ИНФОРМАТИКА
COMPUTER SCIENCE

DOI 10.31489/2019M2/121-128

UDC 004.9

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Digitalization of healthcare system of Kazakhstan

The article is devoted to the development of digital technologies in the field of healthcare of Kazakhstan. The process of automation of a medical institution hospital is considered. The functionality of the developed information system and the prospects for the implementation of this system in this area are described. The developed information system allows it to accumulate the medical and statistical information in the databases of the hospital and use in practice, automates the management of the hospital workflow. The capabilities of the system consist in registering patients in a hospital, maintaining an electronic medical history and obtaining complete statistical reports. The patient's electronic medical history contains his personal data, diagnoses, recommended procedures and medications. The introduction of information and communication technologies in the health sector will improve the quality of care and significantly speed up the work of staff.

Keywords: health digitalization, hospital automation, information system functionality.

The health of every person, as a component of the health of the entire population, becomes a factor that determines not only the usefulness of its existence, but also the potential of its capabilities [1].

President N. Nazarbayev in his message to citizens of Kazakhstan emphasized that one of the directions of state policy at the new stage of development of our country should be the improvement of the quality of medical services and the development of a high-tech healthcare system. The quality of medical services is a complex concept and depends on many reasons, among which the material and technical equipment of medical organizations, the level of professionalism and motivation of clinical specialists to improve it, the introduction of modern technologies to manage and organize medical care, the introduction of effective methods of paying for medical help. Improving the management of the quality of medical services occupies an important place in the context of the strategic development of health care in Kazakhstan until 2020 [2].

Today, digital technologies are beginning to change the most conservative sphere of human activity – health care. As part of the «Digital Kazakhstan» program, domestic clinics face the challenge of introducing digital health care. Already this year, the full transition to the electronic format of medical services is announced [3].

The transition to such a model will help digitization, omni-channel, the use of big data and the use of artificial intelligence to process them. Working with data will provide an opportunity to improve the quality of medical care, reduce treatment time, and, at the same time, increase the medical activity of citizens and lead to an increase in the number of patients. But all these changes will not be possible as long as patient data is not collected in digital form.

Health care is generally one of the most difficult branches. It is very conservative. The difficulty is also associated with a large amount of accumulated data, and unstructured. At the same time, all this is connected

with human health – the topic is very sensitive. In the coming years, we are waiting for a radical transformation of this industry. Health care will begin to interact more and more with information technology and management issues. It has ceased to be merely treating people. Health care will come to digitalization, it is inevitable. For centuries, people thought about the need to go to the doctor in a negative way, when something bad happened. This approach will change. There appears a service component – rating of doctors. The doctor ceases to be the person from whom only knowledge is required. Convenience, good service, digitalization, big data – all this is necessary for medicine today [4–10].

Health becomes a service. We cannot escape from this: people who are accustomed to receive this service in other areas of life today want the same from health care too – so that they can be comfortable, understandable, with feedback. An affiliate model will determine the future development of medicine.

Kazakhstan is just entering into the trends that will determine the development of health care in the future. Modern medicine seeks to create ecosystem, where patients anticipate until they get sick, but visit doctors at healthy state, just to maintain and strengthen health. In addition, the experience of other industries already dictates increased requirements for service in medicine – people want low-cost, personalized medical services. So far, the health care sector has remained aloof from current market changes. But this is the same service sector, and patients, customers of these services, want convenience, proactivity, electronic services, mobility [11, 12].

E-medicine will be a huge breakthrough for the industry. All the data on patients that will be collected and systematized will help in the future to receive better service, correct diagnosis and the appointment of effective treatment not only in Kazakhstan, but also in any location in the world.

The government provides proper financial support and a certain «moral pressure», which is necessary now. All people will come to digitalization. And the presence of good competition in terms of medical systems will be only an advantage. Every Head of a medical organization will be able to choose a system that suits him. The issue of improving the quality of medical care is relevant and most common among the problems of the organization and healthcare institutions management. In large multidisciplinary hospitals, the need to create a system of rapid and effective interaction between the services and departments involved in the examination and treatment of patients is particularly vivid. So far, in the field of medical care, information systems are designed as unique for each organization and, as a rule, are focused on statistical data processing and partial automation of administrative and business activities [13–18].

The process of automating a hospital of a medical institution was reviewed in this article. The object of automation is the Karaganda Regional Clinical Hospital. Analysis of the current day hospital data processing system of this hospital showed that data processing is mainly done manually. Installed computers are mainly used as typewriters for printing statements. Documents are stored in paper form, that complicates their processing and storage [19].

Having analyzed the existing hospital system, began to develop own information system «Hospital» using the high-level programming language Delphi 7.0. The developed software product is designed to automate the activities of day hospital, allows accumulating the medical and statistical information in the databases of the hospital and using in practice, automates the management of documents. The «Stationary» automated information system has an easy-to-use interface, i.e. this system can be used not only by specially trained users, but also by medical personnel [20, 21].

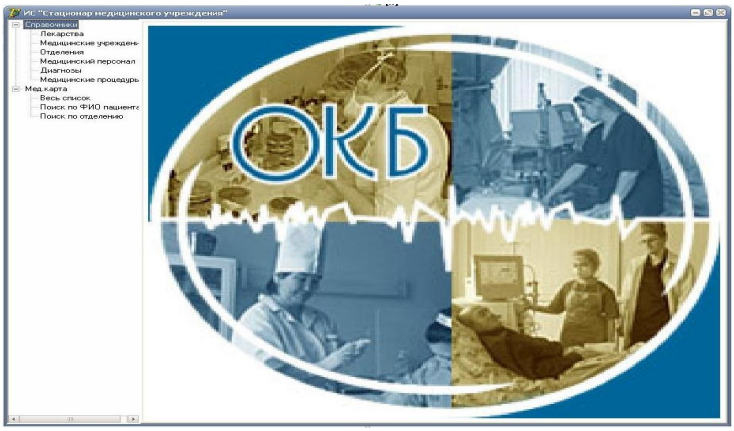

Figure 1. The main boot form

The application launch is carried out by double clicking the left mouse button on the MedStacionar.exe file shortcut. After that, the main boot form will appear on the screen (Fig. 1).

The program menu is presented in the form of a hierarchical tree, where all commands are divided into two groups:

– Reference books;
– Medical card.

All menu commands are selected by double-clicking.

The «Directory» menu provides work with the main system directories:

– Medicines;
– Medical institutions;
– Departments;
– Medical staff;
– Diagnoses;
– Medical procedures.

The «Medication» directory contains a list of medications (Fig. 2). The window has a navigator for working with records: navigating through the records, adding, editing and deleting records.

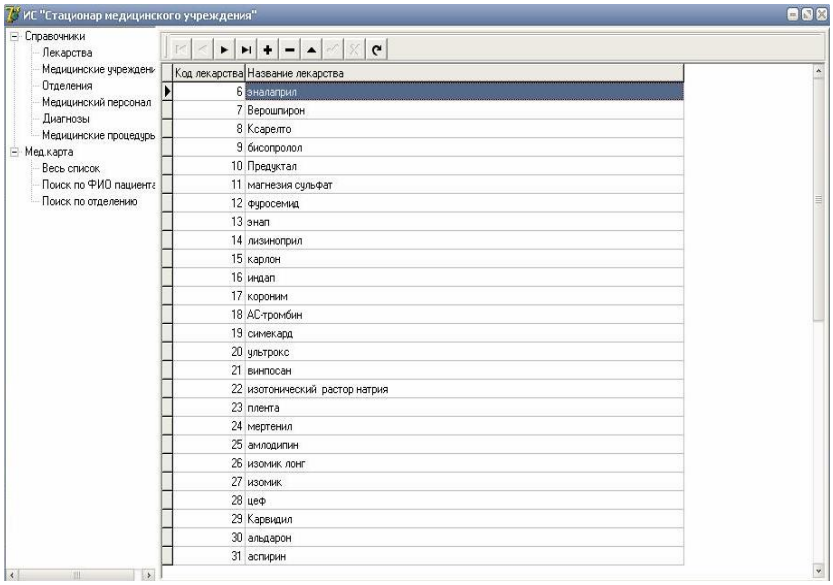

Figure 2. The «Medication» directory window

The directory «Medical institutions» contains a list of medical institutions with which the hospital works. Directory «Branch» contains a list of departments of the hospital. The reference book «Medical personnel» contains a list of medical personnel of the hospital with indication of the position. The «Diagnoses reference book» contains a list of diagnoses and their symptoms. The reference book «Medical procedures» contains a list of medical procedures that are conducted by the hospital.

The menu command «Medical card» contains three commands for working with medical cards:

– The whole list;
– Search by name of the patient;
– Search by branch.

When you select the entire list command, the patient's medical record window will be opened (Fig. 3).

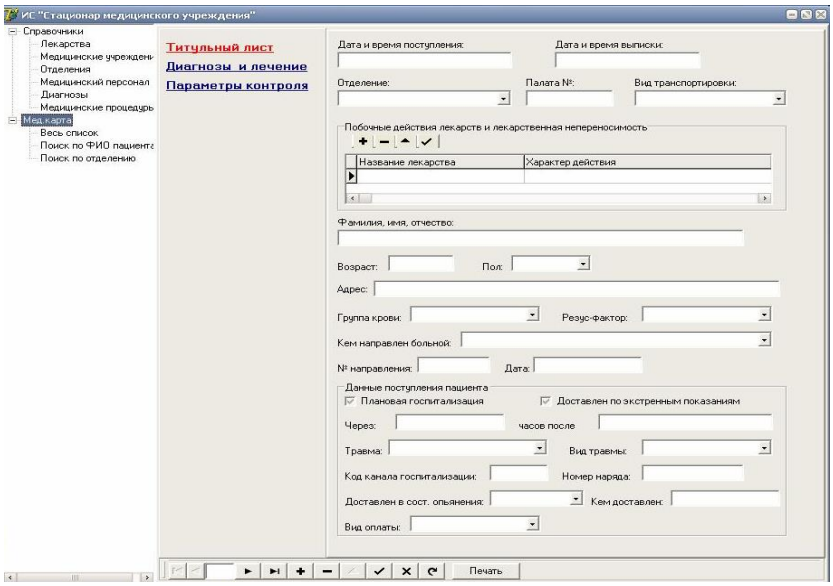

Figure 3. The window of the medical record of the patient

The patient's medical record consists of three sections:

– Title page;

– Diagnoses and treatment;

– Control parameters.

The «Title page» contains general information about the patient, the order of his arrival, the presence of allergic reactions to drugs. The «Diagnoses and Treatment» section contains a list of the diagnoses that have been made, the procedures prescribed and the medications for treating the established diagnosis assigned to the patient. Section «Control parameters» contains daily information on the patient's condition.

At the bottom of the «Medical Record» window there is a navigator for working with records, a card number and a button for printing a card. When you select the print command, medical record data will be imported into Word (Fig. 4).

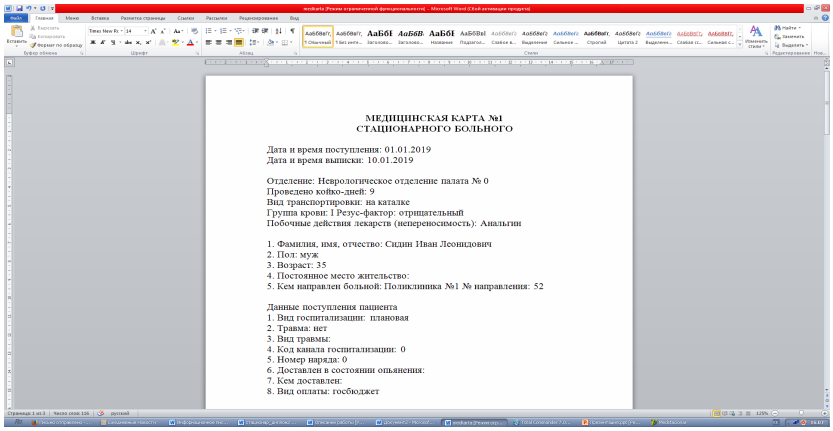

Figure 4. Medical record extract

When selecting the «Search by name of the patient» command, a window opens that asks to enter the name of the desired patient. Then the found medical record is opened. The search by department is the same.

The developed software product is designed to automate the activities of a day hospital at the Regional Clinical Hospital. In this institution, the information system «Hospital» was tested and is at the implementation stage.

The developed software product is designed to automate the activities of a hospital medical institution, allows it to accumulate in the hospital databases and use in practical work medical and statistical information, automates the management of hospital records.

System functionality:

1. Accounting of hospital patients.

2. Accounting of hospital patients receiving medical care in accordance with various types of payment: for compulsory health insurance, with their own expense, on voluntary medical insurance, under contracts with organizations, with the expense of budget funds.

3. Keeping an electronic medical record; print medical history in the required format.

4. The accumulation in the database of full information about the case of hospitalization, including:

- information about diagnoses;
- information on the assigned and executed medical services and surgical interventions;
- results of tests and diagnostic examinations of patients;
- information about the patient's daily condition;
- information about patient transfers within the hospital;
- information on the appointment and issuance of medicines;
- data on sick leave.

5. The accumulation of information about outpatient services provided to hospital patients.

6. Obtaining complete and consistent statistical reporting on approved forms based on common information resources.

The program does not require any special equipment in addition to a computer and printer, which will simplify the implementation process.

All the necessary work on the implementation of methods of access to information stored in the database, its modification, maintaining the database in a coherent form is hidden inside and the user does not need to know about it in order to successfully solve the whole range of emerging tasks related to the use of information stored in the database. Moreover, the program interface simplifies the work with the database as much as possible (up to a choice from the proposed number of options). Even accessing the database with complex queries is carried out in such a way that the structure of the returned data is visible even before its execution. The system independently tests the records in the database and brings the database to a complete state, eliminating possible errors. All routine operations of this kind are taken by the machine, which no doubt saves the efforts and time of the end user [22–26].

The development of this information system is relevant:

- first, in the age of information breakthrough, it is impossible to imagine any serious organization without a computer and data processing programs;
- second, it is minimization of manual labor and information processing on paper;
- third, reduction of time for searching and processing the necessary information;
- fourth, saving money.

References

1 Sackett D.L. Evidence-based medicine: what it is and what it isn't / D.L. Sackett, W.M. Rosenberg, W.S. Richardson, R.B. Hynes, J.A. Muirgray // BMJ. – 1996. – 312. – P. 71–72.

2 Государственная программа развития здравоохранения Республики Казахстан «Денсаулық» на 2016–2019 годы [Электронный ресурс]. — Режим доступа: http://adilet.zan.kz/rus/docs/U1600000176.

3 Государственная программа «Цифровой Казахстан» [Электронный ресурс]. — Режим доступа: http://adilet.zan.kz/rus/docs/P1700000827.

4 Rodrigues, J. Information systems: the key to evidence-based health practice / J. Rodrigues // Bull. World Health Organ. — 2000. – 78. – No. 11. — P. 1344–1351.

5 Sackett D.L. Evidence-based medicine: how to practice and teach EBM / D.L. Sackett, S.E. Straus, W.S. Richardson, P. Glasziou, R.B. Haynes // BMJ. — 2000.

6 Jeffrey A. History and development of evidence-based medicine / A. Jeffrey, C. Timothy // World J. Surg. – 2005. – 29. – P. 547–553.

7 Rube T. Electronic health information: The key to evidence-based medicine and improved patient care / T. Rube // Gov. Insights. — 2008.

8 Hunt D.L. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review / D.L. Hunt, R.B. Haynes, S.E. Hanna // JAMA. – 1998. – 280. – P. 1339–1346.

9 Bukken S. An informatics infrastructure is essential for evidence-based practice / S. Bukken // J. Am. Med. Inform. Assoc. — 2001. — 8. — P. 199–201.

10 Wells L. Role of information technology in evidence-based medicine: advantages and limitations / L. Wells // Internet J. Healthc. Admin. — 2007. — 4. — No. 2.

11 Сайт о казахстанском рынке информационных технологий [Электронный ресурс]. — Режим доступа: https://profit.kz.

12 Бабич Т.Н. Прогнозирование и планирование в условиях рынка: учеб. пос. / Т.Н. Бабич, И.А. Козьева, Ю.В. Вертакова, Э.Н. Кузьбожев. — М.: НИЦ ИНФРА-М, 2013. — 336 с.

13 Aminpour F. Medical informatics: concepts and applications / F. Aminpour // Iran. J. Med. Educ. – 2004. – 4, No. 2. – P. 95–103.

14 Mueller M.L. Workflow analysis and evidence-based medicine: Towards integration of knowledge-based functions in hospital information systems / M.L. Mueller, T. Ganslandt, T. Frankewitsch, C.F. Krieglstein, N. Senninger, H.U. Prokosch // Proc AMIA Symp. – 1999. – P. 330–334.

15 Hemiear M. Improving patient safety with technology / M. Hemiear // Int. J. Med. Inform. — 2004. – 73, No. 7. – P. 543–546.

16 Humphreys L. Electronic health record meets digital library: a new environment for achieving an old goal / L. Humphreys // J. Am. Med. Inform. Assoc. – 2000. – 7, No. 5. – P. 444–452.

17 Humphreys B.L. The UMLS project: making the conceptual connection between users and the information they need / B.L. Humphreys, D. Lindberg // Bull. Med. Libr. Assoc. – 1993. – 81, No. 2. – P. 170–177.

18 Ahmadi M. Evaluation of hospital information system in the medical records department / M. Ahmadi, M. Barabadi, M. Kamkar Haghighy // Health Inf. Manag. – 2010. – 7, No. 1. – P. 16–23.

19 Официальный сайт областной клинической больницы [Электронный ресурс]. — Режим доступа: https://okbkar.kz.

20 Шаяхметова Б.К. Технология создания программ для сложных систем / Б.К.Шаяхметова. — Астана: МПА Туран-Профи, 2010. — 170 с.

21 Вирт Н. Алгоритмы + структуры программ = программы / Н.Вирт. — М.: Мир, 1985. — 406 с.

22 Clamp S. Electronic health record: is the evidence base any use? / S. Clamp, J. Keen // Med. Inform. Internet Med. – 2007. – 32, No. 1. – P. 5–10.

23 Wright A. Clinical decision support capabilities of commercially-available clinical information systems / A. Wright, D.F. Sittig, J.S. Ash, S. Sharma, J.E. Pang, B. Middleton // J. Am. Med. Inform. Assoc. – 2009. – 16, No. 5. – P. 637–644.

24 Young J.M. Evidence-based medicine in general practice: beliefs and barriers among Australian GPs / J.M. Young, J.E. Ward // J. Eval. Clin. Pract. – 2001. – 7, No. 2. – P. 201–210.

25 Hersh R. How well do physicians use electronic information retrieval systems? A framework for investigation and systematic review / R. Hersh, H. Hickam // JAMA . – 1998. – 280, No. 15. P. 1347–1352.

26 Mansson J. Collection and retrieval of structured clinical data from electronic patient records in general practice / J. Mansson, G. Nilsson, C. Bjorkelund, L.E. Strender // Scand. J. Prim. Care. – 2004. – 22. – P. 6–10.

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Қазақстанның денсаулық сақтау жүйесін цифрландыру

Мақалада медициналық мекеме стационарының процесін автоматтандыру үрдісі қарастырылған. Стационар қызметін автоматтандыратын ақпараттық жүйе әзірленді. Құрастырылған программалық өнімнің функционалдық мүмкіндіктері мен аталған өнімді медициналық қызмет көрсету саласына ендіру болашағы сипатталған. Құрастырылған ақпараттық жүйе медициналық және статистикалық ақпаратты стационар базасында жинақтауға және практикалық жұмысында пайдалануға мүмкіндік береді, стационардың құжат алмасуын басқаруды автоматтандырады. Жүйенің мүмкіндіктері стационарда науқастарды тіркеуден, электрондық аурулар тарихын жүргізуден және толық статистикалық есептерді алудан тұрады. Науқастың электрондық аурулар тарихында оның жеке деректері, қойылған диагноздары, ұсынылған процедуралары мен дәрі-дәрмектер тізімі бар. Денсаулық сақтау саласына ақпараттық-коммуникациялық технологияларды енгізу медициналық көмектің сапасын арттыруға және қызметкерлердің жұмысын едәуір жеделдетуге мүмкіндік берді.

Кілт сөздер: денсаулық сақтауды цифрландыру, стационарды автоматтандыру, ақпараттық жүйенің функционалды мүмкіндіктері.

М.У. Баешова, А.М. Омаров

Цифровизация системы здравоохранения Казахстана

В статье рассмотрен процесс автоматизации стационара медицинского учреждения. Описаны функциональные возможности разработанного программного продукта и перспективы внедрения данного продукта в область медицинского обслуживания. Разработанная информационная система позволяет накапливать в базах данных стационара и использовать в практической работе медицинскую и статистическую информацию, автоматизирует ведение документооборота стационара. Возможности системы заключаются в учете пациентов стационара, ведении электронной истории болезни и получении полной статистической отчетности. Электронная история болезни пациента содержит его личные данные, поставленные диагнозы, рекомендованные процедуры и лекарства. Внедрение информационно-коммуникационных технологий в сферу здравоохранения позволит улучшить качество обслуживания и заметно ускорить работу персонала.

Ключевые слова: цифровизация здравоохранения, автоматизация стационара, функциональные возможности информационной системы.

References

1 Sackett, D.L., Rosenberg, W.M., Richardson, W.S., Hynes, R.B., & Muirgray, J.A. (1996). Evidence-based medicine: what it is and what it isn't. *BMJ, 312,* 71-72.

2 Hosudarstvennaia prohramma razvitiia zdravookhraneniia Respubliki Kazakhstan «Densaulyk» na 2016–2019 hody [The state program for the development of health care in the Republic of Kazakhstan «Densaulyk» for 2016–2019]. (n.d.). *adilet.zan.kz.* Retrieved from http://adilet.zan.kz/rus/docs/V1600000176 [in Russian].

3 Hosudarstvennaia prohramma «Tsifrovoi Kazakhstan»[The state program «Digital Kazakhstan»]. (n.d.). *adilet.zan.kz.* Retrieved from http://adilet.zan.kz/rus/docs/P1700000827 [in Russian].

4 Rodrigues, J. (2000). Information systems: the key to evidence-based health practice. *Bull. World Health Organ, 78, 11,* 1344-1351.

5 Sackett, D.L., Straus, S.E., Richardson, W.S., Glasziou, P., & Haynes, R.B. (2000). Evidence-Based Medicine: How to Practice and Teach EBM. *BMJ, 452,* 152-154.

6 Jeffrey, A., & Timothy, C. (2005). History and development of evidence-based medicine. *World J. Surg, 29,* 547-553.

7 Rube, T. (2008). Electronic health information: The key to evidence-based medicine and improved patient care. *Gov. Insights.*

8 Hunt, D.L., Haynes, R.B., & Hanna, S.E. (1998). Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. *JAMA, 280,* 1339-1346.

9 Bukken, S. (2001). An informatics infrastructure is essential for evidence-based practice. *J. Am. Med. Inform. Assoc, 8,* 199-201.

10 Wells, L. (2007). Role of information technology in evidence based medicine: advantages and limitations. *Internet J. Healthc. Admin, 4,* 2.

11 Sait o kazakhstanskom rynke informatsionnykh tekhnolohii [Site about the Kazakhstan market of information technologies]. *profit.kz.* Retrieved from http://profit.kz [in Russian].

12 Babich, T.N., Kozyeva, I.A., Vertakova, Yu.V. & Kuzbozhev, E.N. (2013). *Prohnozirovanie i planirovanie v usloviiakh rynka [Forecasting and planning in market conditions].* Moscow: NITs INFRA-M [in Russian].

13 Aminpour, F. (2004). Medical informatics: concepts and applications. *Iran. J. Med. Educ., 4, 2,* 95-103.

14 Mueller, M.L., Ganslandt, T., Frankewitsch, T., Krieglstein, C.F., Senninger, N., & Prokosch, H.U. (1999). Workflow analysis and evidence-based medicine: Towards integration of knowledge-based functions in hospital information systems. *Proc AMIA Symp,* 330-334.

15 Hemiear, M. (2004). Improving patient safety with technology. *Int. J. Med. Inform, 73, 7,* 543-546.

16 Humphreys, L. (2000). Electronic health record meets digital library: a new environment for achieving an old goal. *J. Am. Med. Inform. Asso, 7, 5,* 444-452.

17 Humphreys, B.L., & Lindberg, D. (1993). The UMLS project: making the conceptual connection between users and the information they need. *Bull. Med. Libr. Assoc, 81, 2,* 170-177.

18 Ahmadi, M., Barabadi, M., & Kamkar Haghighy, M. (2010). Evaluation of hospital information system in the medical records department. *Health Inf. Manag, 7,* 16-23.

19 Ofitsialnyi sait oblastnoi klinicheskoi bolnitsy [Official site of the regional clinical hospital]. *okbkar.kz.* Retrieved from https://okbkar.kz [in Russian].

20 Shayakhmetova, B.K. (2010). *Tekhnolohiia sozdaniia prohramm dlia slozhnykh sistem [Technology of creating programs for complex systems].* Astana: Turan-Pro [in Russian].

21 Virt, N. (1985). *Alhoritmy + struktury prohramm = prohrammy [Algorithms + program structure = program].* Moscow: Mir [in Russian].

22 Clamp, S., & Keen, J. (2007). Electronic health record: is the evidence base any use? *Med. Inform. Internet Med, 32, 1,* 5-10.

23 Wright, A., Sittig, D.F., Ash, J.S., Sharma, S., Pang, J.E., & Middleton, B. (2009). Clinical decision support capabilities of commercially-available clinical information systems. *J. Am. Med. Inform. Assoc. 16, 5,* 637-644.

24 Young, J.M., & Ward, J.E. (2001). Evidence-based medicine in general practice: beliefs and barriers among Australian GPs. *J. Eval. Clin. Pract, 7, 2,* 201-210.

25 Hersh, R., & Hickam, H. (1998). How well do physicians use electronic information retrieval systems? A framework for investigation and systematic review. *JAMA, 280, 15,* 1347-1352.

26 Mansson, J., Nilsson, G., Bjorkelund, C., & Strender, L.E. (2004). Collection and retrieval of structured clinical data from electronic patient records in general practice. *Scand. J. Prim. Care, 22,* 6-10.