

## The Impact of Lean Technology on the Efficiency of Medical Organizations

Vladimir Alexandrovich Shelgunov<sup>1</sup>

<sup>1</sup>Federal Research Institute for Health Organization and Informatics of the Ministry of Health of the Russian Federation, Moscow, Russia.

### Abstract

*The financial problems of the health sector affect almost all countries. The introduction of market mechanisms in this sector, despite the resistance, has become inevitable. Today, hospital managers are faced with competition and rules that govern the market, which de facto forces them to optimize business, including financial activities, using tools that are specific to the market environment. One of the methods of optimizing the activities of medical organizations is the use of the Lean management concept.*

*The purpose of this article is to consider the impact of the use of Lean technology on the efficiency and quality of the work of medical organizations.*

*The article provides a detailed description of the use of Lean technologies in medical organizations. Based on the expert survey, the types of losses in medical organizations and Lean management tools in the healthcare sector have been determined.*

*It has been concluded that the use of Lean technology in medical organizations will contribute to the rationalization of processes in the healthcare sector: minimizing the number of medical errors and nosocomial infections, reducing treatment time, while at the same time making hospital beds more accessible, using fewer materials and waiting for a visit to a specialist doctor, and optimizing the use of resources (premises, equipment, and materials). These and many other positive effects of using the Lean approach in medical organizations lead to a significant reduction not only in the cost of treating patients but also in the global cost of operating medical organizations.*

**Key-words:** Lean Management, Lean Management Tools, 5s, Kanban, Kaizen, Visual Management, Error Prevention Method.

## 1. Introduction

Demographic, epidemiological, technological, economic changes and other processes occurring in the field of health care face medical organizations with the problem of optimal use of limited resources (for example, financial, human) to meet the needs of patients related not only to the purely medical aspect of health services but also non-medical areas (for example, accessibility, quality of service) [26,27]. Therewith, the specifics of medical services and the importance of the health sector do not allow isolating economic efficiency from social efficiency – their interdependence affects the overall assessment of the system by the patient [28].

Observation of the work of Russian medical organizations suggests that so far these organizations have not experienced strong competitive pressure, focusing in management processes on the essence of their activities – the treatment of patients. However, even in this industry today, it is possible to see the consequences of the functioning of the market mechanism, mainly in the availability of funding sources, which is closely dependent not only on the growing number of competitors (the volume of the commercial medicine market in Russia in 2020 increased to 811 billion rubles, and by 2025 it will exceed a trillion rubles [10, 24]) but also on patient satisfaction with the treatment process.

In addition, state-owned health care entities have less freedom in the variety of services provided, in comparison with purely private entities, which should be another factor in the strong pressure of internal transformation of this group of units towards modern organizational trends. It should also be emphasized that the efficiency of the functioning of public hospitals, which are both a structural element of the public health service and separate units operating on market principles, significantly affects the efficiency of the entire health system. Thus, it became necessary to look for such management systems for these organizations that would allow maximizing the use of available resources and generating positive financial results (although not necessarily to maximize them).

Therefore, the existing management methods should give way to proven, modern, and effective concepts. One of them is the Lean management method. The concept is to optimize the processes carried out within the organization, mainly by eliminating waste and improving efficiency and productivity, which as a result leads to a reduction in the duration of treatment, while at the same time ensuring high quality, so important for the health sector.

This type of management is successfully used in the United Kingdom, Spain, Sweden, Italy, as well as in the United States and Australia. "Lean management" is not only about cost optimization (according to the study [1], more than 20% of hospital expenses are associated with incorrect working methods), but, above all, the safety of the facility's operation.

In the Russian healthcare sector, the Lean management concept became known in connection with the launch in 2016 of the federal project "Lean Polyclinic", the main goal of which is to introduce lean manufacturing in outpatient settings to reduce waiting lists, speed up the delivery of tests and simplify the appointment to the therapist. Currently, about 300 polyclinics across the country are involved in the transformation process, and it is planned to transfer 95% of children's polyclinics to lean production by 2026. [25]

## **2. Literature Review**

Lean management is the concept of business management, which is to maximize the use of available resources. Its essence is to simplify (reduce) the actions performed by employees, save money, eliminate unnecessary downtime and bottlenecks in the organization. The principles of lean management were created in the 1950s as a response to the crisis of the Japanese Toyota concern. Due to their implementation, the company soon became the world leader in the automotive market. [2] The effectiveness of the method has led to the fact that it is now used by various organizations around the world, regardless of the size and specifics of the action. We find many definitions of the essence of Lean management in the subject literature (Table 1).

Table 1 - Definition of the concept of the Lean management entity

Source	Definition
[3]	a management method focused primarily on reducing costs by eliminating losses
[4]	a management methodology that allows an organization to have a culture that let all its members be interested in continuously reducing cost and improving quality, to meet customer expectations as much as possible, and to thrive, following the smoothly changing environmental conditions
[5]	a concept in which the main goal is to prevent all types of losses, through a continuous process of rationalization of the entire enterprise and its relationship with the environment
[6]	the concept is to eliminate actions that do not give value to the product, that is, those for which the customer does not want to pay
[7]	a concept that shows how to produce more and more while consuming less and less – less human labor, less equipment, time, and space – while meeting customer needs at an increasingly high level
[8]	a set of management tools and systems, a method for continuous improvement and interaction of employees, a way to solve problems that are important from the point of view of managers and at all levels of the organization

Lean management is defined in medical organizations as a set of tools, a management system, and a philosophy that can change the way hospitals are organized and managed. A method that allows hospitals to improve the quality of patient care by reducing errors and waiting times. [11] Lean management is a concept that can support doctors and other employees by removing obstacles and allowing them to focus on those actions that serve to treat and care. Lean management allows strengthening the organization of the hospital for the long term – by reducing costs and risks and simultaneously increasing opportunities for development and growth [12].

In the field of healthcare, lean consists in improving the procedural approach [13], to organize the process of providing medical services (or other services performed for an external and internal client) in such a way that it will reduce the time of their implementation, affects both improving the efficiency of activities, reducing erroneous actions, reducing costs, implemented benefits, as well as

expanding opportunities for providing medical services, and improving the efficiency of the implementation of this process and, as a result, improving its quality. The way to achieve this goal is to ensure the stability of the implemented actions and their standardization, which promote reproducibility, reduce execution time and maximize the degree of uniformity of the resulting effects.

According to [14], the essence of lean management in medical organizations is based on: 1. determining what brings value to the patient; 2. recognizing all processes, stages that affect patient satisfaction; 3. optimizing the flow of all operations and actions within these processes; 4. rational use of all available material and non-material resources of this object; 5. providing what benefits the patient, exactly what he/she expects; 6. continuous ordering of actions and operations by constantly reducing losses that occur due to failed mistakes, misses and omissions.

Research hypothesis: the use of Lean technology in medical organizations will contribute to the rationalization of processes in the healthcare sector.

Research objectives:

1. based on an expert survey, to determine the types of losses in medical organizations;
2. based on the expert survey, to specify and rank the Lean management tools in the healthcare sector;
3. based on the selected sources for the analysis of the literature and the results of the expert survey, to characterize the results of the use of Lean technology in medical organizations.

The article consists of an introduction, a literature review, methods, results, discussion, and conclusion.

### **3. Methods**

#### **3.1 Research Design**

To achieve this goal, the following research methods were used in the article:

theoretical methods: theoretical generalization – to define the concept of the "Lean management" essence; analysis and synthesis – to detail the use of Lean technologies in medical organizations;

empirical methods (expert survey method) – to determine the types of losses in medical organizations, Lean management tools in the healthcare sector.

### **3.2 The Procedure, Research Tools**

The survey was attended by 34 experts, heads of medical organizations of different levels. The experts were asked the following questions regarding the use of Lean technology in organizations:

1. What types of losses currently exist in medical organizations?
2. What are the Lean management tools in healthcare?
3. What are the results of using Lean technology in medical organizations?

All participants were warned about the purpose of the survey and the planning of the organizers of the study to publish the results of the study in a generalized form.

### **3.3 Statistical Analysis**

The mathematical processing of the research results determined the percentage of expert mentions of types of losses in medical organizations, as well as promising Lean management tools in the field of healthcare.

The ranking of the entire set of expert opinions consists in their arrangement by each of the experts in the form of a sequence according to their decreasing preference. In this case, each of the opinions is evaluated by the rank (number) under which they are located in this sequence. The final rank is the arithmetic mean of all the expert ranks in the sample of experts.

## **4. Results**

In the case of a medical organization, losses are all actions that do not add value to the client of the medical organization, do not affect the treatment process, the patient's stay, and the final result of the hospitalization process. For example, according to one expert, nurses in many hospitals devote only about 20-25% of their working time to the patient. In the remaining time, they perform many actions (transporting material for research, searching for documents, etc.).

Based on the expert survey, Table 2 provides examples of the types of losses in medical organizations.

Table 2 - Types of losses

Loss type	%*	Rank	Characteristics	Example in hospitals
Shortcomings and errors (qualitative defects)	94.1%	1	Time spent on incorrect execution of an action, checking and correcting errors	Lost or destroyed materials /medicines; failure to meet the deadlines for procedures; provision of incorrect/incomplete information; lack of instruments on the surgical table; provision of the wrong medicine or the wrong dose to the patient; repetition of medical procedures, for example, in the same patient when transferring to another department
Redundancy of activity	88.2%	2	Perform actions in a larger number or earlier than the patients need. Performing work that does not add value to the client or performing actions longer than intended	Creating information without proper understanding of the needs of patients; performing unnecessary diagnostic procedures; printing out hospital discharge earlier than necessary; too far-fetched controls (requiring too many approvals); excessive reporting; unnecessarily lengthy meetings
Logistics	85.3%	3	Unnecessary movement in the system (patients, samples, materials, documents)	Too frequent transfer of "paperwork"; transportation of the patient by ambulance from hospital to hospital; insufficient use of information technology; incorrect location of the object, for example, a laboratory remote from the emergency department
Expectation	79.4%	4-5	Excessive waiting for further actions, decisions, and information	waiting for employees due to an incorrect schedule; waiting for appointments; ineffective behavior during registration; postponement of actions to the latest allowed date; filled baskets/folders of incoming mail (paper and email)
Stocks	79.4%	4-5	Excess inventory that generates unnecessary costs associated with the purchase, storage, and transportation, as well as leading to damage	Expiring stocks to be disposed of

			and the need for disposal	
Excessive employee movement	73.5%	6	Employee movements in the workplace that can be avoided	Incorrect placement of items (equipment) in the workplace; unjustified call for employees to "personal" appearance; poor ergonomics of workplaces (for example, unnecessary bending, walking, lifting due to incorrectly designed workplaces, premises)
Wasted human potential	70.6%	7	Wastefulness and losses resulting from the non-intervention of employees or the involvement of persons who do not have the necessary qualifications, as well as from ignoring the ideas of employees or from a lack of concern for their development	lack of a system that motivates employees to seek improvement; imperfect teamwork; insufficient interdisciplinary training; too limited/excessive employee responsibility; lack of mutual support

Note: compiled based on an expert survey; \* – percentage of expert mentions

Experts believe that the ability to identify the types of losses by the personnel of medical organizations should be the first (and decisive) step in the implementation of lean technologies, and the second is training in how to eliminate (or at least significantly reduce) losses so that the actions taken by employees contribute to improving the quality of medical services provided to the patient.

According to experts, visual management, 5S, kanban, kaizen, and poka-yoke deserve special attention from the many tools to help lean health management (Table 3).

Table 3 - Lean management tools in healthcare

No.	Tools	%*	Rank
1	5S	79.4%	1
2	management card (kanban)	70.6%	2
3	continuous improvement (kaizen)	64.7%	3
4	visual control	58.8%	4
5	error prevention method (poka-yoke)	50%	5

Note: compiled based on an expert survey; \* – percentage of expert mentions



## 5. Discussion

The purpose of the 5S is to establish and maintain order and discipline in the workplace. According to experts, this method, due to its simplicity in implementation, is especially useful in healthcare.

Therewith, the practice of 5S is one of the foundations for creating a working environment that promotes its harmonious execution, projective actions, and the constant improvement of human relations, which leads to the effectiveness of the organization and increased work safety. The name of the method comes from the first letters of the Japanese words that define its steps. [15] Their breakdown and method of use in medical organizations are presented in Table 4.

Table 4 - Using the 5S method in healthcare

5S Component	Description	Example of use in healthcare
Seiri (selection, sorting)	Selecting and removing unnecessary items, leaving only items used regularly; having only what is needed	Removal of faulty equipment from the operating unit, laboratory, etc; putting in order of escape routes; transfer to the archive of expired documents in the department; removal of expired drugs
Seiton (taxonomy, storage)	The correct arrangement of abandoned items following the principles of logic and ergonomics; marking of items, raw materials, parts, and tools and determining the place where they should be available	Packing of medicines in pharmacy cabinets according to the accepted rules, use of medicine trays, schemes of the correct choice of surgical instruments; packing of items according to the frequency of their use, for example, several places of storage of gloves
Seiso (cleaning)	Daily maintenance of order and cleanliness in the workplace	Drawing up sanitary plans that define the frequency, order, measures, and materials for cleaning individual surfaces
Seiketsu (standardization, systematization)	Development of uniform rules in the organization; establishment of procedures, schemes, control cards, methods of behavior, regulations, prohibitions	Development of the procedure for receiving a patient in the emergency department/office; development of rules for ordering and distributing medicines
Shitsuke (discipline)	Creating a system of continuous compliance with procedures; checking and monitoring the preservation of previous steps and rules	Audit plan to verify compliance with established training standards; grassroots programs for mutual support of activities; symbolic discretionary awards; achievements in the field of 5S

The deployment of 5S is possible due to the use of *visual management tools* that are already used in many medical organizations. [16] In hospitals, they are often used to determine the status of patients and their needs. An example is a light signal, the so-called *andon*, which is used to determine the location of the process that requires additional attention (a light bulb above the door of the room where the patient requires immediate intervention). [17] An example of visual solutions in the field of healthcare is also the implemented patient identification systems-sorting within the so-called START system (Simple Triage And Rapid Treatment), which uses the categorization of victims using bracelets or badges of four colors, which are awarded at the scene, depending on the state of health of the victim and the injuries suffered by him/her. [18]

Another example of visual management can be the use of department maps of a medical organization, available in the electronic version. They allow quickly finding a patient in a given department, for example, his/her relatives, quickly finding empty seats, for example, when a patient is admitted to the hospital. [9, 19]

A specific visual control technique is *the kanban card*, which provides employees with access to the necessary materials (sterilized instruments, disposable needles, dressings, medicines, clean sheets, etc.), at the right time and in the right quantity, with a minimum level of inventory maintenance. [20] The implementation of *kanban* often involves the use of elements of other methods, such as visualization, 5S. In this method, the most important element is to determine the optimal level of stocks, which, on the one hand, will ensure the safety of operation, and on the other – will not be generated into unnecessary stocks. A very good example of the application of the *kanban* method in a hospital is its use when ordering medicines, within the framework of an electronic procurement system, that is, their delivery to the department exactly on time, when it is necessary, in the amount determined by current needs. This prevents the excess of medicines and their delinquency resulting from excessive accumulation. [21]

Another tool of Lean management in the healthcare sector is *the kaizen management system*, which allows supporting the implemented improvement solutions, as well as initiating actions. This approach is based on constant, persistent improvement of even small details, theoretically insignificant errors. This requires constant improvement of all employees [22]. This is mainly due to the involvement of all employees (regardless of level) in the constant search for ideas to improve the various areas of the organization's functioning. This is important because even small changes, which often do not involve costs, can be a significant source of savings in the organization's resources.

Another answer to the constant search for ways to improve work processes is poka-yoke, a method of developing (or improving) processes in such a way as to limit the possibility of making mistakes (for example, to prevent the use of expired medicines). The method focuses on the error itself and the actions that should prevent it. All employees of the medical organization should participate in the work since they are the ones who best know the working processes (the costs of time, activities, and material resources that exist in them), and can suggest ways to improve them (add value). In the practical use of this tool, it may be useful, for example, to develop a standard checklist of actions performed when patients are discharged from the hospital, or to use barcodes [23] in the functioning of medical organizations.

## **6. Conclusion**

The results of the study showed that the main advantages of using Lean technologies in the field of healthcare can be attributed primarily to their impact on cost savings, leading to an improvement in the economic situation of the facility; the impact on time savings associated with the ordering and optimization of actions and processes that bring immediate value to patients; improving patient safety; improving the quality and safety of staff; the introduction of uniform rules of conduct due to standardization and repeatability of procedures and actions. Therewith, according to experts, the most useful tool of Lean management in the field of healthcare, due to its simplicity in implementation, can be the 5S method.

The results of the study confirmed the hypothesis that the use of Lean technology in medical organizations will contribute to the rationalization of processes in the health sector: minimization of the number of medical errors, nosocomial infections, reduction of treatment time, while at the same time higher availability of hospital beds, less consumption of materials and waiting for a visit in specialized offices, and optimization of the use of resources: premises, equipment, and materials. These and many other positive effects of using the Lean approach in medical organizations lead to a significant reduction not only in the cost of treating patients but also in the global cost of operating medical organizations. It also helps to improve the management of a particular organization.

## References

- McGlynn E.A. There is no perfect health system// *Health Affairs (Millwood)*. 2004. Vol. 23. pp. 100-102.
- Raab S.S., Grzybicki D.M., Sudilovsky D., et al. Effectiveness of Toyota process redesign in reducing thyroid gland fine-needle aspiration error// *American Journal of Clinical Pathology*. 2006. Vol. 126. pp. 585-592.
- Teich S,T, Faddoul F,F. Lean management—the journey from Toyota to healthcare// *Rambam Maimonides Medical Journal*. 2013. Vol. 4(2). e0007.
- Spear S., Bowen H.K. Decoding the DNA of the Toyota production system// *Harvard Business Review*. 1999. Vol. 77. pp. 96-106.
- Mazzocato P., Thor J., Backman U., et al. Complexity complicates Lean: lessons from seven emergency services// *Journal of Health Organization and Management*. 2014. Vol. 28(2). pp. 266-288.
- Zidel T.G. Lean principles// *Lean Guide to Transforming Healthcare: How to Implement Lean Principles in Hospitals, Medical Offices, Clinics, and Other Healthcare Organizations*. 1st ed. Milwaukee. - WI: ASQ Quality Press; 2006. pp. 1-6.
- Kaplan G.S., Patterson S.H., Ching J.M., Blackmore C. Why Lean doesn't work for everyone// *BMJ Quality and Safety*. 2014. Vol. 23(12). pp. 970-973.
- Baker G.R. Improving healthcare using Lean processes// *Healthcare quarterly*. 2014. Vol. 17(2). pp. 18-19.
- Young T.P., McClean S.I. A critical look at Lean Thinking in healthcare// *Quality and Safety in Health Care*. 2008. Vol. 17. pp. 382-386.
- Panning R. Using data to make decisions and drive results: A LEAN implementation strategy// *Clinical leadership & management review*. 2005. Vol. 19. E4.
- Balle M., Regnier A. Lean as a learning system in a hospital ward// *Leadership in Health Services*. 2007. Vol. 20. pp. 33-41.
- Kim C.S., Spahlinger D.A., Kin J.M., Billi J.E. Lean health care: what can hospitals learn from a world-class automaker?// *Journal of Hospital Medicine*. 2006. Vol. 1(3). pp. 191-199.
- King D.L., Ben-Tovim D.I., Bassham J. Redesigning emergency department patient flows: application of Lean Thinking to health care// *Emergency Medicine Australasia*. 2006. Vol. 18. pp. 391-397.
- Toussaint J.S., Berry L.L. The promise of lean in health care// *Mayo Clinic Proceedings*. 2013. Vol. 88(1). pp. 74-82.
- Young F.Y. The use of 5S in healthcare services: a literature review// *International Journal of Business and Social Science*. 2014. Vol. 5(101). pp. 240-248.
- Aboumatar H.J., Weaver S.J., Rees D., Rosen M.A., Sawyer M.D., Pronovost P.J. Towards high-reliability organizing in healthcare: a strategy for building organizational capacity// *BMJ Quality and Safety*. 2017. Vol. 26(8). pp. 663-670.

- Casey J.T., Brinton T.S., Gonzalez C.M. Utilization of lean management principles in the ambulatory clinic setting// *Nature Clinical Practice Urology*. 2009. Vol. 6(3). pp. 146-153.
- Moraros J., Lemstra M., Nwankwo C. Lean interventions in healthcare: do they actually work? A systematic literature review// *The International Journal for Quality in Health Care*. 2016. Vol. 28(2). pp. 150-165.
- McIntosh B., Sheppy B., Cohen I. Illusion or delusion — Lean management in the health sector// *International Journal of Health Care Quality Assurance*. 2014. Vol. 27(6). pp. 482-492.
- Vats A., Goin K.H., Villarreal M.C., Yilmaz T., Fortenberry J.D., Keskinocak P. The impact of a lean rounding process in a pediatric intensive care unit// *Critical Care Medicine*. 2012. Vol. 40(2). pp. 608-617.
- Aasebo U., Strom H.H., Postmyr M. The Lean method as a clinical pathway facilitator in patients with lung cancer// *The Clinical Respiratory Journal*. 2012. Vol. 6(3). pp. 169-174.
- Burgess N., Radnor Z. Evaluating Lean in healthcare// *International Journal of Health Care Quality Assurance*. 2013. Vol. 26(3). pp. 220-235.
- Joosten T., Bongers I., Janssen R. Application of lean thinking to health care: issues and observations// *The International Journal for Quality in Health Care*. 2009. Vol. 21(5). pp. 341-347.
- BusinesStat. Analysis of the medical services market in Russia in 2016-2020, assessment of the impact of coronavirus, and forecast for 2021-2025. <https://businessstat.ru/catalog/id8707/>
- PwC. Innovation Management in Healthcare: Lean Manufacturing in a Private Clinic. <https://www.pwc.ru/ru/publications/lean-health-care.pdf>
- Mokhov, A. A., Svirin, Y. A., Gureev, V. A., Kulakov, V. V., and Shestov, S. N. (2020). Social and Legal Healthcare Models and Their Functioning During a Global Crisis. *Cuestiones Políticas*, 38(66), 248-265. <https://produccioncientificaluz.org/index.php/cuestiones/article/view/34324>
- Glembotskaya, G. T.; Eremin, S. Y.; Chupandina, E. E. 2020. Scientific priorities and real prospects for cost optimization in formulation development, *Entrepreneurship and Sustainability Issues* 7(3): 1484-1499. [https://doi.org/10.9770/jesi.2020.7.3\(4\)](https://doi.org/10.9770/jesi.2020.7.3(4))
- SAKTAGANOVA, Indira Sovetovna et al. Legal Framework of Developing Corporate Governance in Healthcare Organizations in Kazakhstan. *Journal of Advanced Research in Law and Economics*, [S.l.], v. 10, n. 3, p. 890-903, June 2019. ISSN 2068-696X. <https://journals.aserspublishing.eu/jarle/article/view/4686>