

Lean manufacturing + healthcare= lean healthcare, a way to optimize efficiency in the healthcare sector

Abstract

The concept of Lean Manufacturing arises within the Toyota Production System (TPS) with the aim of eliminating all activities that do not generate value to enhance and increase productivity. Lean Manufacturing is applied in the West, and the concept transforms into Lean Manufacturing (LM). This concept no longer belongs solely to the automotive sector; all its tools have now migrated to all activities of daily life. An important application, particularly in dealing with human lives, is in the healthcare sector, specifically in hospitals. This gives rise to the concept of Lean Healthcare, which has broad applications, often resulting in process improvements, the elimination of non-value-generating activities, and better resource management.

Keywords: lean manufacturing, DMAIC, lean healthcare, value stream mapping, spaghetti, 5's

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Abbreviations: TPS, Toyota production system; LM, lean manufacturing; VSM, value stream mapping; MRSA, methicillin-resistant staphylococcus aureus; ED, emergency department

Introduction

Currently, the concept of Lean Manufacturing is expressed and involved in various areas of study, and it has also been making significant strides in the healthcare sector,¹ giving rise to the concept of Lean Healthcare. This integration involves the application of methodologies such as Value Stream Mapping (VSM), spaghetti diagrams, Kaizen, the Five S's, among others, to improve healthcare delivery, patient outcomes, and cost-effectiveness. The impact of Lean Healthcare on healthcare systems, especially in low- and middle-income countries, has been the subject of systematic reviews and research studies. The application of Lean Manufacturing principles in the healthcare sector, including interoperability, visualization, decentralization, and real-time capabilities, has been identified. Lean Healthcare has revolutionized healthcare delivery by enabling more efficient healthcare services and achieving personalized care, thereby improving access to quality healthcare. The symbiotic relationship between Lean Manufacturing and Healthcare is driving the development of innovative solutions in the healthcare field and transforming the future of healthcare.

In summary, Lean Healthcare² is a methodology based on Lean Manufacturing principles, adapted, and applied to the healthcare domain. Its goal is to optimize efficiency and quality in the healthcare sector, minimizing waste and improving patient satisfaction. Key aspects of the Lean Healthcare methodology include:³

Patient focus: The patient is always at the center of attention, and their satisfaction, along with that of the healthcare workers, is fundamental.

Emphasis on specialization: It relies on the specialization of workers to always provide added value.

Effective communication: Special emphasis is placed on communication among all areas involved, including medical, technical, administrative, and management personnel.

Continuous improvement: The Lean methodology is based on continuous improvement in processes to achieve the highest quality and minimize waste.

Staff participation: Successfully applying the Lean method in healthcare requires the participation of all members of the organization, as they are responsible for identifying areas for improvement and finding solutions.

Lean Healthcare has been adopted by many healthcare organizations worldwide. The application of Lean principles in healthcare has allowed organizations to leverage a set of tools to improve efficiency and quality in the healthcare sector.⁴ Therefore, this document focuses on analyzing and summarizing the main methodologies applied in the healthcare sector that have made hospital processes more efficient through the application of Lean Manufacturing.

Literature review

We begin this review with the work of A. Becerril-Alquicira and M.R. Ortiz-Posadas,⁵ who propose to improve the management process of medical technology within the Health Service in the State of Morelos, Mexico, using the five stages of the Six Sigma methodology (DMAIC): Definition (to know what the current status of medical technology management was), Measurement (characterization of the current status of Health Service, identifying the involved activities), Analysis (identification of non-value-added activities within the process, each one related to one of the seven wastes), Improvement (the generation of new activities that will generate better results benefiting the customers involved in the process), and Control (the necessary controls designed to ensure that the changes should be kept implanted). They executed these five stages, resulting in a set of proposals to improve the current process of managing medical technology and thereby establish a program to control medical equipment that impacts the three levels of the Health Care Service in the State of Morelos, Mexico.

Additionally, Clark Carboneau et al.,⁶ applied the DMAIC methodology to address a hand hygiene issue in a hospital at Healthcare Services in Albuquerque, New Mexico, which increased hospital-acquired infections for patients. As a result of implementing this

methodology, a 51% decrease in methicillin-resistant *Staphylococcus aureus* (MRSA) was achieved, saving the hospital \$276,500.00 USD and improving hand hygiene among hospital staff.

Martínez Sánchez et al.,⁷ present a proposal to reduce patient waiting times by applying Lean methodology in the gynecological-obstetric emergency service of a clinic in Bogotá. Excessive waiting times were identified, contrary to the standards established by Law 237 of 2008, Republic Senate. The fieldwork was conducted over 6 months, using Lean manufacturing tools such as Value Stream Mapping (to detect value-generating activities) and spaghetti diagrams (to understand worker movements). A time study on a representative sample of patients was also conducted to examine areas and/or processes to identify activities that do not add value to patients and create action plans to improve waiting times. As a result of the proposals in the ARENA simulator, improvements in waiting times of up to 56% were achieved, and processes needing improvement or elimination were defined to reduce patient waiting times.

Marlena Kane et al.,⁸ consisting of a multidisciplinary group led by nurses and doctors, developed a plan to meet the growing demand and improve the patient experience in the emergency department (ED) without expanding the department's current resources. The approach included efficient tools and the involvement of frontline staff and doctors. The application of efficient management principles resulted in faster service, increased patient satisfaction, greater capacity, and reduced resource utilization. The methodologies of the Five S's and Value Stream Mapping (VSM) were applied over a two-year period, achieving the success of their project.

Also, Eric W Dickson⁹ and colleagues worked with Lean tools in an emergency department (ED), implementing a variety of Lean techniques to improve patient and staff satisfaction. The implementation followed a six-step process of Lean education, ED observation, patient flow analysis, process redesign, testing of the new process, and full implementation of the methodology. As a result, they achieved a slight reduction in the ED stay, increased patient satisfaction, and experienced increases in costs per patient. Their work was conducted over the course of one year.

In the study by Peter Hasle¹⁰, it was found that Lean is widely implemented in hospitals, but its impact tends to be limited. In his article, he investigates three possible explanations for this limitation: 1) maturity of personnel regarding the Lean concept, 2) complexity of processes, and 3) value concepts. These explanations are analyzed in a case study of Lean implementation in a university hospital in Denmark. The results show that Lean tends to be applied to secondary and logistical support functions, resulting in a limited impact on overall healthcare performance. Limitations are related to low Lean maturity, the complexity of processes and operations, and differences in value perceptions among various professions (e.g., doctors, nurses, and managers) in hospitals.

The question now is: How to maintain sustainability in healthcare using Lean Healthcare? This is achieved by working on continuous improvement, operational efficiency, and error reduction, leading to safer, more cost-effective, patient-centered long-term care, and achieving a satisfied workforce.¹¹

Operational Efficiency: Lean Healthcare aims to eliminate waste and optimize processes in healthcare systems. By reducing wait times, improving inventory management, and optimizing resource utilization, healthcare becomes more efficient and cost-effective.¹²

Continuous Improvement: The focus of Lean Healthcare extends beyond immediate problem-solving to foster a culture of continuous

improvement. Healthcare organizations must constantly seek ways to enhance care quality, reduce costs, and increase patient satisfaction over time.

Error Reduction and Risk Mitigation: Standardizing processes and promoting effective communication among healthcare team members, Lean Healthcare helps reduce errors and risks associated with patient care. This can lead to improved clinical outcomes and greater patient safety.

Increased Workforce Satisfaction: By engaging staff in problem identification and resolution, Lean Healthcare can improve job satisfaction and reduce staff burnout. This can lead to higher employee retention and a more engaged, productive workforce.¹³

Economically, the implementation of Lean Healthcare also yields benefits, such as reducing operational costs by eliminating waste and improving process efficiency. This helps optimize resources by using them more efficiently, maximizing facility, personnel, and equipment utilization, resulting in better financial management. Additionally, improving patient flow by reducing wait times and care cycles enhances cash flow and profitability for healthcare organizations.

Addressing environmental aspects, Lean Healthcare also aims to eliminate waste, leading to reduced resource consumption and waste generation. Consequently, by optimizing patient care processes and reducing wait times, energy consumption in healthcare facilities can be reduced. Waste reduction and efficient resource use can have a positive impact on the local and global environment, contributing to long-term sustainability.

Regarding social aspects, implementing Lean Healthcare in the healthcare sector and reducing wait times and improving care processes can increase access to healthcare services for all community members. By focusing on patient needs and preferences, Lean Healthcare can enhance patient satisfaction and strengthen the provider-patient relationship. These economic, environmental, and social aspects demonstrate how Lean Healthcare not only benefits healthcare organizations in terms of efficiency and profitability but also has a positive impact on the environment and the community at large.

Conclusion

The conclusion is that Lean Healthcare is beneficial for hospitals, but both the Lean concept and its implementation methods must be tailored to organizational complexity and the diverse values within them to achieve a greater impact. Therefore, it is necessary to develop new models for the Lean concept and its implementation, adapted to the specific context of hospitals, with a stronger focus on patient experiences and the coordination of social relations.

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Conflicts of interest

Authors declare that there is no conflict of interest exists.

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