knowledge that healthcare facilities and organizations have at their disposal. When healthcare providers adopt an information management system, it fosters a culture of continuous collaboration and innovation and creates a more efficient flow of information between providers and staff. The scientific contribution of the work is reflected in the presentation of the problem that accompanies health care in the newly emerging conditions of the need to reform the health system towards sustainability and quality preservation with an emphasis on primary health care, identified as the "gatekeeper of

the health system". The social significance of the work is manifested through an analytical approach to the open question of the future functioning of the health care system and health services at the national level (Rajković et al., 2013). The importance of the work is also contributed by the primary results of empirical research on the level of functioning of the health system in conditions of a severe general social and financial crisis and the formation of the current and future direction of development in the organization and provision of health services according to the principles of modern management, through redistribution and restructuring towards prevention, i.e. primary health care activities.

Conclusion

The results of this work indicate the need for long-term and systematic approaches to the use of medical information and the establishment of a local health information system, along with implementation plans. As a first step, it is imperative to clarify the goal of building a medical information system, the information that must be provided to build the system, and the data that must be collected to provide such information, while moving away from the mentality of focusing on technology-oriented medical information services. In addition, it is necessary to consider information management, the development of data-based services and the framework of medical innovation, which are ways to effectively manage, use and systematize the data that is collected. In general, digital technology has changed the face of healthcare. And this change is predicted to continue in the coming years. Artificial intelligence, machine learning, blockchain, mobile health apps, smartwatches and a host of other technological breakthroughs will have an impact on the future of healthcare. There is no limit to how far digital technology can take healthcare if healthcare organizations and professionals keep their eyes open and build the necessary infrastructure and processes.

Although scientific knowledge has improved, much remains to be learned and much remains to be done. These challenges, taken together, represent a necessary but not complete set of key tasks for all the work that must be done before we can expect to have the safe, reliable, and efficient IT-based health systems needed to care for patients. Although we are seeing rapid adoption of health IT globally, it is still not clear how much this technology actually improves safety. If we are to realize the potential return on this investment, addressing the challenges we describe must be a high priority for the organizations that use these systems, the health IT vendors that develop them, and the government organizations that help fund and establish policies to oversee them.

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Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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