Possible directions of increasing the efficiency of the health system through software development

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Abstract

In the modern world, software is practically inevitable and present everywhere. Today, software represents the key to the success of most computer systems and at the same time the differentiation factor of the organizations that own it. Software has become an essential component in healthcare decision-making and the basis of scientific research and healthcare problem solving. The development of microprocessors enabled the widespread infiltration of computers into biomedical instruments for measuring, monitoring and displaying a number of parameters in physiology, clinic, radiology, nuclear medicine, laboratories and others. Digital communication techniques have enabled the networking of computers and the exchange of large amounts of information needed by expert systems to improve the quality of decision-making.

Keywords: medical software, health information system, health sector, information communication technologies, computers.

Possíveis direções para aumentar a eficiência do sistema de saúde por meio do desenvolvimento de *software*

Resumo

No mundo moderno, o *software* é praticamente inevitável e está presente em todos os lugares. Hoje, o *software* representa a chave do sucesso da maioria dos sistemas informáticos e ao mesmo tempo o fator de diferenciação das organizações que o detêm. O *software* tornou-se um componente essencial na tomada de decisões em saúde e a base da pesquisa científica e resolução de problemas de saúde. O desenvolvimento de microprocessadores permitiu a infiltração generalizada de computadores em instrumentos biomédicos para medir, monitorar e exibir uma série de parâmetros em fisiologia, clínica, radiologia, medicina nuclear, laboratórios e outros. As técnicas de comunicação digital possibilitaram a interligação de computadores e a troca de grandes quantidades de informações necessárias aos sistemas especialistas para melhorar a qualidade da tomada de decisão.

Palavras-chave: *software* médico, sistema de informação em saúde, setor de saúde, tecnologias de informação e comunicação, computadores.

1. Introduction

In recent years, the healthcare sector has been undergoing a major workflow transformation. Hospitals and healthcare facilities have begun to implement technologies in their daily work, simplifying complex processes. Today, we see many examples of how digital innovations are being successfully integrated into the healthcare industry, ranging from electronic medical records and hospital management systems to advanced technologies

for complex surgeries (Blois, 1984; Bloom; Duncan, 1990).
And with the advancement of custom software, it has become possible to perform many tasks such as screening, remote patient monitoring, and disease progression monitoring. Along with improving the self-care experience, such solutions reduce the burden on the healthcare system and minimize the physical presence of patients in healthcare facilities, which becomes especially important during a pandemic.
Custom medical software is customized business solutions used within the healthcare system. Developers create them from scratch to meet individual client requirements. Such tailor-made solutions are created for the specific needs of each medical organization and often require a special approach. This is why many healthcare facilities choose to develop custom software instead of using conventional solutions because there are many specificities of custom software compared to conventional software (Ruparelia, 2010; Software Medical Service, 2014). There are many types of medical software. Each solves different tasks and can bring different benefits to patients, doctors, medical organizations and the entire healthcare ecosystem.
Medical diagnosis software allows doctors to detect warning symptoms and make an accurate diagnosis, as well as share real-time patient records within the system. This type of software often uses AI tools to analyze all the collected data and generate the most appropriate diagnosis and solution. During the pandemic, when personal contacts had to be reduced, it became very relevant for both patients and medical professionals. It allows patients to check their symptoms without going to the hospital, and doctors to make diagnoses and monitor the voice of the disease remotely.

2. Medical software development process

The medical industry is among the most critical sectors that need crucial support from any other related industry. Like any other sector, the technology department has a role to play when there is a connection between them. Furthermore, there is a need to integrate the medical world with reliable first-time software, some of which are essential to automate services and enable faster service delivery. Technological advances in health departments are critical because they improve the operating procedures of doctors and increase the efficiency and quality of care. With the introduction of medical software, there has been minimal human error and proper management of medical data.

The emergence of informatics, as a science of information, in the middle of this century, can be interpreted not only as a consequence of the speed with which changes take place and the very nature of those changes, or as a consequence of the exponential growth of all the basic elements of the global world model (knowledge, population, agricultural and industrial products, spending non-renewable natural resources and pollution), and the technical-technological development of data processing equipment, but also as a consequence of the influence of a number of related sciences, fields and disciplines developed immediately before or after the Second World War (decision theory, game theory, computer science, information theory, cybernetics, systems theory, eg with systems thinking and communication as a common denominator.

Systems thinking presupposes the observation and examination of new objects and phenomena as a system; a system is a whole that cannot be broken down into its elements without losing its basic characteristics, the system is in constant interaction with its own around the environment. The very parts of the system, the elements, are explained on the basis of mutual interactions and relationships within the process of functioning of the whole, and not the other way around.

Systemic thinking is a way of unifying traditionally separate spheres of human activity. It is preceded, in terms of the development of scientific thinking, by observation - observing and describing the observed in detail, and analytical thinking - characterized by the attitude that all empirical phenomena and objects are independent elements that need to be analyzed, in order to explain the phenomenon as a whole. The relationship between the elements is explained by a cause-and-effect connection, and description by strict definitions and rules, with the possible use of statistical methods when it is not possible to explain phenomena without introducing randomness - a certain probability of the occurrence of individual events. Communication implies the establishment of an information link between two systems that have the ability to receive, send, process and store physical, chemical or biological signals (Deželić, 1987; Devedžić; Božović, 1992).

Different communication relationships can be established between individual systems, depending on the direction of signal movement, partners in the communication process (human – human, human - computer, computer - computer) and the type of information transmitted, data or commands. The communication system enables the source of information to transmit it to the destination with appropriate reliability and efficiency.

The development of any health information system today relies on a modular and distributed approach. Namely,

information systems are designed, tested and implemented that support, or only some functions of healthcare, or the work of typical healthcare institutions. A compatible synthesis of such subsystems of the health information system is the health information system itself. Usually these subsystems are: medical documentation system, hospital information system, care system, laboratory information system, radiological information system, pharmacological information system, patient monitoring system, office information system, bibliographic - search system, medical decision support system, information system medical research, medical education information system and health assessment system (Weiguo; Xiaomin, 2009; Debois, 2011; Dora; Dubei, 2013).

The information system of medical documentation is a system that enables the management of all types of medical and administrative data, i.e. medical records - health record or medical history, e.g. the use of computerized medical records has advantages over paper documents (accessibility, durability) but also some disadvantages (large initial material investments, special type of education or failures of the computer system itself). Today, problem-oriented medical history is most often used.

3. Medical practice management software

Medical practice management software (PMS) is a category of healthcare software that handles the day-to-day operations of medical practices, including veterinarians. Such software often allows users to capture patient demographics, schedule appointments, maintain insurance payer lists, perform billing tasks, and generate reports.

Healthcare organizations use practice management software to manage all aspects of their business, including patient information management, treatment planning and scheduling, and back office functions such as accounting. This type of software helps doctors manage patient treatment, and healthcare administrative staff manage patient flow. Scaled-down versions of medical practice management can meet the needs of small clinics or private practices (McNurlin; Sprague, 2004).

The American Medical Association defines the goal of health practice management as increasing practice efficiency, professional satisfaction, and the delivery of patient care. Organizations apply practice management to manage registration, scheduling, patient tracking, patient accounting and reporting through a single workflow across operations. This enables a single platform to collect payments across all patient accounts.

Practice management software (PM software) is designed to help medical practices of any size run more efficiently. Typically, small and medium-sized businesses use practice management software to manage day-to-day operations such as financial and administrative functions; some offices use it to connect to electronic medical records.

Some of the features of practice management software include:

- Entry and monitoring of patients,
- Capture patient demographics,
- Scheduling patient examinations,
- Charge capture management,
- Execution of collection procedures,
- Applying for insurance,
- Processing payments from patients, insurers and third parties,
- Generating reports for staff members.

Medical practice management software only requires an internet connection and a simple computer network. It can be deployed in three different ways: as desktop-only software, client-server software, or Internet-based software (McNurlin; Sprague, 2004). Desktop-only software: Used on one computer by up to a few people who share access.

Client-server software: Allows multiple users to share data and access to an on-site server that the practice must purchase or lease. Web-based software: Users access the system over the Internet, which eliminates the need to purchase a server but moves patient data out of the office.

In addition to the patient databases that a practice may maintain, practice management software manages large sets of data, including lists of ICD codes, procedures, insurance companies, medical facilities, physicians, and other providers in the healthcare system.

3.1 Implementation of practice management software

Implementing practice management software into your healthcare business is the best way to optimize your productivity. As we're sure you know, staying on top of the administrative side of things in the healthcare business requires constant organizational skills and plenty of time. The right practice management software will help you streamline these administrative tasks, maximizing your practice's efficiency and saving you time, energy and resources! With appointment scheduling software, clinical note templates, secure storage capabilities, and medical billing and coding features, Carepatron's sophisticated system has something for you, no matter what area of healthcare you work in (McNurlin; Sprague, 2004; Hu et al., 2017).

For companies in the health and medical industry, the three main objectives represent a difficult optimization problem. These goals are best outcomes for patients, best practices for healthcare professionals/providers, and cost-effectiveness on the business side. The best care and patient outcomes are always a win-win for both healthcare professionals and patients, but without good business practices, healthcare companies and organizations can end up suffering from poor quality and financial losses.

Software solutions can help achieve these three goals, but choosing the ideal medical practice management software is no easy task. In addition, it is important to stay in touch with patients at every stage of their visit, from check-in to consultation, review of medical records, diagnosis, therapy and other medical procedures, if any. This then continues to post-procedure patient monitoring, remote monitoring and patient care. An EMR or EHR system that can perform these steps seamlessly and efficiently would be a boon to patients, physicians, and hospitals.

The success of your medical practice depends on patient care and satisfaction. Patient satisfaction depends on several aspects of their experience in your office, and managing them can be quite difficult. To make the process easier for yourself and help with the day-to-day activities of your office, you can enlist the help of medical practice management software. They are commonly used by medical practices across the country because they are convenient and easy to use.

Medical office management software is a form of medical software that allows medical office staff to get on top of their daily tasks such as managing patient files, records, and can even help with appointment scheduling and follow-up. Furthermore, this type of software can also help manage billing tasks while cross-checking patients' insurance plans. All the tasks that would take your administrative staff hours to complete can be easily undertaken and completed automatically with medical practice management software.

Most medical practice management software is mostly cloud-based, which means that all patient information is stored securely on the internet and only authorized personnel have access to the information. There is no risk of HIPAA violations or information leaks with this type of software. Some medical practice management software can also be deployed on-premises, as opposed to cloud-based setups.

4. Software components for medical practice management

Medical practice management software packages are types of applications that help run the business side of a medical practice. These applications automate scheduling, insurance claims, invoicing, and accounting functions in medical offices. Different types of medical practice management software are specifically designed for use by small and medium-sized offices or independent billing agencies. Although medical practice management software does not allow entry of medical records, it integrates with electronic document management systems to complete the loop of customer care within the healthcare system. Although there are many competing systems available to healthcare professionals, there are some commonalities among them all (AAMI, 2012; Hu et al., 2017).

4.1 Personal data of patients

Practice management software is typically used first to record incoming personal patient information. New patients submit demographic data items such as their names, phone numbers, physical addresses, and email addresses. Other items collected are employment and insurance information. Depending on the type of system available and its connection to external databases, medical administrators verify in real time whether patients are eligible for insurance benefits so that there are fewer surprises for patients during the billing process (ISO, 2003).

4.2. Scheduling appointments for patients

A large part of the day-to-day operations of most doctors' offices involves scheduling patients for appointments. Healthcare administration has made great strides in efficiency by automating this important function. The scheduling feature of the medical practice management software allows medical administrators to quickly schedule non-conflicting appointments for hundreds of patients and gives patients flexible options when making better choices about available appointment times. Also, if someone needs schedule changes, medical administrators can easily download appointment information from this software system. The medical practice management software offers great efficiency with a seamless front-end graphical user interface and a hidden yet powerful database that allows for fast entry, storage and retrieval of appointment data (Deželić et al., 1995).

4.3 Insurance claim

To the layman, transactions for recording and processing health insurance claims are mysterious ones that involve special billing codes for different procedures. While medical administrators still need to understand billing codes and the claims process, medical practice management software makes submitting claims much easier. With mundane but important tasks such as insurance claims and automated billing, medical administrators have time to thoroughly answer patient questions and attend to other client needs.

4.4 Reporting

Medical practice management software enables a greater level of transparency between medical staff, insurance companies and patients. Medical administrators compile informative reports drawn from raw data collected during the patient care process. Medical practice management software packages vary in the number of reporting features available (McNurlin; Sprague, 2004). For example, some practice management software has basic reports available for insurance companies and patients related to billing. Other software packages have customizable reporting capabilities that allow relevant stakeholders to quickly compile financial and other patient data into useful information.

5. Contribution of software in medicine

Medical errors can have a number of causes, ranging from people's cognitive limitations, to temporary lapses in knowledge and problems in healthcare workflow. Information technology has the potential to reduce medical errors by streamlining workflow and providing such features as automated alerts and reminders. Several studies have documented a reduction in adverse events, including unnecessary laboratory testing, drug-drug interactions, and transcription errors.

Such tasks are ideally suited to computerization, and it intuitively makes sense that designing appropriate computerized systems will lead to fewer adverse drug effects. Even so, systems and applications that have historically been considered a source of error reduction may actually lead to other latent types of errors when such systems are introduced. In some cases, they may contribute to higher and new total errors. These types of errors can be called technology-induced errors.

In order to use CDSS for health care, they must not only be factually accurate, but also designed in a way that will be reasonable and useful to users. As such, certain usability principles should be used in the design of CDSS. Usability is a quality attribute that refers to how easy something is to use. More specifically, it refers to how quickly people can learn to use something, how efficient they are while using it, how memorable it is, how error-prone it is, and how much users enjoy using it. If people can't or won't use a feature, it might as well not exist. Another definition states that usability can be broadly defined as the capacity of a system to enable users to perform their tasks safely, effectively, efficiently, and pleasantly.

Various cognitive approaches for evaluating the usability of health information systems have been developed based on ideas from cognitive engineering and usability. Methods typically borrow from an interdisciplinary perspective and draw from a number of fields including cognitive psychology, computer science, systems engineering, and the field of application engineering. Beginning in the 1990s, the emerging field of usability engineering began to apply scientific methods to this multidisciplinary approach in an effort to fully work out the complexities of human-computer interaction (Kušniruk; Patel, 2004; Dragićević et al., 2013).

4. Conclusions

Continuous improvement of health care is a top priority for developed countries. Thanks to the introduction of new information technologies, medical services are beginning to be provided to the population at a fundamentally new level. Software for medical institutions allows solving the issue of availability of medical care, providing it in a timely manner, prescribing correct and timely treatment. Moreover, the set of preventive measures provided by the software makes it possible to prevent the risk of disease or to prevent too frequent exacerbations.

We live in a truly amazing time where technology has allowed us to overcome barriers that were otherwise fantasy a few decades ago. Technological advances in the healthcare industry have allowed us to perform miracles. We created real-life cyborgs whose bodies are augmented by technologies. We've even gone further and introduced nanorobots into the bloodstream that deliver drugs to harmful target tissues.

You will agree that without technologies like artificial intelligence, such a level of innovation and sophistication would remain a pipe dream. Although artificial intelligence has been touted as a magic bullet for earlier disease detection, accurate imaging assessment, and affordable testing in multiple clinical areas, physician-patient interactions remain a touchy subject. Ultimately, doctors will have to strike a delicate balance between AI's potential for hospital management and maintaining close contact with their patients.

Although open source medical practice management software exists, each software package has its own unique design and user interface that is mostly proprietary. Developers have designed the systems to run on various configurations such as desktop, client-server, and Internet-connected systems. Any medical practice management software package must also be secure enough to comply with the Health Insurance Portability and Accountability Act and other statutes related to securing private information. Medical practice management software has positively changed the face of the medical front from a capricious experience to a professional process.

This study provides a framework for evaluating CDSS applications in a clinical setting and has identified specific areas for improvement in the applications used. Moreover, the numerous interface problems that can directly lead to adverse medical events identified in this relatively small sample give pause for thought about the potential for similar undocumented problems in other clinical applications currently in use or being developed for implementation. End users must request to be involved in rigorous testing of the healthcare CDSS prior to implementation.

Applying usability engineering principles can help identify interface problems that may lead to medical adverse events, and should be incorporated early in the design phase to ensure that such problems can be corrected while there is still time and it is cost-effective to do so. Such techniques should be widely applied to ensure that the systems we create do not inadvertently lead to medical errors.

6. Authors' Contributions

Laxmi Rathour: contribution to ideas, writing and research. *Dragan Obradovic*: contribution to ideas, writing and research. *Lakshmi Narayan Mishra*: study design, writing, research, corrections and creation. *Vishnu Narayan Mishra*: research, corrections, description of topics and submission and publication.

7. Conflicts of Interest

No conflicts of interest.

8. Ethics Approval

Not applicable.

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