

# Application of Medical Information Systems for the Implementation of Lean Technologies in the Management of Medical Institution

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**Abstract.** The article considers the principles of application of lean technologies for management of medical organization. It is shown that the introduction of medical information systems can improve the business processes of the clinic, increase patient satisfaction, availability of services, increase efficiency and eliminate temporary, financial and other losses.

Specialized software for organization of logistic flows during medical examinations is presented. The article describes the experience of implementing the automation system of the medical institution within the framework of the target program "Digital economics of the Russian Federation".

Among the results that can be achieved in the implementation of the approach, it is possible to identify a reduction in the waiting time for the patient to receive services, increasing patient satisfaction with the quality and timing of services, ensuring a balanced distribution of functional responsibilities between doctors and the average medical staff, as well as the restriction of staff functions within individual structural units (registry, clinical laboratory, etc.), optimization of information flows, including improving the efficiency of the medical information system, elimination of duplication and excessive manual labor when entering medical information into an electronic medical record.

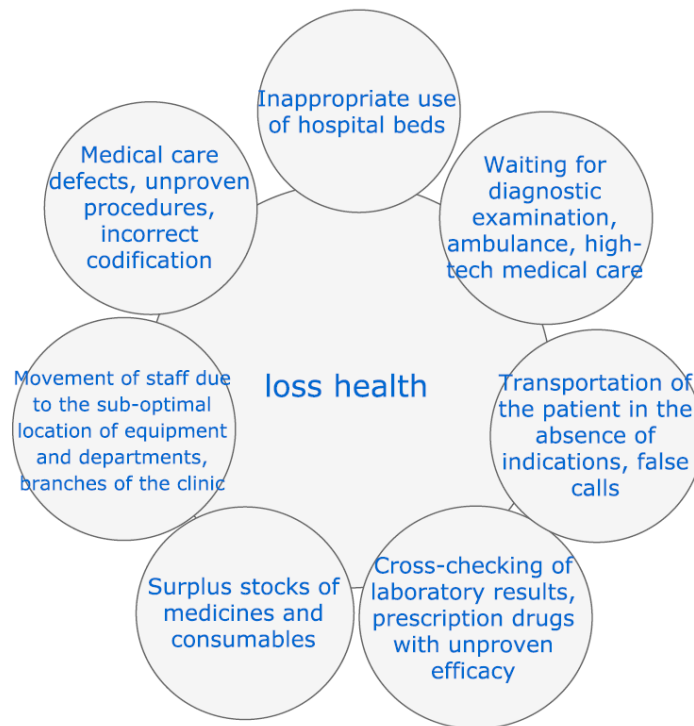
The necessity of formation of doctors competences in the field of information technologies within the system of continuous medical education is also shown, the program of professional development on the basis of effective interaction of higher educational institution and practical health care is offered.

**Keywords:** lean manufacturing technologies, medical information systems, automated control system of medical examinations

## 1 Principles of Lean Production for Health Care

In recent years, great attention has been paid to the development of one of the most socially important sectors of the economy – healthcare. However, despite the emerging positive trends in the growth of life expectancy, reduction of mortality, including infant mortality, yet health care reforms in Russia have not yet yielded the expected result.

A possible solution - a set of approaches and methods to improve production efficiency and product quality, which received the definition of Lean production (LP) is a management concept based on a steady desire to eliminate all types of losses. Lean production involves the involvement of each employee in the process of business optimization and maximum focus on the consumer. RyazGMU participates in the implementation of this approach in the leading institutions of the Ryazan region in the framework of a joint project of the Ministry of health of the Russian Federation and the state corporation "Rosatom". The project "Lean hospital" are implemented to improve processes in medical organizations aimed at increasing patient satisfaction and availability of services, increase efficiency and eliminate the existing time, financial and other losses, improving the workplace, ensuring the safety and comfort of employees' work (see Fig.1).



**Fig. 1.** Scheme of possible losses detected in healthcare institutions

So, in short, the project "Lean clinic" is designed to optimize the work of the registry, health workers, laboratories and remove unnecessary walking around the offices so. In the framework of the joint project of the Ryazan state medical university in Ryazan and "Ryazan-stroy" is carried out on the development and implementation of specialized software for the implementation of lean production concepts, in particular engaged in the logistics of patient flows in the institution. With its help, it is possible to create a itinerary for visiting doctors with a minimum waiting time, which signifi-

cantly reduces the presence of the patient in a medical institution and as a result, reducing queues [1].

## **2 Digital Transformation of Medicine**

Great hopes in the modernization of the management system in medicine are placed on the transition to digital health care, the widespread introduction of telemedicine technologies. The approaches that they provide, you can solve the problems of efficiency at all stages of rendering of medical aid.

Over the past ten years, the Russian Federation has accumulated considerable experience in the development and implementation of information systems used in the work of health care institutions and health management at various levels [2]. As part of the construction of "Digital health" at the state level, the task is to create conditions for the construction of a common information space in the field of medicine, the widespread introduction of information technologies for the real improvement of the quality of medical care.

The introduction of information systems of different levels for the effective management of the medical institution is associated with the solution of several tasks of modernization of the health system:

- creating the necessary economic conditions;
- development and updating of computer and communication tools;
- operational improvement of information systems in connection with the introduction of new requirements;
- improvement of the user's intellectual environment through various forms of training and retraining.

Thus, the process of informatization in health care has several components: economic (investment), technical (computing and communications), information (medical information system, specialized software), the intellectual (trained personnel and patients).

If the technical and economic components are completely dependent on financial investments, then the rest is also determined by the human factor, and the elimination of difficulties here is the most laborious task.

Therefore, one of the most significant problems of informatization of medical and technological processes and management of health care is the creation of the necessary software and intellectual level among physicians, starting with managers and ending with average medical workers.

## **3 Specialized Software for Implementation of lean Manufacturing Approaches in Polyclinics**

The project "Lean hospital" aims to optimize the registry, health care workers, laboratories and deleting the unnecessary walking from office to office patients. In the

framework of the Ryazan state medical University jointly with "KIVTS Ryazan'stroy" on the basis of 1C program was written which optimizes the logistics flow of patients in a medical facility. With its help, it is possible to create a route list of visits to doctors during medical examination with a minimum waiting time, which significantly reduces the presence of the patient in a medical institution and as a consequence reduces queues, reduces the economic costs of the organization.

To get started in the program you need to fill in the directories. Reference "EXPERTS" designed to maintain a database of the specialties of the doctors of the medical institution.

Directory "EMPLOYEE" is designed to maintain a database of hundreds of medical organizations in accordance with their specializations. Templates for preventive examinations are created for each age group, in which doctors and their time of admission are entered.

Reference books "PATIENTS" and "INSURANCE COMPANIES" are used to maintain a database of patients and their details, if the medical institution in the course of work need to store data on patients. Help is created for each section of the program to facilitate the use of all functionality.

After filling of reference books it is necessary to fill in the section "SCHEDULES of WORK" in which the schedule of doctors according to types of examinations contains (see Fig.2).



**Fig. 2.** The formation of a single card for medical examination

On the basis of the schedule of doctors, a single coupon per day is created in the SINGLE COUPON section to visit several doctors.

When creating a single pass selects the type of inspection, date of visit, change of doctor and pressed to FORM a UNIFIED CARD ACCORDING to the SCHEDULE. A list of doctor's visit vouchers per day is created.

Thus, the passage of medical examinations is carried out for one visit, the patient passes the maximum possible number of doctors, which significantly reduces his time in the clinic and reduces the size of queues, optimizes economic and labor costs.

This program has been successfully installed and is already used in children's polyclinic №7, as well as installed and is being tested in children's polyclinic №1. With its help, it was possible to reduce the time spent on the examination of the patient in the clinic for 1 month old children to 35 minutes (need to be examined by 3 doctors), and for 12 months – up to 1 hour 15 minutes (need to be examined by 5 doctors). At the moment, additional modules of the program are being developed, thanks to which it will be possible to collect statistics of medical examinations.

## **4 Modernization of Medical Education in the Field of Information Technology**

### **4.1. Advanced Training of Doctors and Interaction of the University with Practical Health Care**

As our experience shows, the introduction of any automated systems should be accompanied by training of users and their material stimulation, since the use of computer technology entails not only organizational and technological restructuring, but also requires intensification of labor.

Without the creation of a system of total training and retraining of medical personnel and the field of Informatics, it is impossible to solve the problems of informatization of the industry. At the moment, among the heads of health care bodies and institutions and practitioners, the percentage of retraining is very low.

In this regard, Ryazan state medical University, on the basis of the Department of mathematics, physics and medical Informatics, organizes advanced training courses for doctors using distance learning technologies to teach them the basics of work in medical information systems [3].

For the implementation of lean manufacturing methods the medical staff should have skills in the field of IT:

- maintenance of medical records in electronic form,
- registration of sick-lists in electronic form,
- create medical documentation of statistical reports,
- development of templates for electronic maps;
- organization of referral to another institution or appointment with a specialist and laboratory tests.

The peculiarities of training of existing specialists-doctors are revealed [4]:

1. different level of computer literacy of medical workers, often complete rejection of computer technologies (applied individual approach to training, the use of a multi-media projector to demonstrate all operations);
2. the presence of features of the input medical data in the field of e-forms (used to work with filters and templates);
3. the presence of features of documentation for different types of reception (technical specialists need to advise specialists on the organization of health care);
4. the need for step-by-step instructions for students (detailed developed clear step-by-step instructions for laboratory work).

During the training, students increasingly noted the advantages of using information technologies in medicine in General, in the design of copper-zinc documentation and organization of polyclinic.

The use of information technology as a tool for safe production in medicine has already yielded excellent results. The time of direct work of the doctor with patients increased by 2 times, queues decreased by 8 times, and the waiting time of the doctor at the office – by 12 times.

#### **4.2. Training of Students and Residents**

One of the goals of modern medical education is the formation of the necessary professional information competencies, so RyazGMU is modernizing the course "Medical Informatics" for students in the direction of "Medical care" [5]. The purpose of mastering the discipline is to form students' systemic knowledge in the field of computer technology, informatization of medical activities, automation of clinical and laboratory research, computerization of management in the field of health care and the ability to receive and process information from various sources, work with information on the Internet, use the capabilities of modern telemedicine technologies to solve professional problems.

The possible strategy of teaching medical Informatics is proposed by the chief freelance specialist of the Ministry of health of the Russian Federation on informatization, doctor of medical Sciences, prof. Teaching medical Informatics for students in the direction "medicine" on 1 course helps to build competence related to the simple processing of information with the use of application software, but not having the required specialized knowledge, a student is unable to learn and apply in practice these sections of the course, systems of support of decision-making, computer modeling of pharmacokinetic processes, automated medical-technological system of monitoring and control functions of the body, the use of an automated workplace doctor in clinical practice, the use of information medical systems in the management of medical institutions.

It is advisable to divide the discipline "Medical Informatics" into three relevant modules, one of which is designed to form the basic skills of the use of medical information systems (MIS) of different classes in the professional activity of the doctor. For training, training versions of MIS are used to fill in electronic medical records, automated workplaces of medical personnel, systems for supporting medical decision-making, etc. Of course, training in the second and third modules should be conducted

at senior courses, as students should have a significant amount of knowledge about the main medical technological processes.

In clinical departments it is also necessary to develop the use of information technologies, for example, the treatment of patients can be based entirely on the technology of electronic medical records instead of traditional medical histories. For methodological support of disciplines it is necessary to introduce widespread use of remote educational resources and distance courses [7].

To improve the level of ownership of medical information systems (MIS) of primary health care workers in RyazGMU organized courses PC "Basics of work in MIS", as well as developed and implemented in the educational process course "Medical information systems" for all special functions of the residency.

Higher education should train specialists ahead of the demands of the economy, which is why it is also necessary to note the importance of improving the skills of teachers in the field of it.

## 5 Conclusions

Thus, the proposed approach to the introduction of information technologies in the organization of medical institutions allows to achieve the goal of improving the availability and quality of medical care to the population by optimizing the processes, improving the skills of health workers, and is also a means of developing health information.

The aim of the project "Lean polyclinic" is to improve the processes aimed at increasing patient satisfaction, availability of services, increase efficiency and elimination of existing temporary, financial and other losses, as well as the organization of jobs, ensuring the safety and comfort of employees. Within the framework of the project, a specialized software was developed to manage the logistic flows of patients in the polyclinic during medical examinations.

The described modifications of medical education, the integration of the University with practical health care and the widespread introduction of it in the framework of continuous medical education will ensure the formation of information competencies of future doctors and their readiness to work with new information technologies in digital health.

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