DESIGN DEVELOPMENT OF MEDICINE MANAGEMENT SYSTEM FOR TELERADIOGRAPHY FIELD

Abstract. An electronic medical record of a patient is a part of any medical information system. The system allows you to monitor and manage information about patients in medical institutions. A medical program for evaluating results for both doctors and patients. At the same time, it is necessary to monitor the state of his health, be sure to identify diseases and carry out treatment. Due to the fact that there is a lot of information and additional business processes which must be used correctly and use the reduced use of working time without data loss. The solution to one of these problems is associated with the release of waste, as a result of which the design of a medical information system for maintaining electronic medical records of patients was developed. The proposed design of the application model provides a solution that consolidates all medical records, visits and reviews in one place, and also allows you to compare results over time. This allows patients to access their medical history in a convenient and secure format.

Keywords. Telemedicine system, electronic medical card, medical information system, health information system, telemedicine platform, remote medical registration, telemedicine application.

Introduction.

Everyday information technologies penetrate more and more into various spheres of human life and help to improve its quality. In case, the development of the computers and IT technologies in healthcare, a physician gets rid of the need to do what a computer can do for him for reason to improve for providing medical service. This saves the most important human resource where it is really necessary and need to be immediately – time and resources that can be spent on performing other important. In healthcare, time plays a crucial role, because a person’s life can be at stake. Therefore, the need for high-quality implementation of information technologies and digitalization of healthcare leaves no doubt. One of the technologies in the healthcare system that has been changed routine work is medical information system [1]. The medical information system consists of multiple functions. One of the parts is an electronic medical record for registration and maintenance patient’s information is an integral part of the healthcare platform. This is a medical document; without which it is impossible to imagine the normal functioning of the operation processes in a medical organization. The patient’s medical record contains detailed information about the patient, allows monitoring his health status, timely detection of diseases and treatment, even it could be remotely [1-2]. Due to the fact that there is a lot of information that needs to be stored and retrieved at the right time, this process takes up a significant part of the working time of medical workers. At the same time, there is a need to combine all data about the patient and his/her health into a single database, since in most cases they are dispersed across different medical institutions to which the patient applies [1-2].

The electronic medical record (EMR) of the patient is an integral part of any medical information system. It could help to face a convenient and understandable functionality for
storing and managing information about patients, even the patient and physician located in the distance. Medical information application designed for both doctors and patients. When they need to make an appointment with a specialist, they can share this data with him. One doctor has several patients. It’s not easy to keep paper records of everyone. Thus, to simplify the management of medical records, applications are needed to obtain medical records. This topic is also very relevant in Kazakhstan. Patients cannot carry all his notes, X-rays and appointments with them every time. When they move to another city, they may lose these sheets. These applications perfectly synchronize all data about the health status of users. In addition, it reduces the amount of paperwork [1-3].

According to information above, the goals of the paper is presentation new way of the design development of the medical information system for electronic patient's records to provide a solution that can combine all medical records, visits and reviews in one place and compare results over time. Moreover, this article is organized as follows. The next section presents the analysis of literature review according to selected topic of the research. Section 3 provides an overview of the methods and architectures used to implement medical information platforms. Section 5 includes conclusions from this study and suggestions for future work.

Materials and methods.

Since 20th century it could be seen the development of the contemporary medical record, which involved recording, organizing, and storing information about each patient, including clinical information [2]. Traditional paper medical records have significant issues with information loss, poor search ability, and lack of standards among doctors and healthcare organizations. As it has been evolving for a while, electronic medical records have consistently fallen well short of providing effective and individualized patient care. The Regenstre Institute in the US created the first electronic medical record (EMR) in 1972, which was hailed at the time as a significant development in medical practice [3]. The expense was a significant barrier to uptake, which resulted in the limited uptake. President Obama’s American Recovery and Reinvestment Act of 2009, which included incentives for EMR users, provided the crucial impetus [3]. Since then, a number of EMR programs have been created and are now readily accessible worldwide. Although the concept of computerizing patient medical information has existed for some time, it has only recently gained widespread acceptance. The handwritten notes, typed reports, and test results that made up a patient’s medical records before the invention of the electronic health record (EHR) were kept in a hardcopy file system. Fewer healthcare facilities now employ paper medical records. Electronic health records are increasingly being used [3-4].

The storage of patient’s information has been changed, and paper medical records are now obsolete. Patients relocate more frequently and switch doctors in a culture that is becoming more mobile, necessitating the transfer of their medical records from one doctor to the next. Furthermore, many patients no longer receive all of their care from a single general practitioner [5]. The capacity to communicate exam information between various specialists and testing institutions is necessary due to increased specialization and the development of new diagnostic and preventive medical techniques. Healthcare has been impacted by the Internet, one of the most powerful drivers for societal change in the last two decades [5].

In Kazakhstan's case, The Republic of Kazakhstan’s Ministry of Health is aiming to connect private health information systems with its own information system in order to swiftly and accurately create accounting and auditing documents, track and analyze data, and guarantee efficient management and diagnostic choices [6]. According to the official data there have been found. medical information systems, namely Avicenna MIS, Zhetysu MIS, MedStory MIS, and others were created by combining the IS of government agencies and the information systems of the Ministry of Health a year after it was discovered that in 2017 medical staff spent a significant amount of time on paperwork and scheduling appointments with patients [6].
The most significant benefits of EMRs include altering the conventional understanding of patient medical records, access types to those records, patient-physician relationships, patient privacy, lowering healthcare costs, minimizing medical mistakes, and assuring patient safety [7]. Additionally, it can give users access to resources like clinical decision support reports and reminders, which help teams and clinicians administer care based on the best available evidence [7]. EMR systems can also have electronic interfaces that make it easier to enter data into computers where health data is kept and shown in a variety of ways that are understandable. Furthermore, unlike the conventional health record system, other information formats, such as radiological images and echocardiographic video loops, can be integrated. Data can be utilized by administrators to create health-related policies for a population as well as by a single patient to direct care [8]. EMR improves the exchange and accessibility of health records among authorized parties. The requirement for the portability of patient data has also grown in importance. EMRs can also be accessed remotely. Legitimate users may access it via a secure network from anywhere, enabling them to take prompt choices. For example, authorized users can access it from their home, business, or emergency hospital. To implement the privacy rules required by the Health Insurance Portability and Accountability Act, the system can also offer the capabilities necessary to restrict and monitor access to patient information (HIPAA) [8].

The use of EMRs in healthcare institutions is being hampered by several issues. The key obstacles to the effective introduction of EMRs are administrative and governmental commitment, lack of infrastructure, and participation of healthcare providers [9-11]. Issues with privacy, security, the law, and the digital divide are further obstacles to the use of EHRs. Due to its personal nature, importance, and possible consequences if the data is used maliciously, health information privacy and security is receiving a lot of attention. When someone’s personally identifiable information, such as health information, is collected, disclosed, or used in a secondary way without their consent, their right to privacy is infringed. Securing patients’ electronic medical records is a difficult undertaking in the linked digital world [12-14]. To ensure patients’ and service providers’ trust in the use of EMRs, security of EMRs is of utmost significance. Security flaws in healthcare organizations may seriously harm both the institution and the patient. In the worst instance, unauthorized access to and purposeful alteration of patient medical information by an infiltrator might cause fatalities. Organizations must carefully consider the administrative and technological factors connected to the security of EHRs because of the significant repercussions associated with an EHR security breach [12]. The physical security of the whole network, from the central data storage to the numerous desktop and mobile devices used by employees throughout the firm, must be addressed in the security plan of the organization [12-14].

In case of the article research, it has been decided to analysis existing platform that has been deployed and working in Kazakhstan.

Results.
Analysis of existing system.
MedElement Medical Information Platform (Medelement.com) are "cloud"services and reference systems for doctors and medical organizations, medical students and everyone who cares about their health [15]. The goal of the MedElement project is to improve the quality of medical care and improve the health of the population (Figure 1).

There are notice for key advantages of the platform:
1) Access to information and web services from anywhere in the world - cloud data storage.
2) Easy communication between the clinic and the patient using convenient web services.
3) Extensive database of medical information collected on one platform.
From the strengths according SWOT analysis it could be noticed that the platform is user-friendly and intuitive interface that allows user to find the necessary information quickly and efficiently. The wide functionality of the platform, which allows user to make an appointment with a doctor, receive online consultations, order medications and diagnostic tests, as well as receive the results of tests and examinations. The presence of a mobile application that allows you to use the platform anywhere and at any time. It also has a high level of security and confidentiality of personal information. Providing API functions for integrating platform services with other information systems is good way for developing.

Going to the next point, the weakness is limited selection of doctors and medical institutions that are represented on the platform. This can be problematic for patients who are looking for specialized services or prefer specific doctors. Also, limited opportunities for online consultations. Although the platform provides an opportunity to receive online consultations, some diseases and problems require a personal examination and direct contact with a doctor. Insufficient response time to user requests to the support service. This can be a problem for patients who need urgent help or support. Noticing that some users may have difficulties using the platform, especially if they do not have experience with technology or access to high-speed Internet. Combination of different modules: this means different design and UI, UI system of pages, which can confuse the patient when using the site.

Another software that provide telemedicine technologies should be pointed is Damumeed application. The Damumeed product has been introduced in Kazakhstan, which interacts with public health organizations. DamuMed is a software that was created for residents of the Republic of Kazakhstan in order to gain access from mobile applications to certain medical centers, while it is possible to record attached patients to a district doctor, call a doctor remotely and other necessary assistance (Figure 2). This application was developed by Damu Information Technology Center LLP and is a web application, it is accessed via a web browser [16].

The points that should be pointed:
1. The Doctor’s Office module - allows to view patient data and make an appointment.
2. The module Prevention - allows to monitor routine examinations and screenings.
3. The module Patient’s Office - allows to make an appointment and call a doctor at home.
4. The module Situation Center - monitoring of information for the statistics of the organization’s work.
5. The Hospital module helps to organize the workplace of a medical worker, track the patient’s indications and various financial indicators.

Starting from the strengths parts it could been seen that the application has a simple and intuitive interface, which makes it accessible to a wide audience. The application provides the ability to track health indicators, such as blood pressure, pulse, blood oxygen levels and others, thanks to the use of sensors in the smartphone. Also, the application allows to save medical data in electronic form, such as medical history, test results and others. Moreover, the application provides consultation service with doctors online, which can be convenient for people who cannot visit a doctor in person or are away from medical institutions.

Figure 2 – Damumed medical platform

In other hand, the weaknesses are related with following statements. Firstly, it is low level of confidentiality. It means that storing medical data in electronic form may pose a risk to the confidentiality and security of this data. Secondly, errors may occur when measuring performance parameters when using smartphone sensors. In addition to the web application, Damumed offers software for stationary self-service terminals for self-appointment of a patient to a doctor. The only drawback, perhaps, due to the powerful functionality and monopoly position in the market, is the high cost of this software product that is no allowable to small medical organizations.

For designing the electronic medical system, the points mentioned above should discussed and mention in the developing system. For that reason, it could have followed that the technologies and model should face for point and requirements.

Design of EMR model.
The section provides explanation of the designing for EMR model. To ensure a robust and flexible application architecture, we reviewed and analyzed several existing applications operating in Kazakhstan. This analysis was carried out in the previous chapter. This system design model will easily extend to any existing telemedicine application, whether similar or not, and it ensures that there is no gap between the transfer of information from one telemedicine application to another. The architectural design ensures that there is no binding to the supplier of medical equipment and vendors. The following figure (Figure 4) presents the main users of the system and their relationships.

The use case diagram depicts the interactions and relationships between the actors and the system in the Telemedicine application. The system provides functionalities for Patients,
Doctors, and Moderators to perform various tasks. The following is a brief description of the use case diagram:

Actors:
- Patient: A person who uses the system to schedule appointments, view doctors and clinics, and access notifications.
- Doctor: A medical professional who uses the system to view patient schedules, create patient records, and manage their own schedule.
- Moderator: A person who oversees and manages the system by editing doctor schedules, upgrading the map, adding/editing clinics and medicaments, and viewing/editing the list of doctors and patients.

Use cases:
- Registration: Patients and Doctors can register to use the system by providing their details.
- Login: Patients and Doctors can log in to the system using their registered credentials.
- View and Edit Profile: Patients and Doctors can view and update their personal information.
- Access Notification: Patients can receive notifications related to their appointments, while Doctors can receive notifications related to their schedule.
- Search Doctors and Clinics: Patients can search for doctors and clinics based on various criteria such as location, specialization, and availability.
- Appointment: Patients can schedule appointments with doctors based on their availability and preferences.
- Write a Doctor Review: Patients can provide feedback and ratings based on their experience with a doctor.
- View Review: Doctors can view the feedback and ratings provided by their patients.
- Viewing Doctors Schedules: Doctors can view their own schedules to manage their appointments.
- Viewing Patient Schedules: Doctors can view their patients' schedules to manage their appointments.
- Create Patient Record: Doctors can create a medical record for their patients.
- Edit Schedule: Doctors and Moderators can edit schedules to manage appointments efficiently.
- View/Edit Doctor and Patient List: Moderators can view and edit the list of doctors and patients in the system.
- Add/Edit Medicaments: Moderators can add and edit the list of available medicaments in the system.
- Upgrade Map: Moderators can upgrade the map by adding new clinics and hospitals.
- Add/Edit Clinics: Moderators can add and edit clinic information in the system.

Use case diagram provides a visual representation of the system's functionalities and actors involved in a healthcare application. It highlights the various tasks performed by Patients, Doctors, and Moderators in the system and how they interact with the system. The diagram can be used as a reference for designing and implementing the healthcare application.

The ERD diagrams (Figure 4) show the basic design of the relationship between different users.

Figure 4 – ERD diagram of EMR system
The Model shows the following activities:

1) The "Doctor" table contains information about doctors, including their full name, specialization, work experience, phone number and contact with the relevant clinic through the clinic ID. This data allows you to manage information about doctors and provide the ability to perform the appropriate operations in the database.

2) The Clinic table contains information about clinics, including their unique identifier, name, address and work schedule. The connection with the "Doctor" table allows you to determine which doctors work in a particular clinic.

3) The Pharmacies table contains information about pharmacies, including their unique identifier, name, address and contact number. This data allows you to manage information about pharmacies.

4) The Medicines table store information about medicines, including their unique identifier, name, description and price. The table is linked to the Pharmacies section to keep track of which pharmacies have certain medications available.

5) The "Doctor's Schedule" table store information about the doctors' work schedule, including the record ID associated with a specific doctor, the day of the week, the start and end time of work. This data allows you to manage information about the work schedule of doctors and perform operations related to the appointment of doctors for certain days and time intervals.

6) The appointment table store information about patient appointment records, including the record ID, associated doctor, associated patient, date and time of appointment. This data allows you to manage information about appointments and perform operations related to making and managing an appointment, such as searching for an appointment by date or contacting the appropriate doctor and patient.

7) The "Patient" table allows you to store information about patients, including their unique identifier, full name, gender, date of birth, address and contact number.

8) The "Doctor's Record" table store information about medical records associated with specific doctors. It contains the ID of the record, the associated doctor, the associated patient, the date of creation of the record, the diagnosis and prescriptions written. This data allows you to manage information about medical records, perform communication operations with other tables, as well as provide documentation and tracking of information about patients and their treatment.

9) The "Reviews" table store information about patients' reviews of doctors. It contains the ID of the review, the associated doctor, the associated patient, the rating and the patient's comment. This data allows you to manage feedback information, analyze patient satisfaction, and provide feedback between patients and doctors.

10) The notification table store information about notifications sent to patients. It contains the notification ID, the associated patient, the text message, the date and time of sending and the status of reading the notification. This data allows you to manage information about notifications, track the history of sent messages and ensure timely communication with patients.

**Discussion.**

The development of a management system in the field of medicine has the potential to revolutionize healthcare delivery and improve patient outcomes. Such a system can bring numerous benefits, including streamlined processes, enhanced efficiency, and improved communication among healthcare providers. One of the key advantages of a management system in medicine is the automation and integration of various administrative tasks. This includes appointment scheduling, patient registration, electronic medical record keeping, billing and invoicing, inventory management, and reporting. By digitizing these processes, healthcare facilities can reduce paperwork, minimize errors, and increase operational efficiency.

Additionally, a well-designed management system can facilitate seamless communication and collaboration among healthcare professionals. It can enable the sharing of patient
information, test results, and treatment plans in real-time, ensuring that all members of the healthcare team are well-informed and can provide timely and coordinated care. This can lead to improved patient safety, reduced medical errors, and better patient outcomes.

However, the development of a management system in the field of medicine also presents challenges. It requires substantial investments in terms of technology infrastructure, software development, and training of healthcare professionals. Data privacy and security concerns must also be carefully addressed to protect patient information from unauthorized access or breaches.

Conclusion.

In conclusion, the development of a management system in the field of medicine holds great promise for improving healthcare delivery and patient outcomes. By automating administrative tasks, facilitating communication, and enabling data-driven decision-making, such a system can enhance operational efficiency, promote collaboration among healthcare professionals, and drive quality improvement initiatives. However, it is essential to address the associated challenges, such as resource allocation, training, and data security, to ensure the successful implementation and long-term sustainability of the management system. With careful planning, investment, and collaboration between technology providers and healthcare organizations, the development of a robust management system can contribute to the advancement of healthcare and ultimately benefit patients worldwide.

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ТЕЛЕМЕДИЦИНА УШІН ДӘРІЛЕРДІ БАСҚАРУ ЖҚУЙЕСІН ДАМЫТУ

Аннотация. Бұл ғылыми мақала пациенттің электронды медициналық картасы кез келген медициналық ақпараттың жұмыс істеуін болып табылады. Бул жүйе медициналық мекемелердегі науқастар туралы ақпаратты бақылауға және басқаруға мүмкіндік береді. Дәрігерлер мен пациенттер шешімдерді бағалуға бөлінген медициналық жүйелерге қатысты. Дәрігерлер мен пациенттер шешімдерді бағалуға бөлінген медициналық жүйелерге қатысты. Сондықтан, бұл мәселелер болуы маңызды, оны дұрыс пайдалану және жұмыс қуатын құрастыруға негізделеетін жүйеде оларға барлық функционалдық, барлық мақулдық құпейшіліктің жұмыс істеуін жеткіле алады.

Түйінді сөздер. Телемедицина жүйесі, электрондық медициналық карта, медициналық ақпараттық жүйе, денсаулық сақтаудың ақпараттық жүйесі, телемедицина платформасы, қашықтықтан медициналық тіркеу, телемедицина қосымшасы.
РАЗРАБОТКА СИСТЕМЫ УПРАВЛЕНИЯ ЛЕКАРСТВЕННЫМИ СРЕДСТВАМИ ДЛЯ ТЕЛЕМЕДИЦИНЫ

Аннотация. Электронная медицинская карта пациента является частью любой медицинской информационной системы. Эта система позволяет контролировать и управлять информацией о пациентах в медицинских учреждениях. Медицинская программа для оценки результатов как для врачей, так и для пациентов. При этом необходимо следить за состоянием своего здоровья, обязательно выявлять заболевания и проводить лечение. В связи с тем, что появляется большое количество информации и дополнительных бизнес-процессов, которые необходимо правильно использовать и использовать сокращенное использование рабочего времени, без потери данных. Решение одной из этих проблем связано с выделением отходов, в результате чего был разработан проект медицинской информационной системы для ведения электронных медицинских карт пациентов. Предложенный дизайн модели приложения обеспечивает решение, которое консолидирует все медицинские записи, посещения и отзывы в одном месте, а также позволяет сравнивать результаты с течением времени. Таким образом, пациенты получают доступ к своей истории болезни в удобном и безопасном формате.

Ключевые слова. Телемедицинская система, электронная медицинская карта, медицинская информационная система, информационная система здравоохранения, телемедицинская платформа, удаленная медицинская регистрация, телемедицинское приложение.