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ANALYSIS OF ICT SYSTEM IN THE DELIVERY HEALTH CARE SERVICE

Case of Kalevala Hospital

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Abstract of Thesis

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The objective of this research was to propose appropriate software to enhance doctors' performance. Furthermore, an important aspect of creating a unified database with electronic health records was discussed. Moreover, the study provides extensive information regarding the application of information systems in hospitals, hence creating the need to evaluate various ways in which the Russian healthcare system can be improved regarding records keeping. The research was performed at the case organization. The diffusion theory and qualitative research were the main methodologies throughout the work. The case companies' employees and patients were interviewed in order to get a better understanding of their requirements, preferences, expectations and suggestions to the new system. Received data was analysed and used in research.

As a result of the qualitative research, integrated with interviews, the researcher suggested few existing systems that the case organization could use in the future work. Moreover, the screenshots and technical decisions on the new system development were offered. The detailed description of the paper-based records transfer, database forming and application implementation, results and propositions for the future are documented in this thesis.

On the basis of the findings, it can be recommended that it is highly important to change the old hospital system and include the Information Technology in the work of the hospital. It can be concluded that the healthcare industry has experienced the spread of innovations aimed at increasing life expectancy, quality of life, diagnostic and treatment options, as well as the efficiency and cost-effectiveness of the health system. Therefore, Information Technology plays an important role in the innovation of health systems.

Key words Healthcare Information System, Electronic Health Records, Unified Medical Database, Personal Data, Automation of the Process, Decision-Making, Analysing

CONTENT

SYMBOLS AND ABBREVIATIONS

ANT Actor Network Theory

AMR Automated Medical Record

ASM Automatic Storage Management

CMR Computerized Medical Record

DSS Decision Support System

EMIAS Unified Medical Information and Analytical System

EMR Electronic Medical Record

EPR Electronic Patient Record

GEHR Good European Health Record

MIS Medical Information System

NPT Normalization Process Theory

OpenMRS Open Medical Record System

SaaS Software as Service

SynOM Synapses Object Model

TCO Total Cost of Ownership

VistA Veterans Affair

1 INTRODUCTION

The background information, the main topic, and motivation of this research are given. Moreover, the main objectives of the research are explained. Moreover, the structure of the thesis is presented.

1.1 Background Information and Motivation

In the past years, Electronic Health Records (hereinafter EHR) have been realized by growing number of hospitals worldwide. EHR systems have different forms, and this term can refer to a wide range of electronic information systems used in health care. EHR systems can be utilized in individual organizations, as a system of interacting in affiliated medical institutions, at regional or national level. Medical institutions that use EHRs include hospitals, pharmacies, general surgery practices, and other health care professionals.

The realization of the entire hospital EHR systems is a complex issue, which includes some organizational and technical factors, including human skills, culture, organizational structure, technical infrastructure, financial resources, and coordination. As Grimson (2001) maintain, implementation of information systems (hereinafter IS) in hospitals is more difficult in other places because of the difficulty of health data, data input problems, the issues of security and privacy, as well as a general lack of awareness of advantages of Information and Communications Technologies (hereinafter ICT). Boonstra and Govers (2009, 24), suggest three reasons why hospitals are different from many other industries, and these differences can affect EHR realizations. The first reason is that hospitals have several purposes, such as to treat and to care for patients, and training of new doctors and nurses. Second, hospitals have complex and very varied structures and processes. Third reason is that hospitals have the diverse workforce, including health care workers who have a high level of knowledge, power, and autonomy. These features justify the study, which focuses on identifying and analysing the results of previous studies on the implementation of electronic medical records in hospitals. (Boonstra & Govers 2009, 24-27.)

The general research area concerns the healthcare information system. In medicine, as in many other areas, there is a significant gap between science, practice, and education. The main reason for this situation is that scientific research is very slowly being introduced into the treatment process. It is information technologies that are effective in solving the existing problem. "Over the past several decades a wide variety of information technologies have been deployed within an ever increasingly variety of clinical and healthcare settings to streamline and modernize healthcare delivery" (Kushniruk 2009, 18).

One of the issues of modern medicine organization is that there is no cohesion. Patients can be registered in various medical institutions, having their own paper-based medical records, doctors not possessing full information concerning the patient, as it is stored in different places. The implementation of a common base of knowledge about the people who ask for professional medical help is of importance. Moreover, there is a problem of territorial distribution of laboratories and medical institutions that carry out tests or other procedures. This problem results in delays in the responsiveness of obtaining the required information both for patients and doctors. Therefore, the research focuses on the creation of a unified information base of patient's health records that is necessary today. It is shown that "in today's information-intensive society, consumers of healthcare need and want to be better informed of their health options and are therefore demanding easy access to relevant health information. Even so, the challenge lies in using various forms of it in the strategic and intelligent manner for supporting effective health-related decision making."(Beaver 2003, 10.)

My personal interest derives from my personal experience since I am a part of this system. Throughout my life, I have experienced the problem and the complexity of the work structure of the hospital. Doctors are wasting time when filling out patients health records, patients are wasting time queueing and at the same time, their health condition deteriorating. By doing this research, my aim is to create a system that encourages and facilitates easy access to health care services, as well as to health records. Considering the fact that health patients in Russia often undergo long procedures for them to get access to health care

services. The implementation of ICT system in the delivery health care services will not only make access to medical services easy but will save many lives.

Furthermore, ICT systems allow patients in the rural areas access professional medical services online. It has come to the time when medical services should be accessible to every individual despite their geographical location. It can be expected that the overall digitization of Russian's healthcare system will not only help the patients get better healthcare services but will enable healthcare practitioners to access the patients' medical history records.

Moreover, on 1 January 2016, according to the Federal State Statistics Service (2016), in Russia there were 146,544,710 permanent residents, and for example, in Kalevala, the town where I was born approximately 8000. This topic should be interesting and important to all citizens of the village, as they are the users of public health services, and quality of the service provided depends on the success of the prototype. The relevance for the case organization stems from the fact that doctors are interested in the automation of the process, as they will be able to spend the less time on paperwork and gathering information about the patient's health, and more time on the main job. This would increase the efficiency and productivity of doctors' work and their work of the whole hospital.

1.2 Scope and Objectives

The research focuses on studying an existing project of creating a healthcare information system in the Russian Federation. This research aims at developing the scheme of the interaction of all those participating in the provision of health services, setting goals that each of them pursues.

The scope of my work involves analysis of the healthcare information system. It includes analyses of existing unified healthcare information systems, its advantages, and disadvantages, the suggestion for the case organization. In Russia, the main medical document reflecting the state of the patient and the efficiency of health care is a medical card, which is stored in the hospital. The topic of the work involves such an important aspect, as the transformation of handwritten the paper-based medical records, i.e. patient records, in a

standardized electronic format, available for analysis. According to Shortliffe and Cimino (2006, 18), “It is important to change a way that healthcare information has been traditionally collected, retrieved and communicated. For example, hand-written paper-based medical records which have been the predominant form of recording patient and medical information for over a century. This includes difficulty in obtaining information stored in paper-based records, illegibility of handwritten notes and lack of ability to connect information in the paper-based record with relevant data being stored in the hospital”.

The relevance of creating a healthcare information system in the hospital today is due to the urgent necessity of using large and constantly growing volumes of information for decision making in diagnostic, therapeutic, statistical, administrative and other tasks. “With the rise in the acuity and complexity of patients, health professionals are increasingly becoming more reliant upon technology to aid patients in the process of recovering, recuperating and managing severe patient illness and disease” (Sandelowski, 2000, 149).

The main emphasis is on the study of the value of Unified Healthcare System in details. Moreover, the study is focused on the proposing system for the case organization, developing the scheme of an interaction of all those participating in the provision of health services, and setting goals that each of them pursues. The overall advantage of implementing a healthcare information system in the case organization is considered. The study is able to elaborate various software and IT systems that need to be installed to achieve the set objectives. In addition to this, the study extensively focuses on the ways in which a health care information system can help healthcare professionals perform their duties better. According to Balgrosky (2014, 11), Information Technologies can help doctors take care of patients more effectively in hospitals, clinics, and physician practices, and help people stay healthier and safer in their daily lives.

The main objective of this work is to propose appropriate software to enhance doctors’ performance. Moreover, an important aspect of creating the unified database with electronic health records was discussed.

The first outcome of my thesis work is analyses of the present situation of case organization and requirements for the system that they could apply for their

work. The study provides extensive information regarding the application of information systems in hospitals, hence creating the need to evaluate various ways in which the Russian healthcare system can be improved regarding records keeping. To gain a deep understanding of the problem, the application of computers and servers as record keeping tools are proposed.

The second objective of this study is to identify the most appropriate existed system that enables patients that seek online medical attention and moreover, review their medical records conveniently. The healthcare information system is analysed. Moreover, the analysis of an existing project of creating a healthcare information system in the Russian Federation is conducted. The recommendations are offered for the case organization for selecting appropriate computer technology approaches to enhance doctors' performance.

1.3 Thesis Structure

The thesis is divided into eight chapters. The background information and the motivation, the scope and objectives were outlined in this chapter. Research questions are explained and clarified in Chapter 2. Moreover, information about research methodology is presented. Chapter 3 introduces the general description of Medical Service in Russia. Further, operating project, present the situation in the case organization and its problems are scrutinized and discussed. Chapter 4 outlines Electronic Health Records and different models of it. The suggestion concerning transformation to electronic form is done. Moreover, the information about the influence of EHR on working process is presented. Chapter 5 gives knowledge about systems and tools, which are available today. Types of existing models and differences between them are defined. Examples and purposes for use are presented. Requirements and suggestion for a new system at Kalevala hospital are discussed in Chapter 6. Chapter 7 consists of the final output and example of the new system with figures and explanations. Chapter 8 presents the conclusions, results and suggests directions for further research.

2 RESEARCH QUESTIONS AND METHODOLOGY

This chapter is divided into two sections. The first section is focused on research questions. The second section presents research methodology.

2.1 Research Questions

In order to complete the research, it is necessary to study the following research questions (hereinafter RQ):

1. What is the general situation of the medical service in Russia?

The general situation of Russian medical service is analysed. Moreover, the case organization situation is analysed. These analyses enable to understand the main principles of the medical service in Russia. Furthermore, it covers the automation process of the case organization system, the issues of the existing system of case organization. Therefore, the solutions and recommendations were offered as a final output of this thesis work.

2. How can the paper-based patient history be converted into the electronic format?

This question is supported by the analyses of the existing systems, its advantages, and disadvantages, together with the requirements for the case hospital system. Reasons and benefits for applying one of the suggested systems were researched.

3. What exactly do patients want to receive from the health care system? What do doctors want to recieve from it? How is it possible to achieve this?

To start to do something, there is a need to determine the order, and how the system should work. The potential benefits of using ICT for different purposes at the case organization doctors' decision-making processes were evaluated.

4. What are the existing models that can be used for EHR and Healthcare system creation?

Answering this RQ requires analyses of different existing system and projects that are already presented on the market. Shortcomings of the systems are analysed for answering this question. These results should help the case organization to make correct decision on which system they will use and, furthermore, to guide for the further steps of new system's implementation.

2.2 Research Methodology

In consideration of the fact that this study looks into the adaptability and implementation process of the ICT system in the Russian healthcare system, the diffusion theory is used in my thesis work. Interviews were used to collect the data necessary for the requirements of the new system. Moreover, literature analysis was used to make the best choice from existing systems as well as to facilitate the requirements of a new user interface.

This thesis project can be considered as research and development (hereinafter R&D) activity, where the research component includes technical and user requirements analysis and studying possibilities of using this new system according to the requirements' specification. Accordingly, the development component includes development plans for the new system of the case organization.

The diffusion theory is used because it tends to explain why, how and at what particular rate new technology and ideas usually spread. According to Rogers (1995, 5), "Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas." Diffusion research centers under conditions that increase or decrease the probability that a new idea, product or practice will be adopted by members of a given culture. Diffusion theory predicts that the media, as well as interpersonal contacts, provide information and influence opinion and judgment. (Rogers 1995, 8.)

With regard to this, the various factors that influence the adoption of the new ICT system in Russia's healthcare system are evaluated. According to Rogers (1995, 10), some of the known factors that influence the adoption of innovation

are innovation, communication channels, time and social system. Furthermore, Diffusion research focuses on five elements. ”The first element relates to the characteristics of an innovation which may influence its adoption and, secondly, the decision-making process that happens when individuals consider adopting a new idea, product, or practice. These two elements are followed by a third element, the characteristics of the individual who might choose to make a decision to adopt an innovation. The consequences for individuals and society in adopting an innovation must be considered as the fourth element in the diffusion of a new idea. The last elements to consider are the communication channels used in the adoption process.” (Rogers 1995, 11-26.)

The practical part of the study entails the utilization of interviews as the survey instrument, whereby the medical practitioners and patients in the Russian healthcare system were the main respondents. In this case study, the information obtained from the patients’ and medical practitioners’ responses guide the work in identifying the effectiveness of having an ICT data system in Russia’s healthcare system. Moreover, it is an efficient way to collect relevant information from many respondents for the requirements of the user interface of new system according to the replies of the practitioners and patients.

The theory, i.e. the diffusion theory, is used to evaluate the application process and adaptability of the ICT data system in the healthcare system. Regarding the theory is used as an essential tool in the formulation of the questions in the interviews. The results that are obtained from the interviews are used to evaluate the credibility of the theory in this thesis work. The theory part of the work was therefore used to guide the study especially in evaluating the findings from the study.

Considering the fact that the work is based on analysing the application and use of ICT data systems in the Russian health care system, it is realized that the applicability of the system depends on adaptability rate at which the system is adopted by those involved in using it. With regards to this, a qualitative research method is effective in understanding the effect of the ICT data system in the delivery of healthcare services. There are a variety of methods of data collection in qualitative research, including observations, textual or visual

analysis and interviews. However, the most common methods used, particularly in healthcare research, are interviews and focus groups. (Britten 1999, 11-19.)

The data collected for this research helps to understand the significance of the ICT data system in the Russian healthcare system. It is through the interview process that the study is able to understand the applicability of the ICT systems in the Russian healthcare system. This was made possible through the understanding of the acceptability of the system by the patients, considering the fact that most individuals might not want their medical records to be made public. It is, therefore, important to understand how the system would be implemented, especially when it come to matters related to the delivery of healthcare services.

The research includes qualitative data from several interviews. According to Denscombe (2014, 184), “Research interviews are a method of data collection that uses people’s answers to researchers’ questions as their source of data.”

Britten (1999, 11-19) suggests that when designing an interview schedule it is extremely important to ask questions that are likely to get as much information about the phenomenon of research as possible and be able to address the goals and objectives of the study. In qualitative interviews, good questions should be open-ended, i.e. require more than a yes / no answer, neutral, sensitive and clear. It is usually best to start with the questions that participants can answer easily and then move on to more complex or sensitive issues. It may help to put respondents at ease, build up trust and mutual understanding, and often creates a wealth of data which subsequently develops further interview.

The duration of the interview differs depending on the subject, researcher, and participant. Nevertheless, the average health interviews last 20-60 minutes. Interviews can be done on a one-off or, if the change over time is of interest, recurring basis, for example, examining the psychological impact of oral trauma on participants and their subsequent experience in cosmetic dental surgery. (May 1991, 187-201.)

The interviews were created according to a relevant subject for an interviewee and have a semi-structured scenario. “Semi-structured interviews consist of several key questions that help to define the areas to be explored, but allows the interviewer or interviewee to diverge in order to pursue an idea or response in more detail. This interview format is used most frequently in healthcare, as it provides participants with some guidance on what to talk about, which many find helpful. The flexibility of this approach, particularly compared to structured interviews, moreover allows for the discovery or elaboration of information that is important to participants but may not have previously been thought of as pertinent by the research team.” (Stewart et al. 2006, 317-333.)

To get data about how the patients and doctors want to see the system these people were interviewed. With representatives from the case organization and patients, the researcher gets all necessary information about Healthcare Information System.

Using focus groups as a means of data collection helps to review the applicability of the new innovation in the healthcare system. The information collected through the data collection techniques help to understand the overall effect of having the ICT data system in the Russian healthcare system. ”Focus groups share many common features with less structured interviews, but there is more to them than merely collecting similar data from many participants at once. A focus group is a group discussion on a particular topic organised for research purposes. This discussion is guided, monitored and recorded by a researcher.” (Kitzinger 1994, 103-121.)

3 MEDICAL SERVICE: PRESENT SITUATION

The general idea and the understanding of the present situation of medical services are defined in this chapter. The Healthcare Value System, persons that are concerned in the health service, operating project in Russia and present situation at the case organisation are analysed. Additionally, health records and its role is analysed.

Due to the rapid development of Information Technologies in the country early or later, there is a problem of automation of various industries, including medical system. Today, both the developed and the developing countries are not any left a state that has not announced health care reform, but the reasons for increased attention to the health of citizens and goals that pursued reforms are different. For clarity, let me consider few examples of the problems that arise in different countries. According to Komarov (2008, 12), In the USA, regarding expensive private medicine, about 30% of the population does not receive regular medical care. In Europe, health care is 70% public, but citizens are forced to pay for health insurance more and more. (Amelina 2007, 3.)

Facts, in particular, medical statistics and demography, show similarities of problems faced by the health authorities in various countries, including Russia. Moreover, no matter how different social systems and health care reform are, all countries have one thing in common, the desire to reduce the cost of medical services while maintaining their quality and increasing the volume. (Kalyanina 2010, 2.)

Today, at the current number of doctors according to the information of the Federal State Statistics Service (2010), there are 4,3 physicians per 1000 people. Therefore, it is impossible to provide high-quality health care services within the system focused on inpatient care, i.e. on the treatment. The transition to an efficient universal medicine is possible only in the case where the medical services will be available to a wide range of people at the same time with changing the focus from clinical medicine to preventive methods and early diagnosis. One solution to this problem could serve as the creation of a health information system, which should be directed primarily to meet the needs of

users of the system, namely the country's citizens who apply for health services, and doctors, who provide them. Priorities of the state should be considered as minor problems. However, this approach is relevant only to the parallel development of the information infrastructure as a whole so that electronic services are available not only to residents of large cities but villages across the country.

On the concept of value system by Porter (1985), health policy and strategy makers will inevitably have to find some way to deliver more comprehensive services to meet the growing expectations and demand for maintaining the health, care, and treatment. There is a need for radical transformation of the healthcare delivery process, supported by and using of advanced information and communication technologies, as well as recognizing the reality of consumer influence. Health care systems are being developed to provide a complete package of services, focusing on health rather than assistance, as well as regarding citizens as clients, rather than only patients. Figure 1 shows a schematic model of the processes of health and healthcare, as depicted in the health system of values.

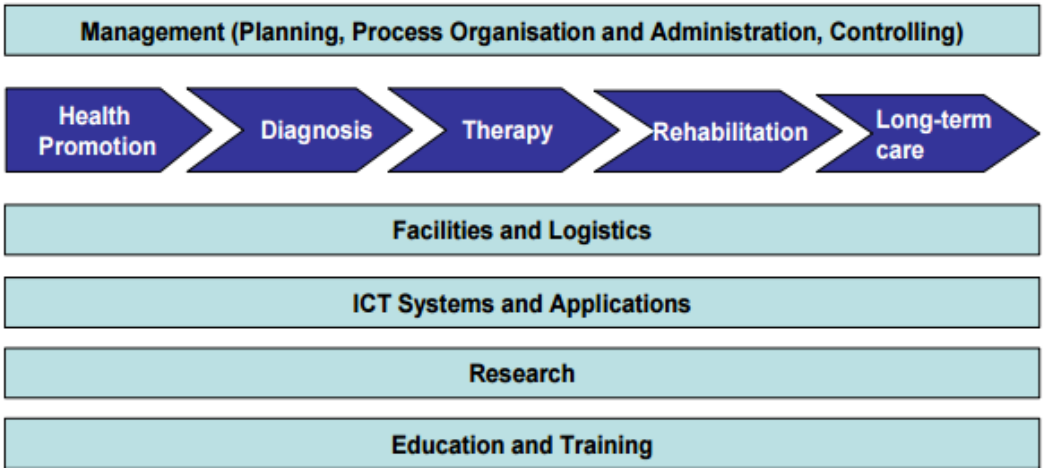


Figure 1. The Healthcare Value System (adopted from Dobrev 2008, 35)

In the center of the figure is the main generic service delivery system that consists of interconnected chains of individual health care service providers in health production from an economic point of view: health promotion, as well as the provision of health care and long-term care. This system is facilitated by supporting processes and tools, inevitably associated with the key processes.

As a system of interrelated processes, they effectively lead to healthy, or at least less sick, citizens.

The EHR system will not only improve processes along the core processes of health production but the relationship with all the supporting procedures, including the role of public health. This is why it is important to understand the structure of these relationships.

According to Dobrev et al. (2008, 35), promoting a healthy lifestyle, as the first element in the service delivery system, relates to the citizen in healthcare. Citizens must be given reliable materials to help themselves. This includes, for example, information on what people should do against bird flue or why the tetanus vaccination is important. It is the duty of public health in general, but of doctors and citizens themselves. Prevention of the disease is seen as part of promoting a healthy lifestyle.

From the Dobrev's et al. (2008, 35) point of view, the diagnosis is the act or process of identifying and determining the nature and cause of a disease or injury through assessment of patient history, examination, and laboratory analyses and other data, health information and knowledge. This activity is often shared between hospitals, general practitioners, and specialists, as well as laboratories.

Three different universal, but in reality, often overlapping forms of medical intervention may be followed by a diagnosis if treatment is called for. First of all, Therapy is a medical or other, for example, physiotherapy or nursing, treatment of disease understood here as acute, usually relatively short-term, often intensive treatment. Furthermore, rehabilitation is part of the recovery process to the good health of the patient, or useful life, but usually by the medium-term treatment. In opposite to therapy is often more focused on restoring or re-training of specific functions through the medium term intervention and learning. Lastly, Long-term care refers to the treatment of and cares for the chronically ill or people with disabilities, which are not expected to fully recover again, focusing on the provision of at least a certain level of quality of life and prevent or delay the worsening of the disease. (Dobrev et al. 2008, 36.)

According to Dobrev et al. (2008, 37), the difference between these three treatments is fluid and is related to the intensity and duration of care, age, and other factors. In addition to these processes, the patient's or directly health-oriented, there are important sub-processes in health care. Firstly, management, including administration, concerns the planning, organization, delivery and management of all health care and support services. Services and logistics related to the management of buildings and goods, procurement, and supply. In a more general sense, it is the task to ensure the right things at the right time in the right place. Secondly, research brings new or improved ways of promotion, diagnosis, or treatment. In this connection, it is an important tool for the change of the basic processes in the health sector. Finally, Education and training are strongly associated with the provision of medical care to the population. Moreover, for clinical and basic research. (Dobrev et al. 2008, 37.)

3.1 Medical Services: Persons Concerned

Provision of health services can be viewed as a system with related persons. Figure 2 shows persons that are concerned about the health service. There are the Ministry that is responsible for the formation of standards provision of health services, the structure that provides payment for medical services. Moreover, it includes medical institutions that provide services to citizens, and finally citizens, who are the main consumer of health care services.

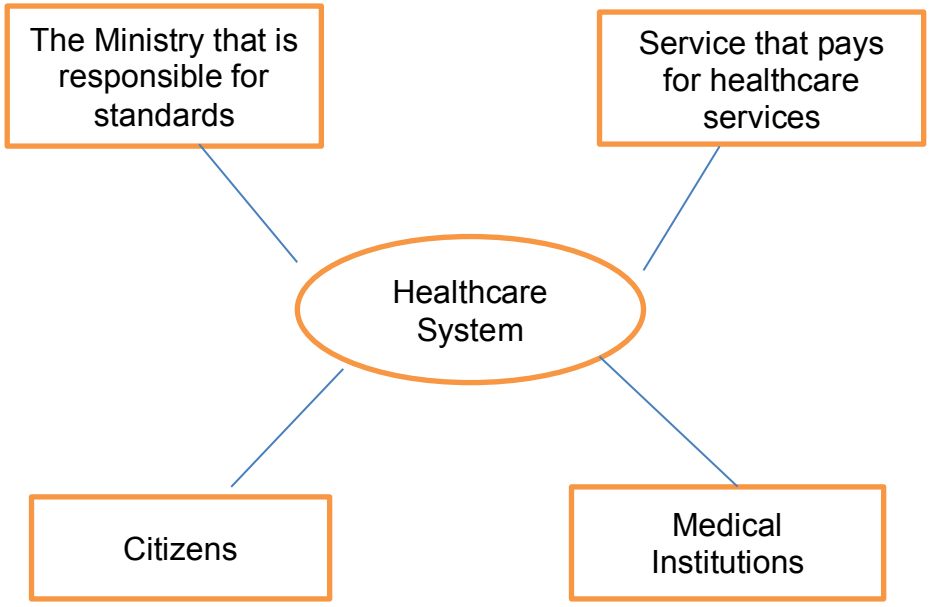


Figure 2. Medical Service: Persons Concerned

Dobrev et al. (2008, 16) claim that modern health care is focused on the most efficient use of scarce resources to balance the medical results, taking into account the needs of all stakeholders in the health care arena. Duties and interests of the various actors in the field of health care are varied. The doctor has interests that differ from those of the patient receiving the treatment. A hospital differs from a doctor's office. Health insurance negotiations for payment of medical services from physicians and their associations. Medical care depends on the data to establish the basis and transparency for balancing all the different needs and interests of these stakeholders.

To emphasize the role of access to information and exchange in the field of health, Figure 3 shows an attempt to compare the healthcare value system processes together with the main organizations involved. The purpose is to illustrate the complexity of the information streams: each of the institutions mentioned needs information from most other organizations, usually on several channels. All this does not even include all the details and data flow within each of these organizations.

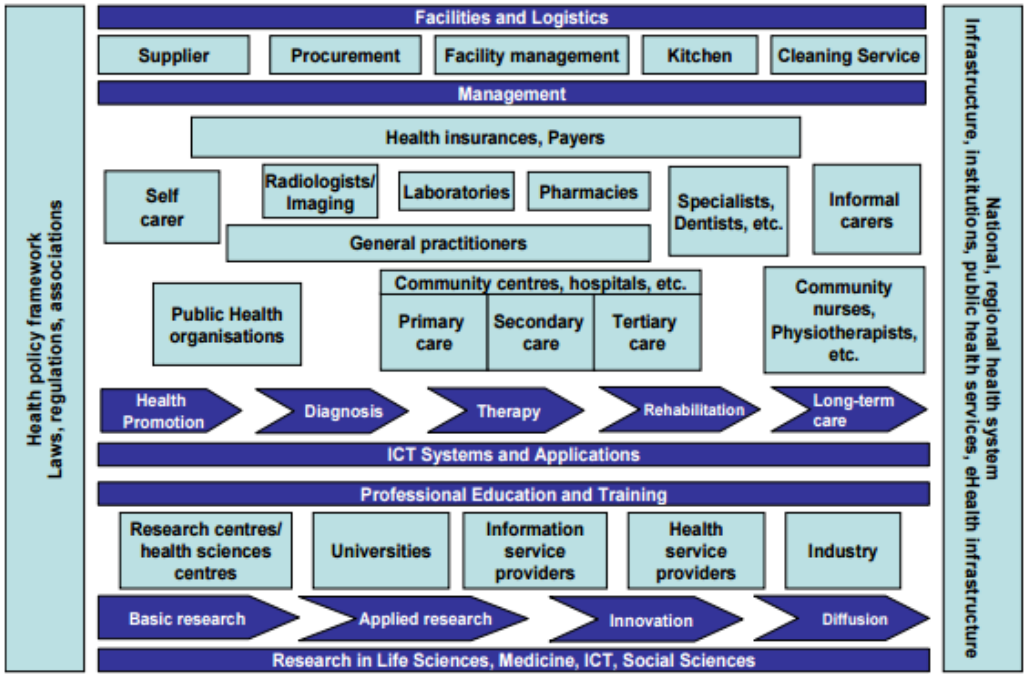


Figure 3. Mapping Processes to Organizations (adopted from Dobrev et al. 2008, 38)

Currently, it is not understandable how all these communication links can be maintained without the use of information and communication technologies, in particular, contemporary EHR systems. Nevertheless, for many centuries, it has always been communication, the exchange of data, information and knowledge, which is related to medicine and health care processes and actors. In recent years, the rapid changes in ICT, as well as the decisions based on them, have led to a new quality and scope of such exchanges and interactions.

3.2 Operating project in Russia

Let me consider the fundamental structure of services and the distribution of roles between the participants in the project for the creation of Medical Information System (hereinafter MIS) in the Russian Federation. Figure 4 presents the common model of roles distribution.

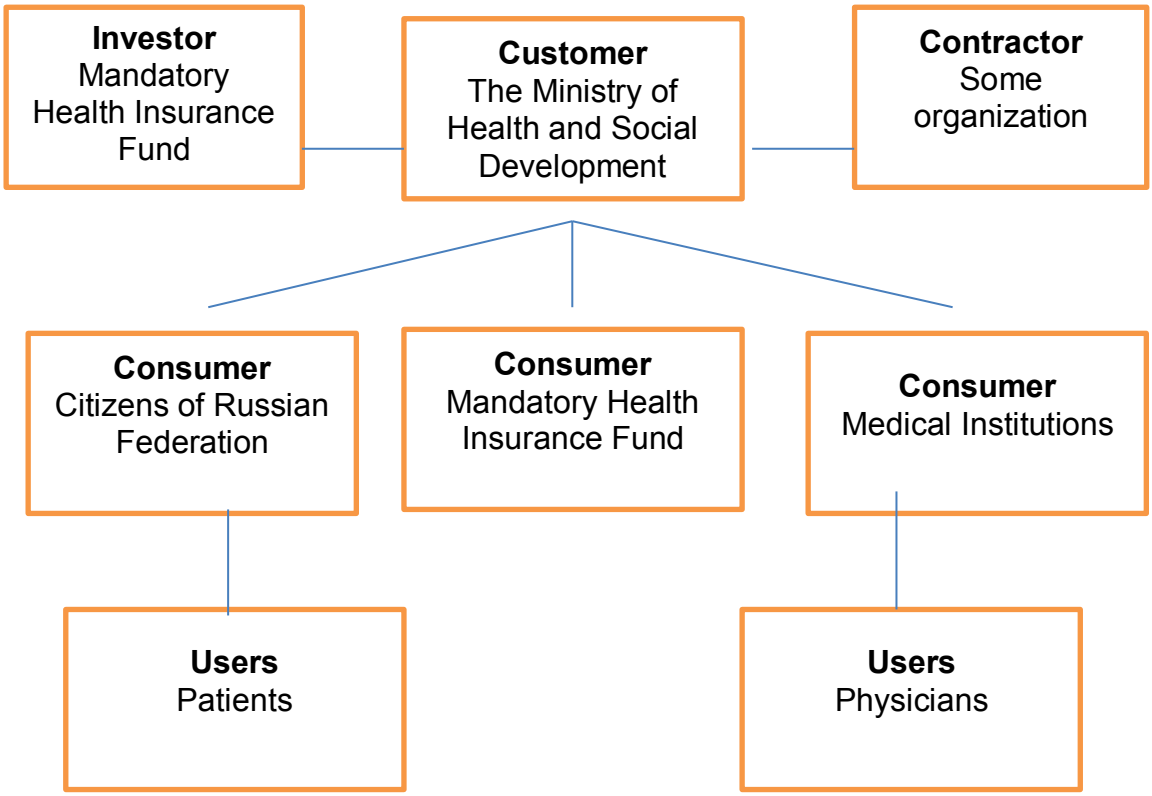


Figure 4. Common model of roles distribution

Getting healthcare in Russia is financed from taxes on citizens who have a right to a certain list of free services, provided by government institutions. The standards defined by the Health Ministry "About the organization the Ministry of Health and Social Development of the Russian Federation" (2008), work to develop the provision of certain types of orders according to profiles, healthcare, and medical care standards. The distribution of funds for the provision of services of tax controls Mandatory Health Insurance Fund. Finance distribution control is carried out by the state. On the role of a contractor was selected some Russian organization.

During examining the documents, which at the moment are in the open access to and relate to an existing project, the following potential problems that may arise during the implementation and use of the information system were made. The first one is provision of health services standards are developed by the state, there is no leverage that service users could impact on its creation; the second is the aging, a mandatory step in the life cycle of any project, it follows that modernization and renewal must be included in the project initially, which was not done. Finally, last but not the least step includes the development of documents and the concept. The development stage is no considered. There is no authority that would be responsible for maintaining the system up to date at all times during the life of the system. (Maickuban 2014.)

Until recently, there were not any automation in the Russian healthcare system. Maps, bulletins, procedural reports, records of patients, medications, i.e. all documents were produced on papers. This affects the speed, and hence the quality of patient service, complicated the work of the medical personnel, which led to medical errors, time-consuming to fill out medical cards and to report. This complicated management, i.e. lack of control of work units, the lack of operational and analytical data, and the work of regulatory authorities. At present, the substantial progress made in Russia to provide electronic medical services. At the same time, there is still a long way towards an integrated regional health informatization. (Maickuban 2014.)

Obviously, it is necessary to create integrated information resources of regional health systems, integrated solutions to ensure the security and protection of

personal data, the organization of interdepartmental interaction with the use of health information. Moreover, development of corporate portals and the widespread introduction of health facilities on the Internet contributes to the increasing role of information and communication technologies to the Russian healthcare system, both at the level of the whole country, and the scale of a given region. (Maickuban 2014.)

3.3 Present Situation in the Case Organization

To ensure access to health services for the population of the republic, improve the efficiency of health care organizations, the formation of uniform rules of patient appointment with doctors the operating procedure of medical institutions in the project of Electronic Registry was approved. This is a centralized flow management system in the provision of patient care in ambulatory, i.e. outpatient and inpatient settings. The hospital of Kalevala is connected to a single corporate network using a single Web portal, i.e. unified database. Moreover, the hospital has its own website, which was opened in the autumn of 2011.

For timely outpatient care patients can choose one of the methods for making an appointment. They can make an appointment through the website or by phone. Directly at the appointment doctor can make re-appointment of a patient, make an appointment with a specialist for diagnostic procedures and electronic check-direction for consultative appointment in other medical organization, hospitalization in a specialized institution. By the regional programs of state guarantees, the waiting time of patients planned medical care in a specialized institution is 14 days in a clinic, and 30 days in the hospital.

The purpose of innovation is to improve access to healthcare. The introduction of a new system of working with patients allows unloading and updating the registration of patients at the appointment.

3.4 Issues of the System

Despite the presence of a significant number of developed solutions in this area at the moment on the territory of Russian Federation does not introduce a single

MIS, fully meeting the requirements of centralized storage and processing of information about the processes of clinics and hospitals function. Considering the health information system in Kalevala hospital, it is seen that it only automates the process of appointment. It does not optimize the time spent on the reception. The information system should be unified and it should allow citizens to make an appointment without reference to their place of residence, thereby realizing the constitutional rights. This solves some problems, taking into account the services rendered to individual doctor and pay for these services.

Automation of existing processes will not achieve the desired efficiency. The system has many problems, one of them, when the person makes an appointment, he still needs to wait more time, because the order and the appointments are moving and finally, patients will have an appointment when the doctor finishes all the paperwork of the previous patients. There is always a big queue at the hospital because people prefer to come to the hospital and make an appointment than to use the system of the Web portal that is not working properly. When the patient come to the hospital, he or she needs to wait when the hospital worker finds patients' health records card, and fill in the records, then make an appointment. It doesn't mean that patient will have an appointment on that day when he or she comes, it could be tomorrow or next week. This is a big problem for people who live far from the hospital or for the old people.

Picture 1. Queue at the hospital

Picture 2. Storage of patients' health records

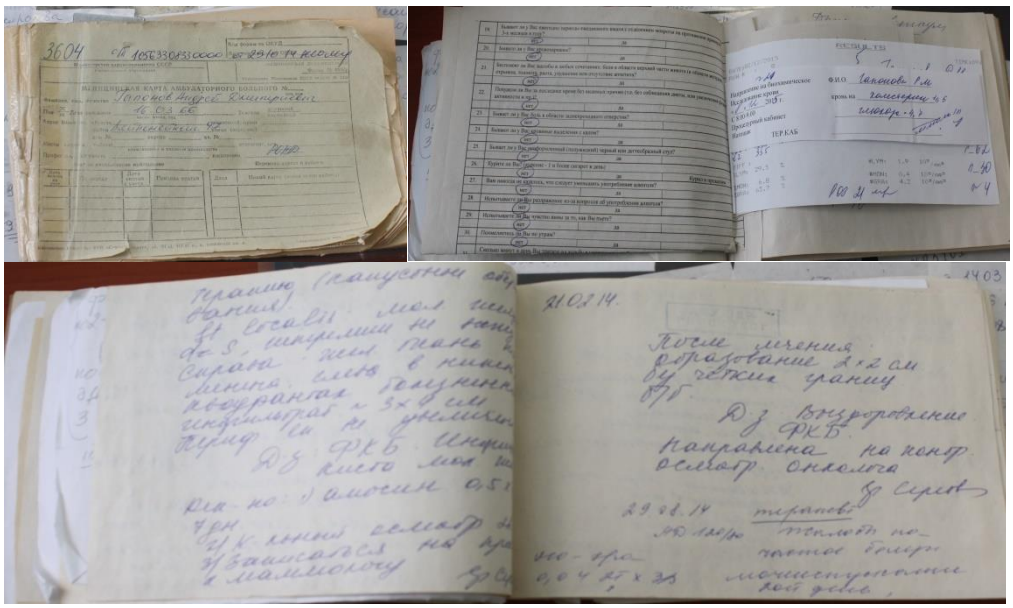
3.5 Paper-based Health Records

Medical records is a historical record, revealing the processes of treatment, which is covered by a long-term monitoring of patients. This is the certain system of records, made by medical professionals, who carry out diagnostics and assigned therapeutic methods.

The second meaning of medical records is a standard document in the form of cards inpatient or outpatient. Here is taken into consideration only the period when the patient was treated at the medical facility.

In this document are introduced the basic information about the patient, such as name, a total number of years, profession, marital status, information about all diseases, the results of all tests and examinations and all the stages of the patient's treatment. Moreover, this document has financial significance and validity.

The history of the disease is presented in the paper. The main idea of doing such a document is an effective treatment of the patient, so the history record diagnosis, monitoring, information about prescribed medicines. In the history of the disease can be found the past of the patient, all this supposed to help medical staff to see a full picture of diseases and to provide quality health care to the patient, consistent with other doctors. Therefore, all health care workers, faced with the treatment of a patient is required to record their recommendations, action, a condition of the patient at different periods in the history of the disease.



Picture 3. Extract from a patient medication sheet

3.6 The Role of the Health Records

Working with documents is the very important process in the activities of each doctor. Medical history not only shows the level of treatment and diagnostic skill of the doctor, but a bit characterizes the institution itself. Filling the medical history always raises the doctor a sense of responsibility for the health of the patient, as well as the responsibility of all remedial measures and recommendations**.** The history of the disease is a mandatory document, which carries a great legal significance, as used in investigations revealing criminal activity against human life or causing heavy damage to health. Thanks to recordings made a doctor, many things become clear, for example, the type of damage, and the time of inflicting grievous bodily harm.

The system in our hospital is outdated and need to be changed. Therefore, currently, Russian Ministry of Health implemented a project to create a unified state information system in health care throughout the country. An important component of this project is to support Electronic Health Records System.

4 ELECTRONIC HEALTH RECORDS

The general idea of EHR is defined in this chapter. Advantages of the EHR systems, key capabilities are analysed. Moreover, the ways of transferring paper-based records are explained.

According to Garets and Davis (2005, 1), EHRs are repositories of electronically stored information about the status of individuals' lifelong health care. The way they are stored they can serve some legitimate accounts.

Research by Eichelberg et al. (2006) illustrated that the EHR must contain information such as observations, laboratory results, reports of diagnostic imaging, treatments, therapies, drugs administered, patient identification information, legal permission and allergies. This information is stored in different proprietary formats through a variety of medical information systems available on the market. Create interoperable EHRs will contribute to more effective and efficient care for patients by facilitating the search and processing of medical information about a patient from different sites. The transfer of patient information automatically between sites of care will accelerate delivery and reduce the number of repeat tests and prescribe. Automatic reminders will improve productivity, reduce errors and benefit patient care. (Eichelberg et al. 2006.)

Over the past 30 years, widespread adoption of EHRs was considered inevitable, as predicted by the diffusion of a theory of innovation. The observation that the absorption was uneven across various countries suggests a more complex situation where the most complex ideas, such as the theory of the process of normalization (hereinafter NPT) or the Actor-Network Theory (hereinafter ANT), must be considered. (May et al. 2009, 4.)

NPT is considering the way that the material practice, for example, computers use in the clinical setting, becomes a part of everyday practice as a result of individual and group decision-making and behavior. These changes have produced some social mechanisms described by the supporters of the theory, as well as sensory solutions work, work interaction, i.e. cognitive engagement,

the work of adopting practices as well as the work of understanding and assessing its effects, i.e. reflexive monitoring. (May et al. 2009, 4.)

ANT argues that this role inanimate objects, such as computers, games in social processes are so significant that they must be considered as part of the entire system, rather than an external force. The contribution of ANT to orientating studies into EHR design, implementation, and use of primary health care emphasize interrelatedness. (Cresswell et al. 2010, 10.)

Competently implemented electronic medical history greatly facilitates the work of medical personnel, removes doctors from the routine paperwork, reduces the number of medical errors, improve the quality of medical care at the expense of the rich expertise and analytical capabilities. Moreover, it increases the trust of patients to the hospital, i.e. the doctor can print the survey results, recommendations, medicinal purposes, an extract from the patient card and these documents patient will be able to read. According to Shortliffe and Cimino (2006, 18), “It is important to change a way that healthcare information has been traditionally collected, retrieved and communicated. For example, handwritten paper-based medical records which have been the predominant form of recording patient and medical information for over a century. This includes difficulty in obtaining information stored in paper-based records, illegibility of handwritten notes and lack of ability to connect information in the paper-based record with relevant data being stored in the hospital”.

In Russia, during the discussion of issues related to electronic health records, often rely on international standards and experience that exists in the international practice. However, in my opinion, the problem of the transition from a paper-based medical records method to the electronic is not fully solved anywhere in the world. A variety of international standards, often competing with each other, for example, the HL7 version 2 and 3, as well as the failure of some major European projects, for example, in the UK suggests that the problem of the electronic medical record is far from being resolved. It is highly important to emphasize that the issue of electronic health records has very big national characteristics and is closely related to the peculiarities of the health system in

the particular country. Therefore, to talk about any direct transfer of the experience of other countries is not necessary. (Kalyanina 2010, 10-12.)

The use of computer technology allows creating an electronic model of an object, such as medical records of the patient in the interests of different users and for different purposes. Ideally, such a model should suit to all interested parties, and improve the quality of patients' health management processes. However, it is obvious that to solve all the issues at once is impossible. The development should be done by some stages. (Kalyanina 2010, 10-12.)

According to Kalyanina (2010, 12—22), it seems that the first step should be the function of gathering and initial processing of information about the patient in the interest of the attending physician, medical consultant, and nursing staff. The use of computer systems built by local networks with specialized database management systems (hereinafter DBMS), can dramatically improve some indicators of quality of database, such as the accuracy, relevance, internal consistency, completeness, ease of use, a speed of search and access to information. However, the level of development should be such that to get a real relief of work. Otherwise, the implementation of the system, which does not provide benefits to employees, will meet their rejection and direct resistance. This phase requires a significant capital investment in the creation of a fast local network, assembling a sufficient number of jobs, the installation of a powerful server, purchase, commissioning and organization of services for complex and expensive system and application software, including server operating systems, databases. The next stage is the automation of the collection consolidated analytical information for firstly, the administration of the institution, secondly, health authorities, and lastly, for health insurance funds. At the same time, development of a model of the institution work will allow making a prediction of its work with the assessment of the quality of the planned management decisions.

The third stage is the creation of a knowledge base and the development of expert systems that allow, on the one hand, help the doctor to develop the optimal strategy in the conduct of the patient, on the other to analyse the

completeness of the necessary measures for a particular diagnosis. (Kalyanina 2010, 12-22.)

Currently, the Ministry of Health developed the requirements for creating "Standard protocols for patients" (1999, №303), work on the formation of such protocols goes across the country. This gives hope that on the market in the foreseeable future will appear software systems, allowing using this knowledge in real-world clinical situations. During this period, at each stage, it is desirable to provide the medical staff an opportunity to obtain information not only from the health records history or hospital departments, but to use the information capacity of the Internet, telemedicine technology, e-mail. (Kalyanina 2010, 10-22.)

The information can be as simple as a reminder of the medication to the patient or as complex as diagnostic support to physicians with the condition of specific sets of clinical guidelines. Accurate recording and retrieval of data are required for the proper continuity of care, especially when it comes to another provider or specialist in a different network. Proper documentation templates and properly recorded clinical notes in the EHR system are central to the information quality and, in turn, the quality of care.

4.1 Adavntages of the Electronic Health Records System

By the Jonathan (2006), one study estimates that its electronic health records system can increase overall efficiency by 6% per year, and the monthly cost of the EHR may be offset by the cost of only a few unnecessary tests or hospitalization. (Jonathan 2006.)

Handwritten paper medical records can be poorly legible, which can contribute to medical errors. Boumstein (2013) maintains that pre-printed forms, the standardization of reductions and standards for calligraphy were encouraged to enhance the reliability of paper medical records.

Moreover, by the EMR Software Information Exchange (2001), Electronic Records can help in the standardization of forms, terminology and data entry.

Digitization of forms facilitates the data collection for epidemiology and clinical research.

EHRs can be continuously updated. If the possibility of the exchange of records between different EMR systems were improved, interoperability would facilitate the coordination of medical care in non-affiliated hospitals. Moreover, data from the electronic system can be used anonymously for statistical reporting in matters such as improvement of the quality, management of resources and public health communicable disease surveillance.

4.2 Key Capabilities of an EHR

Summing up the results, to make EHR implementation and operation successful, the system must meet certain requirements. The Institute of Medicine in its Report “Key Capabilities of an Electronic Health Record System” (2003, 7) identified a set of 8 basic delivery functions of care that electronic health record systems should be able to carry out to promote the safety, quality, and efficiency of health care delivery.

The first function includes health information and data.Direct access to key information, such as patient's diagnoses, allergies, lab test results, as well as medicines will improve educators' ability to make informed clinical decisions promptly.

The second one, result management. The possibility for all providers involved in the care of a patient in a variety of settings to quickly access new and past test results will improve patient safety and treatment efficacy.

The third function is order management. The possibility to enter and maintain orders for prescriptions, tests, and other services in the computer system need to improve intelligibility, reduce duplication, and improve the speed with which orders are performed.

The next one concerns decision support. Using reminders, tips, and alerts, automated decision support systems will improve compliance with best clinical practices, provide regular screenings and other preventive methods, identify potential drug interactions, and promote diagnosis and treatment.

The fourth function is electronic communication and connectivity. Effective, secure, and easily accessible communication among providers and patients will improve the continuity of care, improve the timeliness of diagnosis and treatment, as well as reduce the incidence of side effects.

Patient support is the next function. Tools that provide patients access to their medical records give interactive patient education and help them to carry out home monitoring and self-control can improve the control of chronic diseases, such as diabetes.

The following important function is administrative processes. Computerized control tools, such as the planning system, will greatly improve the efficiency of hospitals and clinics, and provide more timely care for patients.

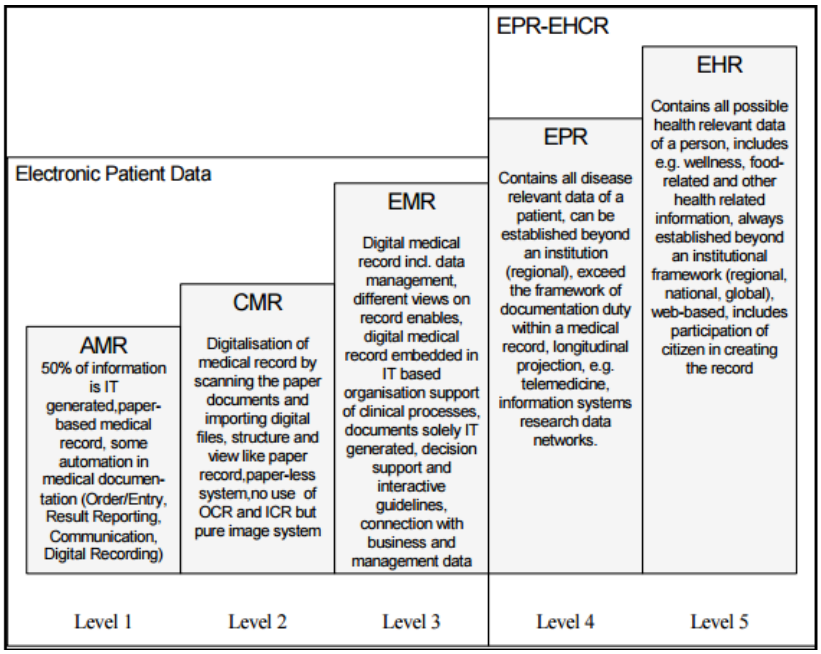
Reporting is the last function. An electronic data warehouse that uses common data standards will enable healthcare organizations to more quickly respond to federal, state and private reporting requirements, including those that support patient safety and surveillance of infectious diseases.

EHR record is the most important component of the health information system, as the most hospital staff works with it and all the medical documentation forms there. Moreover, the quality of assistance provided to the patient depends on of the quality of this electronic medical history.

4.3 Transferring medical paper-based records in the Healthcare Information System

Edwards (2007) argues in his research that “With the advent of electronic versions of health records, a lot of abbreviations were used to reference and classify the various types of electronic health records." The definitions have often been disputed or uncertain, and therefore abbreviations were used improperly and inconsistently.

Table 1. Five Levels of HER (adopted from Waegemann 2003)



Waegemann (2003) distinguishes 5 levels of EHCRs from the lowest to the highest level of difficulty, presented in Table 1, which includes Automated Medical Record (hereinafter AMR), Computerized Medical Records (hereinafter CMR), Electronic Medical Records (hereinafter EMR), Electronic Patient Records (hereinafter EPR) and Electronic Health Records (hereinafter EHR).

After analysing the theoretical models and different EHR, I suggest the next way of transformation paper-based records to the electronic view. Under the electronic view of records, I mean nothing more than a cloud of federal unified health information system, for the financing of which our state has allocated several tens of billions of rubles.

The first step is to transfer medical records data into electronic form by scanning in simply unrecognized image format. This task is realized by relatively small efforts.

An approximate calculation of the cost of digitization of data was made. A number of patients are 8 000. The average size of the medical record card is 100 sheets. Relatively inexpensive solutions can be high-speed scanners, which speed up to 60 pages per minute. High qualification of the user is not required to scan. Totally, it is needed to scan 800 000 pages.

The next formula was performed, as follows:

Time digitizing = number of sheets / scan speed / number of minutes in an hour / hours per day = 800000/60/60/8 = 27 person-days.

If the data digitization involved five people, for example, who work at the reception of the hospital, the digitization of the hospital with 8 000 patients will spend five and a half days, which is an acceptable time. The second stage of digitization is to recognize text contained in the patient's paper-based medical card.

Approaches to text recognition can be, as follows:

- Cost method is text recognition by a person with competence and rights in drawing up such documents
- The Simplified method is the use of technology reCAPTCHA, i.e. Completely Automated Public Turing test to tell Computers and Humans Apart.

The third step is normalization of the digitized data. This step can be performed only by doctors have the knowledge and rights to drawing up such documents. The aim is to spread the recognized or unrecognized data in the system, adhering to the directories and arranging in a certain structure. The work is very big and its solution will take time. The possible solution as one of the ways to solve represented in the figure.

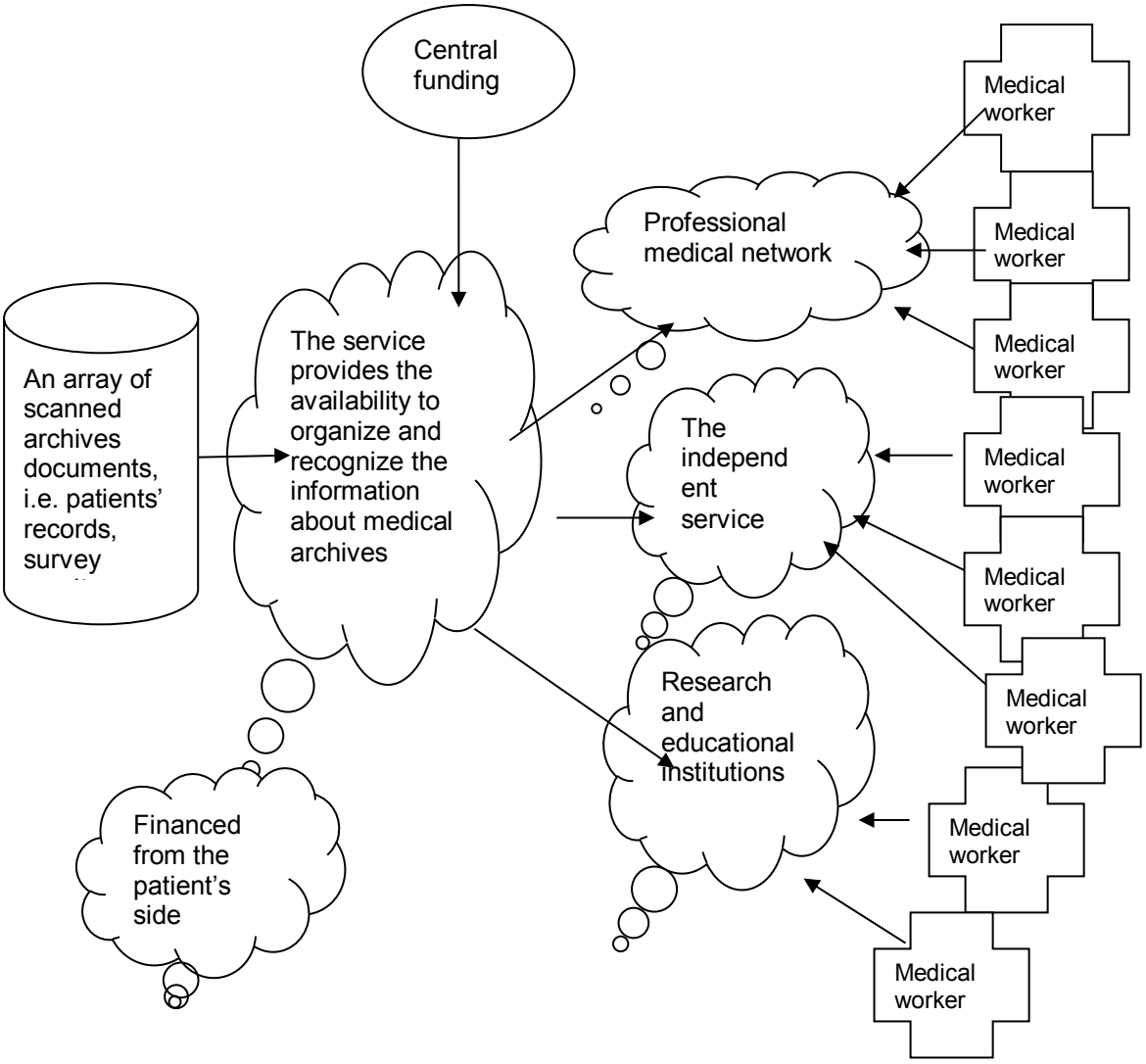


Figure 5. Data transfer scheme

First of all, medical records scanned files attached to electronic cards of patients. Then, an array of medical records, requiring processing is published in specialized communities. The next step is access and the right to change cards only have committed medical workers with the digital signature and registered in the system. Moreover, for setting the card in the processing, the queue must be received funding for this card. The next important aspect is that funding may be centralized, such as for all of the cards or user can pay for individual card processing. Lastly, the physician performing the work on the structuring of the information in the card is paid and signed by the result with its digital signature.

It is important to create an open recognition service of medical records. For the users who have unrecognized data in electronic medical records and health

workers who are eligible for verification and validation of patient data. Each data recognition operation is confirmed by the electronic digital signature of a doctor. Such service may be published in the medical Internet community, a professional network of physicians, either as an independent service

Funding for this operation is possible in several ways. For example, the federal and regional budgets, funds, investors. Moreover, patient who wants to recognize his medical data card out of turn, or in the absence of another financing.

For the recognition of a single card is declared a reward that receives a medical worker who performed the work and signed by its electronic signature. Therefore, there is a large distributed network of employees, ensuring safety, reliability, and responsibility for quality.

5 EXISTING MODELS OF EHR AND HEALTHCARE SYSTEMS

The existing models of EHR and healthcare systems are analysed in this chapter. This gives a possibility for the case organization to choose appropriate system for their hospital.

After analysing research about the framework for electronic health systems, according to Bisbal and Berry (2009, 6), EHR systems and projects that have had a significant impact on the field of EHR and this section describes it. Moreover, in general, the list is representative of the most common solutions which EHR projects are probably to make and illustrates the possibilities and limitations of the resulting system provided in industrialized countries in the health care context.

5.1 GEHR

The Good European Health Record (hereinafter GEHR) was the first major European Union (hereinafter EU) co-financed project specifically focused on the problems associated with the development of EHR systems. It produced a complete analysis of the requirements for this system, and developed an electronic health record system based on the unified model approach.

It followed a consolidated approach. As a result, on a very large data model, which was, simultaneously, necessarily bounded in scope and adaptability due to difficulty of the health sector, which is characterized by many different views and objectives in the perception of all stakeholders. (Bisbal and Berry 2009, 6.)

5.2 Synapses

Synapses was an EU-funded project too. It offered a basic data model for EHR system's on a very limited number of sustainable and abstract concepts, which were referred to as the Synapses Object Model (hereinafter SynOM).

Synapses based EHR was initially developed as a federated EHR system. One class in the SynOM described how client can access the relevant clinical data of original sources, for example, relational databases, personal information, which will be incomporated into a patient's EHR. Some implementations approach of

the Synapses exploited this construction principle in such a way that the system can be used without changing the basic databases. Therefore, EHR can be implemented in a health care organization with minimal damage to its daily activities. (Bisbal and Berry 2009, 7.)

5.3 OpenEHR

The OpenEHR foundation was established by scientific and industrial partners with expertise in GEHR and Synapses, as well as in the commercial sphere of EHR. It has established a set of EHR system specifications, and is now developing reference realization, for instance, Java, NET.

OpenEHR follows a two-level approach to modelling. The first level is analogous to the SynOM, described earlier, and is mentioned to as the reference model. The second level has been inspired by the SynOd, described earlier too, and it is called as Archetypes. However, archetypes comprise cardinality and cost constraints, in addition to the aggregation limits used in Synapses, in order to determine when archetype is an acceptable copy of the reference model. In addition, archetypes are intended to describe clinical concepts. They are not intended to describe the organization full view of the patient's EHR, as it was originally conceived by the project of Synapses, when it defined the concept of the SynOD. (Bisbal and Berry 2009, 7.)

5.4 VistA

The US Department of Veterans Affairs hospital information system, known as the VISTA, is one of the largest nation-wide support for the implementation of medical system solutions in the world that offers the functionality of EHR. Its development began in the late 1970s, and by 2002 were established in 163 hospitals, 800 clinics, and 136 nursing homes. (Bisbal and Berry 2009, 7.)

VISTA is accepted by multiple organizations around the world. Despite the undoubted success of this set of applications, it can not be easily exported to other types of organizations. It is its own decision based on a unified model approach and each node operates its own data for lowing a consolidated approach. Interoperability was not a requirement of design in

the 1970s, and therefore, it is possible only on the human, i.e. functional level.

Semantic compatibility is not possible even between sites that work the same VISTA set up. Compatibility is difficult by the lack of standardized terminologies, data models and clearly defined concepts. Even if semantic compatibility is achieved between VISTA installations, its constructive principles will restrict the compatibility with other systems. (Bisbal and Berry 2009, 7.)

5.5 Health Infoway

Health Infoway is a very enthusiastic program by the Canadian federal government, established in 2001, with $ 10 billion estimated investment by the end of the program (2014), directed to accelerate the development and implementation of electronic medical records systems.

Its strategy for financing is organized into ten different investment programs, for example, interoperable EHR, infrustructure, patient access to quality health care in order to stimulate innovation. Despite being quite good initiative in facilitating the transfer of technology into clinical practice, its objectives and the results were not to make a significant contribution to the concepts, methods, paradigms and challenges in the field of EHR, compared with the projects described earlier. (Bisbal and Berry 2009, 7.)

5.6 Connecting for Health

Connecting for Health is a Health Record System of United Kingdom initiative with comparable objectives as the Health Infoway. It is organized into several main programs, namely secure broadband, associated patient records, digital images, as well as secure mail.

Special attention is paid to the general practitioners needs and ICT infrastructure, in contrast to the entire health care system. As is the case for Health Infoway, the aim of Health Connection is not the modern state in the

field of medical systems. As opposed, it is aimed at the adaptation of current knowledge and technologies in clinical practice. (Bisbal and Berry 2009, 7.)

5.7 Personal Health Record Project

Some projects have been initiated in the last decade in order to encourage the involvement of patients in their own health. Personal health record (hereinafter PHR) allows patients to access their own records of health. This is still a very progressive field of research, from the perspective of the most suitable technological architecture, the role of the patient, safety, confidentiality, ethical issues.

The business model for the system of this type is still unclear. Some of these are designed and arranged in hospitals, while the other are neutral institution. Remarkable new players in the field, as the Microsoft HealthVault, Google Health, introduce additional opportunities in terms of business models and privacy. (Bisbal and Berry 2009, 8.)

5.8 OpenMRS

A number of initiatives to open source are following EMC challenge. The motivation is often satisfy the needs of small clinical practice. One such initiative is OpenMRS following a single model approach, and it is attached to a central database. It argues that uses a data model that has been proven to be very successful in real clinical practice. The resulting system EHR clearly arranged by scene. This is an example of EHR systems specifically designed for use in small clinics. It suffers from restrictions from the standpoint of compatibility, which is not solved, and of its organization, which is encoded to be oriented so alternative views, such as task-oriented can be easily enabled. (Bisbal 2009, 8.)

Some other projects of open source have followed very identical approaches, for example, gnuMed, Carte2X and OpenEmed, although using various data models and organizational principles. These differences are justified only for particular clinical requirements of the users participating in the project.

Cooperation between all these initiatives are likely to carry out their tasks better than is currently done in isolation. (Bisbal and Berry 2009, 8.)

5.9 EMIAS

United Medical Information and Analytical System (hereinafter EMIAS) is a state single medical information-analytical system of the city of Moscow, which is created in order to improve the quality and accessibility of health services of public health institutions. This is “a new service that helps clinics to schedule load dispensary day, visitors to distribute the offices of experts and inform patients about the need to pass a comprehensive examination”. (VitaMedd, Health & Medicine, 2015, 1.) The project was developed and implemented by the Department of Information Technologies of Moscow jointly with the Moscow City Department of Health under the "Info City", on the basis of the Resolution of the Moscow Government on October 27, 2011 N 513-PP.

In December 2011, the Department of Information Technologies began to an extensive deployment of the service. Today EMIAS is connected to all public health center of the capital, as well as more than a dozen medical institutions pilot implementation area, i.e. dispensaries, consultation, diagnostic centers. Functional systems include managing patient flow, integrated health information, consolidated management accounting, personalized medical care records, management of medical registers. (Makarov 2015, 1.)

Implementation of EMIAS takes healthcare to a new level. The process implemented in several stages. The first one is provision of services of independent opportunity of patients to make an appointment to the doctor. The second is inclusion doctors on the system, who will be able to see the patient's medical history and write electronic prescriptions. The last stage is organization of a multifaceted account of provided medical care for the effective management of medical institutions. (Makarov 2015, 1.)

Transfer to an electronic registry with remote appointment to the doctor is available for all metropolitan clinics. Already, the service makes it possible to obtain statistical data, analyse it and make administrative decisions to increase

the efficiency of the health care institutions of the city and improve the quality and accessibility of health care. (Makarov 2015, 1.)

5.10 SaaS Model

SaaS, i.e. software as a service or software on demand, it is “software that is deployed over the internet and/or is deployed to run behind a firewall on a local area network or personal computer. (Menken, 2012). SaaS is the business model of the sale and use of the software in which the supplier is developing a web application and manage it independently, providing customers with access to software over the Internet. The main advantage of the SaaS model for customer service is the absence of costs associated with installing, upgrading and support of the equipment and working software. (Dmitriev 2007, 3.)

According to Dmitriev (2007, 4), in SaaS Model the application adapted for remote use, one application is used by several customers. Moreover, technical support is included in the application payment. Modernization and renewal of the application takes place promptly and transparently to clients.

As part of the SaaS model, customers pay not for owning the software itself but for its rent that is for its use via the web interface. Thus, in contrast to the classical scheme of software licensing, customer bears relatively small recurrent costs, and does not need to invest heavily in the acquisition of software and hardware platform for the deployment, and then maintain its performance. Periodic payment scheme assumes that if the need for the software is temporary unavailable, the customer may suspend its use and freeze payments to the developer. Moreover, SaaS model allows us to effectively deal with the unlicensed use of the software, because the software as such does not fall to the end users. In addition, the concept of SaaS often reduces the cost of deployment and implementation of technical and advisory support systems of the product, although it does not exclude them completely. (Dmitriev 2007, 7-10.)

The disadvantages of SaaS is considered unsafe transmission of commercial data to an outside provider, low speed and unreliability of access due to disruptions to the Internet. However, strengthens the image of SaaS-providers,

the development of encryption technology and broadband Internet access is gradually dissipating these fears. (Dmitriev 2007, 10-11.)

In the case of SaaS, customer does not pay for owning the software, but for its rent. And so it turns out that the client makes a small periodic subscription fee and free from the need to invest substantial sums in the purchase. Firstly, it does not need to buy the software itself, and secondly, the hardware platform to position it. One should not forget that after the implementation of the system to the enterprise customer will have to ensure its further operation. If the whole scope of work left to the developer, the customer would only have to use the functionality of the program and make regular payments for access to the system and related services. (Dmitriev 2007, 11-12.)

The second difference is that in SaaS is that the customer receives not the software itself, but only the functionality that it provides. However, the only thing that customer need is the implementation of business functions. (Dmitriev 2007, 12-20.)

Third, in SaaS introduction procedure is reduced to a minimum and is very easy, i.e. user needs to get a customer login/password from the program and enter it. SaaS-systems do not require a long setup, fine adaptation to the requirements of the customer and expensive consulting services. As a result, the time of the project and all costs associated with it reduced. (Dmitriev 2007, 12-20.)

Fourth, SaaS-model provides universal access to the application that user needs from any location where there is the Internet. Most SaaS-providers undertake to grant almost constant access to the service. Fifthly, of SaaS-model allows small and medium businesses to use applications that were previously inaccessible because of cost. Instead of buying software for a small fee the customer rents business functions which it implements. (Dmitriev 2007, 12-20.)

Moreover, SaaS provides automatic updating of software without additional cost to the customer and the ability to change the volume of functionality at any given time. If there is no need for a specific system functions, client can always give them up, and pay only for those that want to work. (Dmitriev 2007, 21.)

5.11 RoboMed

Professional IT-system for health centers, which increases the profitability of the clinic for 4-6%. It increases the efficiency, transparency, and manageability of center, profitability growth. Moreover, is tested in the realities of Russian clinics and proven to be effective and is ready for Action algorithms for the doctor and staff according to the chosen diagnosis.

According to the website of this system, Robomed is an information system and method for the effective planning and management of all resources of the company, which are necessary for the implementation of sales and services. Robomed system was established in Russia by international and domestic experience. It has been successfully tested in the realities of Russian clinics and proved its effectiveness. Robomed is the basis for a more efficient business model clinic. The system allows increasing the quality of care through the introduction of standards and algorithms for physicians. (RoboMed Medical System 2016.)

DSS (hereinafter Decision Support Systems) is clinical decision support system. It can be configured independently, and buy already completed system. DSS is ready for algorithms for doctors and medical personnel according to the selected diagnosis. The higher efficiency of treatment is achieved through standardization and control of each action. (RoboMed Medical System 2016.)

The first feature of this system is a transparent and reliable evaluation of the effectiveness of the medical staff. Business intelligence module collects and visualizes data from different sources. The second one is the automated enterprise management system. Business Process Designer allows the user to customize the features and personnel actions algorithms, as well as identify business process violations and generate reports. As a result, the user knows exactly what channels attract different types of customers and the size of the average check. (RoboMed Medical System 2016.)

6 REQUIREMENTS FOR THE HEALTHCARE SYSTEM

This chapter presents the results according to the doctors' and patients' responses. Moreover, the information obtained from the patients' and medical practitioners' responses guide the work in identifying the requirements of ICT data system at the case organization.

6.1 Patients' expectations concerning the health care system

There are two fundamentally different types of services provided by the health care system in the hospitals. The first type is planned or periodic examination. This examination, which includes a collection of certificates for work medical examination. Now the user, to collect all the necessary information, need to make an appointment for each specialist, and adapt to his work schedule. To make the survey more efficient and spend for searching fewer time of the person and time of registrars and other people who will be involved in this process, it is necessary to implement an automated time matching systems that offer a few options. The system monitors when professionals who need to conduct a survey are available and then it offers options after analysing the patient's schedule of work. This may be an option with the examination of all doctors to another date, or examination today, but with a big difference in time between doctor's appointments.

The second type is unscheduled examination, for example, when the appointment is due to illness. At the moment when the patient visits the general practitioner for the first time, the doctor has a choice. On the one hand, to send the patient to a specialist or on the other hand, firstly to make different analysis, for further treatment. In this approach, the initial reception loses efficiency and leads to loss of time, resulting in a disease can be exacerbated. To optimize the initial reception, before visiting a doctor the patient is automatically makes an appointment for the necessary analyses, if required. If possible, the system determines a specialist that patient need to visit without the help of a general practitioner. Therefore, the main purpose of the system user is reduction in the time appointment and giving more time for treatment by facilitating access to legal information in the field of medicine.

To achieve this goal, it is necessary to modernize the communication of the patient and the doctor. The time that the doctor spends on each patient by filling in a medical history, can be spent on examination. The nurse can take this responsibility for completing patient card by filling in all necessary information that the doctor says.

According to the interview, the patients want to get the following requirements from the new system, as follows:

1. Appointments to a specific doctor

2. Access to personal records

3. The selection of specialized doctors to the symptoms

4. The collection of information, which the user can provide by himself, such as temperature and blood pressure

5. The system should reduce the time for both, doctors and patients.

6.2 Doctors' expectations concerning the health care system

The main interests of the doctor can be distinguished, as follows:

1. The minimum time spent on paperwork and collect information about the patient's health and more available time for the work, i.e. for the patient's treatment

2. The possibility of using expert system and verification of the actions with its help

3. Help of the colleagues

4. The opportunity to show level of professionalism

5. The system should be simple and easy to work.

To meet the above interests of doctors it is necessary to build a system, which would be convenient and simple to use even for the person who had not had the experience of working at a computer. It is necessary to build a network that

would connect various medical institutions among themselves, thus providing a link between doctors and their communication with each other, data exchange. Moreover, each automated working place (hereinafter AWP) of doctor should communicate with the database in which the required information is stored.

To achieve these objectives assumes the automation of the following processes. Firstly, availability of patient records before the appointment. Secondly, the existence of links between the diseases records of relatives. Thirdly, processes of the implementation of an expert system. Moreover, collecting, structuring relevant and current medical information, various conferences and forums, the organization of these conferences and different learning programs. Lastly, the process of the presence of metrics to assess the quality of service a specific doctor is performed.

7 FINAL OUTPUT

This chapter presents description requirements of the new system, technical decisions, and some screenshots of how the system could look like. Moreover, it includes the description of users' and doctors' interfaces, the features, characteristics and main functions of the new system.

7.1 Description of the System

It is necessary to design an information system for the clinic. The system should be a remote registry of the hospital and simplify the procedure of recording clients to medical appointments. The system should be simple and easy to use.

For greater ease of use, the system should be designed in a way that any user has the possibility to enter without authorization. Drawing from the analyses of the existing project of implementing electronic medical records in such countries as Kenya, Peru, Haiti, Uganda, Malawi and Brazil, the text to follow highlights the most important facts and lessons.

In accordance with the research by Fraser et al. (2005), the discussion starts with the Data Model. The Data Model is the basis of any EHR system. The power of the Data Model will dictate the scalability and flexibility of the system. The design of the database schema is usually caused by the functional requirements of the system.

The requirements are that the system can maintain a variety of functions within the medical assistance, program monitoring and reporting, procurement and logistics, as well as research. These complex systems must be able to handle various types of data. It can accommodate the new data, such as drugs, clinical conditions, and results without changing the data model. Moreover, upcoming data requirements are often not known at the beginning of the project and develop over the life of the system, enables temporary data, data for clinical diagnosis, laboratory tests, treatment, and outcomes are often temporary in nature, in particular for the treatment of chronic diseases. Furthermore, it enables data to be exported in fixed formats for analytical and statistical packages, third-party software. (Fraser et al. 2005, 88.)

7.2 Database Design

Traditional ‘flat file’ database design. Each patient has a single row in the database table. Each data element has its column in a table. Some results for a long time, such as laboratory tests, each need a separate column. The addition of new data items requires changing the structure of the tables in the database. Scaling up to hundreds or thousands of observations is practically impossible. (Fraser et al. 2005, 88.)

Another important type is the Coded database structure. Each case has a single row in the database table. Names of observation and description are stored in a separate table. The addition of a new data element simply requires user to enter a new type of observations. Each case is a timestamp as time data are easy to analyse. Moreover, the data must be converted for easy analysis of statistical tools and spreadsheets. Directly associated with standard medical coding systems. It simplifies support for multiple languages. (Fraser et al. 2005, 88.)

The next aspect concerns the Network architectures. The first one is Stand-alone systems. In these systems, a database and user interface are deployed on a single machine. Examples of stand-alone systems are AMRS, Careware, and Fuchia. EMR system has no apparent functionality for communicating with other machines over the network. These systems range from a simple spreadsheet to store patient data in a simple database. Autonomous systems are the easiest type of EMR to develop and implement and are suitable for stand-alone applications, such as small EMR, patient registry or clinical trial data bases. (Fraser et al. 2005, 89.)

Local Area Network (hereinafter LAN) system is the second example. LAN EMR system is deployed in one place, and the machine has a relatively fast connection to each other approximately 10MB per second. Typically, these systems revolve around a database, for example, Oracle, MySQL, MS SQL Server, which are deployed on a central server. Users have local interfaces of client applications in which they come, query and modify data directly in the central database. (Fraser et al. 2005, 88.)

The next type is Wide Area Network (hereinafter WAN) systems. They consist of a network system, which operates in several geographic areas. Sites may be distributed in one city, state, country, or even may cover several countries. There are many approaches to the WAN EMR systems. They can be divided into three categories. The first one is thin client approach, such as a centralized web-based systems, and PIH-EMR and HIV-EMR. The next one is thick client approach, for example, SICLOM in Brazil and the system used in Israel and the last one is a hybrid approach, such as HIV-EMR. (Fraser et al. 2005, 88.)

To sum up, the above mentioned systems differ in the extent to which they are in the network, at the place and type of databases deployed. A simple system based on a database on the same computer are common because they are easy to develop and deploy to many basic tasks. Networked systems require more experience and technical capabilities to configure, but provide some advantages. (Fraser et al. 2005, 88.)

7.3 User Interfaces

A wide range of user interfaces that may allow employees to interact with the system is available. Interface selection can make a significant difference to the user experience, but do not bind to a specific system data model or architecture. Ideally, any interface should be usable with any data model, such s with most network architectures. Selection of the user interface will depend on the system and user requirements. User interfaces should include minimal functionality and should be readily changed; modification and the creation of new forms should be the quick and painless process that can be delegated to a junior ICT staff. (Fraser et al. 2005, 90.)

According to Fraser et al. (2005, 90), there are different user interfaces that can be used in EMR systems. The first one is Local forms of Windows, such as forms of MS Access or Java-forms. As a rule, rapid to develop and provide a very wide range of functions and flexibility.

The second one is Web pages are greater understanding and use compared to other interfaces and easy to deploy at a distance. They are flexible but may be more limited in the functions and interactions compared to other forms.

The next one is Personal digital assistants (hereinafter PDA), such as a Palm Pilot or Pocket PC devices. Portable, low cost, long battery life and are usually easy to use. Either uses special software, tools generate a form or a web browser, which stores local copies of web pages for viewing or downloading. The small screen size limits the ease of data entry for large forms.

Phone is the following user interface. It can be used to access and enter data through a voice interface, such as a system of surveillance Voxiva diseases in Peru. Moreover, mobile phones can enable recording limited data on the screen.

Furthermore, Scanned paper forms with optical character recognition. Allow the recorded data in a structured form to be automatically entered into a computer system, for example, TeleformsTM. Some systems allow the form to be faxed to a remote site for processing. These systems usually require the data to be verified by the operator, and is usually not good free text processing.

The last one is E-mail that can be generated for sending alerts and reminders, even if the user does not have direct access to the EMR. Some systems allow the input data and downloaded by e-mail, which can be useful when the bandwidth is limited.

The choice of the user interface will depend on the system, user requirements, and preferences. In EMR systems, it is highly important to design and implement the user interface as a separate component. User interfaces should include minimal functionality and should be easy to change. (Fraser et al. 2005, 90.)

7.4 Login to the System

Once logged in, the user is taken to the main window. The main functions of the Electronic hospital system of the process will be, as follows:

1. Make an appointment.

2. Edit application.

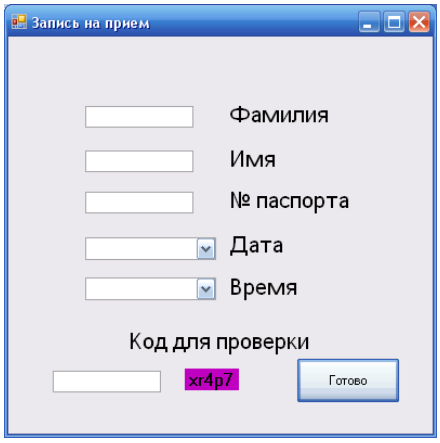
3. Withdraw request.

4. Data entry into the database.

7.5 Use Case of "Appointments"

This use case describes the sending of an application for appointment to the doctor. This use case begins to run when the user clicks on the "Appointments" in the main window.

First of all, the system opens the "Appointments". Then, the user enters the Family name and First name. The next step is when the user enters the number of the passport. Furthermore, the user selects from the drop-down list of the date and time of appointment. Then, the user enters the code shown in the picture. After that, the user clicks the "Finish" button. Therefore, the system compares the code from the image to the internal code. Finally, the system returns the number of the application. An example of the Screen form "Appointments" is presented in Picture 4.



Picture 4. Appointments Screen

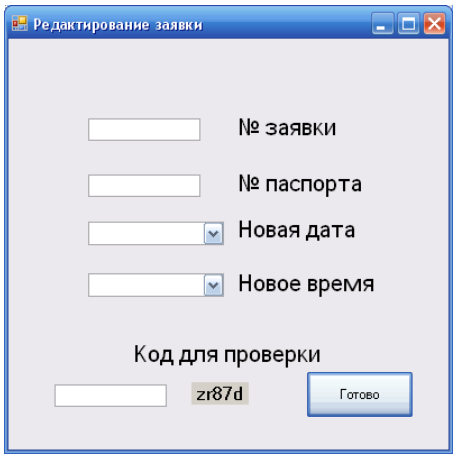
7.6 Use Case of "Edit Application"

This use case describes the change in the date and time of appointment to the doctor of the hospital. This use case begins to run when the user clicks on the button "Edit application" in the main window.

Firstly, the system opens the "Edit application". After that, the user enters the number of the application and number of the passport. Then, the user selects from a drop-down list a new appointment date and time. Furthermore, the user

enters the code shown in the picture and clicks the "Finish" button. Therefore, the system compares the code from the image to the internal code. Moreover,

the system checks the entered number of the passport to the existing in the database and then makes a change to the database. Lastly, the system closes the "Edit application" and takes the user to the main window. Screen form example of "Edit Application" is shown in Picture 5.

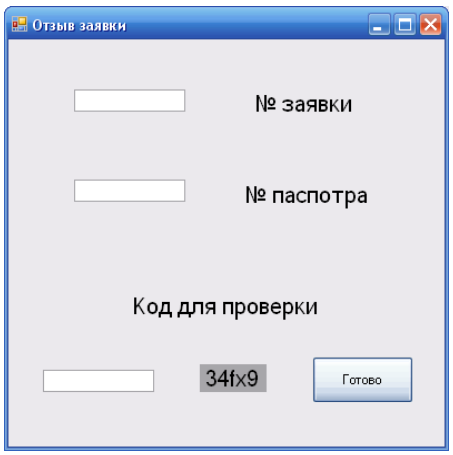


Picture 5. Editing the appointment

7.7 Use Case of "Withdrawal of Application"

This use case describes the removal of the application. This use case begins to run when the user clicks on the "Withdrawal of Application" in the main window.

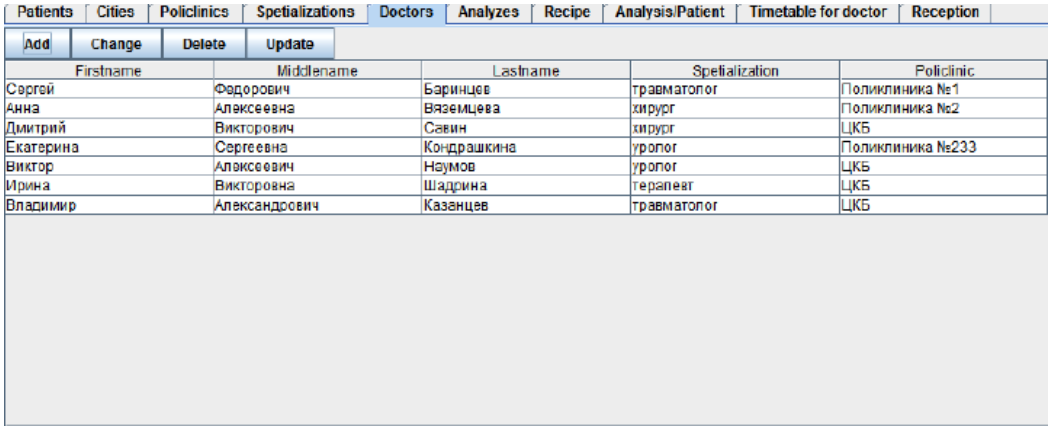
At the beginning, the system opens a window "Withdrawal of Application". The user enters the number of the application and the number of the passport. Moreover, the user enters the code shown in the picture and clicks the "Finish" button. After that, the system compares the code from the image to the internal code and checks the entered phone number with the available in the database, and therefore makes a change to the database. Finally, the system closes the "Withdrawal of Application" window and takes the user to the main window. Screen form "Withdrawal of Application" is shown in Picture 6.



Picture 6. Canceling the appointment

7.8 Use of the Administrator Interface

This example implements the interface for working with administrator database. With the help of this interface, administrator can add, delete and edit the selected entry from the table, as well as download information from the database. The example is shown in Picture 7.



Firstname	Middlename	Lastname	Spetialization	Policlinic
Сергей	Федорович	Баринцев	травматолог	Поликлиника №1
Анна	Алексеевна	Вяземцева	хирург	Поликлиника №2
Дмитрий	Викторович	Савин	хирург	ЦКБ
Екатерина	Сергеевна	Кондрашкина	уролог	Поликлиника №233
Виктор	Алексеевич	Наумов	уролог	ЦКБ
Ирина	Викторовна	Шадрина	терапевт	ЦКБ
Владимир	Александрович	Казанцев	травматолог	ЦКБ

Picture 7. Administrator or/and Doctor interface

This class implements a dialog to add or edit the selected records from the table. By clicking on the button “Add” dialog with empty fields will appear in the main window. Then it is possible to fill in or add elements to the table. If some fields were not filled, an error message appears. When pressing the button “Change”, dialog window appears with already filled-in fields, in accordance with what records the user wants to change.

8 CONCLUSION

This thesis indicates that all defined objectives of the project were achieved and the research questions were answered. I accomplished the proposal of the efficient and usable system customized for case organization. During the whole research process, I was concentrating on needs of users, because of which, certain data-gathering techniques such as interviews were conducted among patients and staff members. The results were analysed and implemented in the suggestion of the design and the content of the new system.

Different kinds of software systems were analysed in order to choose one that is the best suited for the current organization. I followed the main users requirements in suggesting the design of a new system. The new system includes even more features for simplifying the appointment process, access to the health records and paperwork process.

During the development process, I was extending the knowledge in Information Technology, organization, planning and analysing. Furthermore, the knowledge in organizing interviews was gained. Moreover, I became familiar with the fundamental principles of writing and critical reading of the scientific papers that were applied in practice.

Analysis of MIS development in different countries is a hot topic, as evidenced by the number of projects completed and that are in the process of implementation and deployment. At the moment, in the Russian market, there are many prototypes and ready-made solutions for health information to be implemented in individual clinics, but a single network is not working well yet.

The main advantage of the approaches described and explored in this work is that they require the construction of new processes for the implementation of the system, based on the technologies available at the moment. The present system is relying solely on old processes that are based on outdated technology.

This thesis work obtained the following results. Firstly, the big analyses were made, such as the project, which is currently being developed in the Russian

Federation. Moreover, systems providing services and processes that can be implemented within the framework of the medical information systems for clinic were proposed.

To continue, the case organization should decide which system and application they will choose for further work of the hospital. Moreover, it is important to form Database for the hospital. I recommend implementing or using the application that they will choose with the Java programming language. The advantages of this language lie in the fact that there are different frameworks, which allow generating the database components, such as tables, constraints, triggers, communication between the elements of different tables. Moreover, it allows creating a website structure in a single project, using a single development environment. For the database, Oracle Database 11g Express Edition could be selected, as this version is free of charge. There are many Oracle applications that are useful when forming a database, for example, Oracle SQL Developer Data Modeler and Oracle SQL Developer. Oracle SQL Developer Data Modeler is used to develop database architecture with an indication of all required parameters, such as table name, name and type of columns, specify the primary keys in the tables, creating links between different tables and columns. Oracle SQL Developer is used for debugging database and writing complex queries and triggers. Once creating a connection to the existing database, Oracle SQL Developer displays all elements available in it. That makes it quick and convenient to carry out the work.

In order to implement the cooperation of program communication with the Oracle Database, the Hibernate1 base library could be used. The advantage of this library is that it solves the problem of communication of Java classes to database tables. Moreover, it can help to automatically generate and update sets of tables, build queries to the database and process received data. These advantages make it possible to avoid the manual writing of SQL and JDBC codes. Therefore, it helps to reduce development time.

In the future, as a further research, it is planned to consider the project on automation of the medical system from a safety point of view, by analysing the problems that might be associated with it and to find ways to solve them,

because the system operates with confidential user data. According to the order of classification of personal data information systems (hereinafter PD) processed in medical institutions, PD are the most protected class "K1" 1, as concern the state of health of the subject, i.e. patient. This imposes very strict requirements on their system security. Medical Information System is different from other products, foremost, because of the fact that the personal and confidential information is stored and processed therein. In this regard, these systems must have higher features for reliability and limited access to information, legal liability, and technical data protection measures. The main task of the security of the system is the simultaneous protection of information and programs, which is understood as a set of measures, methods, and means of ensuring the following objectives. Firstly, ensuring the integrity of information and secondly, prevent unauthorized access to system resources and stored therein programs and data.

Implementation of the system security must be comprehensive. Firstly, it must be carried out systematically at all stages of the system vital activity, i.e. from design and development to implementation and operation. Further, it should block all known kinds of security threats and be focused on the tactical advance threats. Moreover, it is required to nominate only justified restrictions on the functionality and performance of the system. In terms of architecture security, the system must operate at all the stages of processing and transmission of the information, i.e. the server, communication channels and users' computers. At the same time used methods should be implemented on the whole logical security chain, which includes prevention, detection, alerting decision-makers, neutralizing or blocking, logging and restore normal operation.

Therefore, “It is very important to continue the further research from the point of security aspect. Hospital Information System largely process sensitive personal information. Protecting the security of this information needs to be based on a security plan that has been formulated following a risk analysis and management exercise in the organization. A good starting point that could immediately make the significant difference in the measured levels of security would be the establishment of a strict legal or regulatory requirement to address security issues in healthcare in particular, rather than including this into the

generic legal requirements for the protection of personal data." (Furnell et al. 2013, 122.)

Computers can help to improve the treatment of patients, performing tasks that are not feasible for manual methods, and require of processing vast amounts of information. Monitoring of laboratory test results for each patient and storing the results of tests for susceptibility to antibiotics, conducted at the hospital over a five year period are examples of functions performed by the computers better than humans.

According to Nizamov and Rusak (2002, 243), practical experience of health care facilities with established ICT showed that with the help of Information Technologies, a single information space for all automated systems and management of medical institutions are forming. Moreover, it enables analysis of the required medical aid, to determine the cost of providing medical care to the population, to improve the efficiency of health care resources through the introduction of resource-saving technologies.

Implementation of the system allows to continuously carrying out a full account of all the patients who undergoing treatment at the hospital and offices in general. These calculations are performed in an automated mode. Data are collected in a single hospital-wide computer database. Moreover, this database provides the maintenance and storage of electronic versions of medical records of all the patients undergoing treatment, and patients treated early. For this purpose, the main standard is patient medical personal code that is assigned to him at his first call to the emergency department of the hospital.

The formation of a single hospital-wide database will help to create an integrated information space of the hospital, which integrates administrative and managerial personnel, medical department, clinical department and laboratory, medical statistics office, hospital medical staff, the planning department and the accounting department. Moreover, it will help hospital pharmacy and the Commission on the quality of the examination of the provision of medical help. Personal medical information on each patient is the basis for the organization at the municipal level of the monitoring of the city residents' health.

Therefore, the proposed organizational and information model has a positive effect on indicators, such as health care performance, efficiency, cost, quality and service levels. It contributes to obtain the optimum clinical and economic effects, reduce the period of hospital stay and the cost of medical services provided as a whole, and hence reduce the cost of ongoing comprehensive treatment.

Health Records and other medical documents that are stored electronically in a database of the hospital are the initial information. They reflect all the doctor's action with a comprehensive assessment, such as statistical, economic, legal and other. This information can be obtained in a formalized way for any period. The technology contributes to the quality assessment of medical care at the other information level, and this information is sufficient for the preparation and management decisions. This work leads to a reduction in the number of medical errors about three times.

Medical effectiveness is to improve information provision of basic diagnostic and treatment hospital process, availability of information from health records for each doctor, regulatory and reference information from a single hospital-wide database. The automated technology of examination of the care quality helps to raise the health status of the medical institution, not only in the health system but most importantly, among consumers of medical services.

The socio-medical and economic effectiveness of the introduction of new technologies is achieved by increasing the costly hospital beds, the number of treated patients and improvement of hospital performance work. Social efficiency is clearly seen in the unlimited possibilities of computer databases of personalized medical data for each patient tracking in all stages of his medical care in medical institutions of different types, for clinical supervision, accurate organization, and accounting of medicinal maintenance of preferential categories of patients.

Medical information database allows one to control and analyse the nature, scope, and quality of medical assistance to patients of any category. For example, relating to socially vulnerable groups, it concerns people with disabilities, senior citizens, children, migrants, and others.

At the moment the proposed system is not operational because the case organisation is still in the planning stage. Therefore, I propose to cooperate with the case organization in order to find a decision, I propose to combine some features of existing systems together and to bring a new system that will cover all the required aspects of the hospital. Thus, there will be one unified system with the health records for the whole hospital community, not specifically for the certain group. It is important in the future to come up with the solution based on the combination of already existing systems. The only requirements for this will be the programming knowledge, proper planning and time. Additionally, the interaction level should be increased, patients and doctors should be able to rely on the system and to get assistance from it.

It can be concluded that experience of the introduction of new IT at the city hospital showed that these tools provide a single information space of the medical institution management system, which enables continuous analysis of the desired and rendered volume of the medical assistance in accordance with the level and structure of morbidity of the population. Moreover, it helps to determine necessary costs for providing medical aid at the level of the respective territory, to observe compliance with the guaranteed volume of free medical assistance for citizens of the real volume of financing of the territorial program of compulsory health insurance and to improve the efficiency of hospital management.

Further, a significant result could be testing of the organizational and informational model of interaction between the various healthcare subjects in a single information space with the information support of each patient at the stages of medical assistance.

Lastly, the automated examination system of medical care quality allows generating reliable information for making management decisions to improve the qualifications of the hospital medical staff, by optimizing the use of its material-technical and financial resources that together are objective prerequisites for ensuring the quality of medical care. The combination of informational resource saving technologies of medical care quality expertise

creates a solid foundation for the introduction of advanced medicine methods in a hospital, which are based on evidence.

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APPENDICES

Appendix 1 1(3)

INTERVIEW TRANSCRIPT WITH SVETLANA KRUPENKINA, MEDICAL DIRECTOR AT KALEVALA HOSPITAL. CONDUCTED ON 07 OCTOBER 2016.

Interviewee: Good Morning, Svetlana!

My name is Maria Gaponova. I am a student from Russia graduating from Lapland University of Applied Sciences in this semester. I would like to ask for your help in my thesis/research work. By taking few minutes to answer my questions about the present situation in the hospital and your requirements and preferences what could be changed in the whole work of the hospital, what systems and technologies that are used and how they could be improved, you could grant me great support and assist to my research work.

Interview takes around 15 minutes. Thank you very much for your support! Sincerely,

Maria Gaponova.

Interviewer: Now, I would like to ask you to introduce yourself.

Interviewee: Good Morning, I will try to help you. My name is Svetlana Krupenkina. I am the physician and Medical Director at Kalevala hospital.

Interviewer: How long have you been working here?

Interviewee: I have been working here since 2000. It is 16 years. I started as a physician of the hospital, but now I am also the Medical director and I am really proud of it.

Interviewer: What do you think about effectiveness of using Information Technology at Kalevala Hospital? Would you recommend to use it at our hospital?

Interviewee: Surely, I recommend. It will put our hospital on a new level, it will improve the doctors', admissions work and the work of the whole hospital. Means of information technologies formed a common space for all automated systems and management of medical institutions, which enables continuous analysis of the required medical aid, to determine the cost of providing medical care to the population, monitor compliance with government programs guaranteed volumes of medical aid to citizens, improve the efficiency of health care resources through the introduction of resource-saving technologies, to monitor compliance with the obligations of the executive authorities to implement programs to provide citizens free medical care. The introduction of IT in the health sector can improve the quality of service, notably to speed up the work of staff and reduce maintenance costs for patients.

Interviewer: Since what time does Kalevala hospital use Information Technology?

Interviewee: In 2011 we created the web page of our hospital. The hospital of Kalevala is connected to a single corporate network (hereinafter CEN) using a single Web portal, i.e. unified database. For timely outpatient care a patient can choose one of the methods for making an appointment by the Webportal or by phone. To be honest, the system is not working good, the patient could make an appointment, but then when he or she comes to the doctor, he still needs to wait some time, because the order was changed or due to other reasons. People prefer to come or call directly to the hospital than use this Web portal.

Interviewer: From your point of view, why for so long times have been taken attempts to avoid the import of historical data?

Interviewee: The reasons are simple: "The procedure is very costly because it contains in itself the work with third-party product, which greatly complicates the prediction of the timing, and work to reconcile the correctness of data transferred, and it, in turn, conceals complexity in logic comparison. Moreover, the financing of such operations, as a rule, does not represent large sums.

Appendix 1 3(3)

Interviewer: What do you want to receive from a new system?

Interviewee: It should be easy to use, it should decrease time on paper-work, so we can pay more attention to the patient, it should work and makes all the functions. Moreover, it would be nice if I can see by the work of the doctors the level of their professionalism and skills.

Appendix 2 1(2)

INTERVIEW TRANSCRIPT WITH RUSLAN SULIMANOV, HEAD SURGEON AT KALEVALA HOSPITAL. CONDUCTED ON 07 OCTOBER 2016.

Interviewee: Good Morning, Ruslan!

My name is Maria Gaponova. I am a student from Russia graduating from Lapland University of Applied Sciences in this semester. I would like to ask for your help in my thesis/research work. By taking few minutes to answer my questions about the present situation in the hospital and your requirements and preferences what could be changed in the whole work of the hospital, what systems and technologies that are used and how they could be improved, you could grant me great support and assist to my research work.

Interview takes around 15 minutes. Thank you very much for your support!

Sincerely,

Maria Gaponova.

Interviewer: Now, I would like to ask you to introduce yourself.

Interviewee: Good Morning, my name is Ruslan Sulimanov. I am the head surgeon at Kalevala hospital.

Interviewer: How long have you been working here?

Interviewee: I have been working here since 2005. From that moment not much has changed.

Interviewer: What do you think about effectiveness of using Information Technology at Kalevala Hospital? Would you recommend using it at our hospital?

Interviewee: Yes, I will recommend using it. I think it will help us to make our work better and easier, it will save our and patients' time. Moreover, it will reduce medical's error, which is very important fact. For example, Information technologies in medicine and public health help achieve the following objectives: keep records of the clinic's patients, monitor their condition remotely, to preserve and transmit the results of diagnostic tests. Moreover, it will help to monitor the correctness of the prescribed treatment, to conduct remote training and to provide advice inexperienced staff.

Interviewer: What do you want to receive from a new system?

Interviewee: First of all, it should be understandable. I want to reduce time spending on paperwork and have more time for treatment of the patient. It is good if I need some colleagues' advice, they could access the patient records and help me.

Appendix 3 1(2)

INTERVIEW TRANSCRIPT WITH MICHAIL POPOV, THE PATIENT AT KALEVALA HOSPITAL. CONDUCTED ON 07 OCTOBER 2016.

Interviewee: Good Morning, Michail!

My name is Maria Gaponova. I am a student from Russia graduating from Lapland University of Applied Sciences in this semester. I would like to ask for your help in my thesis/research work. By taking few minutes to answer my questions about the present situation in the hospital and your requirements and preferences what could be changed in the whole work of the hospital, what systems and technologies that are used and how they could be improved, you could grant me great support and assist to my research work.

Interview takes around 15 minutes. Thank you very much for your support!

Sincerely,

Maria Gaponova.

Interviewer: Now, I would like to ask you to introduce yourself.

Interviewee: Hello, Maria, I hope my answers will help you. My name is Michail Popov. I am 45 years old. I am the driver, but now I have to be at Kalevala hospital.

Interviewer: What do you think about the service at Kalevala Hospital?

Interviewee: The service is quite good, but as I work from the earlier morning till late evening, I don’t have time to wait in the queue, because sometimes it takes more than 2 hours. Then when you are finally have your appointment, it takes 30 minutes more for the doctor to fill in all the papers and documents. He or she almost doesn’t have time for the treatment, because he or she knows that the work day will finish soon and there are still a lot of people waiting for their appointment. So, in my opinion the system in our hospital need to be changed.

Appendix 3 2(2)

Interviewer: Do you think that Information Technology could improve the service? Would you like to see some of IT features at our hospital?

Interviewee: Yes, I don't know a lot about this term, but the Technology is always good. I believe that some innovations will improve the system and the work of the hospital.

Interviewer: What do you want to receive from a new system?

Interviewee: I want to reduce as much time as possible waiting for my appointment and I want doctor to spend more time on the treatment and not on the paper work. It will be good if I can make an appointment to the doctor due to my symptoms and to bring some basic info, such as temperature, which I can provide by myself.

Appendix 4 1(2)

INTERVIEW TRANSCRIPT WITH ANNA ZUBANOVA, THE PATIENT AT KALEVALA HOSPITAL. CONDUCTED ON 07 OCTOBER 2016.

Interviewee: Good Morning, Anna!

My name is Maria Gaponova. I am a student from Russia graduating from Lapland University of Applied Sciences in this semester. I would like to ask for your help in my thesis/research work. By taking few minutes to answer my questions about the present situation in the hospital and your requirements and preferences what could be changed in the whole work of the hospital, what systems and technologies that are used and how they could be improved, you could grant me great support and assist to my research work.

Interview takes around 15 minutes. Thank you very much for your support!

Sincerely,

Maria Gaponova.

Interviewer: Now, I would like to ask you to introduce yourself.

Interviewee: Hello, my name is Anna Zubanova. I am 15 years old. I study at school, but now I am staying at Kalevala hospital.

Interviewer: What do you think about the service at Kalevala Hospital?

Interviewee: It is totally outdated. For sure there is a big need for changes. I don't understand that in 21st century we still have a paper based health records, I usually forget it at home and then when I come to the hospital, I can't make an appointment and visit a doctor, I must have this "big book" with me. Moreover, the quality of doctors' handwriting is so poor that I can't understand anything, when I want to know what happened or read some facts in my medical records card it is impossible, because I can't make out anything.

Appendix 4 2(2)

Interviewer: Do you think that Information Technology could improve the service? Would you like to see some of IT features at our hospital?

Interviewee: Yes, I believe it will improve the whole work of the hospital. It will help to many people to safe their time and nerves. It will put our hospital to the next level.

Interviewer: What do you want to receive from a new system?

Interviewee: It should be convenient for all persons, for doctors and patients of different age. For example, it should be clearly for me and at the same time for my grandmother. I want to have a possibility to make an appointment to a specific doctor. Also, I want to have the access to my health records when I need it.