



Campus São Mateus
UNIVERSIDADE FEDERAL DO ESPÍRITO SANTO



IMPROVING PATIENT SAFETY IN A BRAZILIAN HEALTHCARE ORGANIZATION USING LEAN THINKING

Melhorando a segurança do paciente em uma organização de saúde brasileira utilizando o pensamento enxuto
Mejora de la seguridad del paciente en una organización de salud brasileña mediante el pensamiento lean

Macáliston G. da Silva^{1*}, **Michele da Rosa Paz**², **Rafael Maciel da Silva**³, **Maurício Nunes Macedo de Carvalho**⁴, **Victor Bianchini**⁵, **Rodrigo Lara**⁶, & **Isaac Pergher**⁷

^{1 2 3 5 6} Universidade Luterana do Brasil (ULBRA) ⁴ Universidade Federal do Pampa (UNIPAMPA)

⁷ Universidade Federal de Pernambuco (UFPE)

^{1*} macaliston@ulbra.edu.br ² rp.michele@gmail.com ³ rafale.maciell@ulbra.br ⁴ mauriciocarvalho@unipampa.edu.br

⁵ victor.bianchini@ulbra.rede.br ⁶ rodrigo.lara@ulbra.rede.br ⁷ isaac.pergher@ufpe.br

ARTICLE INFO.

Recebido: 04.09.2025

Aprovado: 23.10.2025

Disponibilizado: 03.11.2025

KEYWORDS: Patient safety; Lean healthcare; Health services management; Continuous improvement.

PALAVRAS-CHAVE: Segurança do paciente, Gestão enxuta na saúde, Gestão de serviços de saúde; Melhoria contínua.

PALABRAS CLAVE: Seguridad del paciente; Lean healthcare; Gerencia en servicios de salud; Mejora continua.

* Corresponding Author: Da Silva, M. G.

ABSTRACT

This paper aims to present the trajectory of a Brazilian healthcare organization in a Lean Healthcare (LH) project to enhance patient safety and integrate a culture of continuous improvement. The action research is about a unit dedicated to diagnostic imaging medicine to investigate and improve patient safety. Advances in mitigating inappropriate processing, patient waiting, and wastes due to movements of employees during the on-site exams were evident. The proposed changes directly impacted on reducing the risk of patient safety failures, enhanced patient identification, and makespan reduction by 30.37%. The article can motivate researchers and health managers to explore in depth the LH as a foundation for management decisions, especially in emerging countries. The paper illustrates that LH provides a practical framework for healthcare organizations to enhance patient safety, improve operational efficiency, and reduce waste through systematic process improvements and a culture of continuous learning. This research contributes by providing a real-world case of LH implementation in a challenging environment, detailing specific waste categories and mitigation strategies, and reinforcing the value of Lean principles for enhancing patient safety and operational efficiency in healthcare.

RESUMO

Este artigo tem como objetivo apresentar a trajetória de uma organização de saúde brasileira em um projeto Lean Healthcare (LH) para aumentar a segurança do paciente e internalizar a cultura de melhoria contínua. A pesquisa trata de uma unidade voltada para medicina de diagnóstico por imagem para investigar e melhorar a segurança do paciente. Foram evidenciados avanços a partir da mitigação de processamento inadequado, espera do paciente e perdas por movimento de funcionários

durante o atendimento dos serviços. As mudanças propostas impactaram diretamente na redução do risco de falhas na segurança do paciente, melhoraram a identificação do paciente e reduziram o tempo total de atendimento em 30,37%. O artigo pode motivar pesquisadores e gestores de saúde a explorar em profundidade o LH como base para decisões de gestão, especialmente em países emergentes. O trabalho ilustra que o LH fornece uma estrutura prática para as organizações de saúde aumentarem a segurança do paciente, melhorarem a eficiência operacional e reduzirem o desperdício por meio de melhorias sistemáticas de processos e uma cultura de aprendizado contínuo. Esta pesquisa contribui fornecendo um caso real de implementação de LH em um ambiente desafiador, detalhando categorias específicas de perdas e estratégias de mitigação, reforçando o valor dos princípios Lean para aumentar a segurança do paciente e a eficiência operacional na área da saúde.

RESUMEN

Este artículo presenta la trayectoria de una organización sanitaria brasileña en un proyecto Lean Healthcare (LH) para aumentar la seguridad del paciente e internalizar una cultura de mejora continua. La investigación-acción se centra en una unidad dedicada al diagnóstico por imagen para investigar y mejorar la seguridad del paciente. Se evidenciaron avances mediante la mitigación del procesamiento inadecuado, los tiempos de espera de los pacientes y los desperdicio por movimiento del personal durante la prestación del servicio. Los cambios propuestos impactaron directamente en la reducción del riesgo de fallas en la seguridad del paciente, mejoraron la identificación de los pacientes y redujeron el tiempo total de atención en un 30,37 %. El artículo puede motivar a investigadores y gestores de salud a explorar LH en profundidad como base para las decisiones de gestión, especialmente en países emergentes. El trabajo ilustra que el LH proporciona un marco práctico para que las organizaciones sanitarias aumenten la seguridad del paciente, mejoren la eficiencia operativa y reduzcan el desperdicio mediante mejoras sistemáticas de procesos y una cultura de aprendizaje continuo. Esta investigación contribuye al presentar un caso real de implementación de LH en un entorno desafiante, detallando categorías específicas de desperdicios y estrategias de mitigación, y reforzando el valor de los principios Lean para aumentar la seguridad del paciente y la eficiencia operativa en la atención sanitaria.

INTRODUCTION

A health care unit is categorized as a complex organization (Borges et al., 2019; Santos et al., 2024; Leite et al., 2024), due to the variability and resilience of its various forming elements that interact dynamically (Marciano et al., 2019; Saurin & Gonzalez, 2013). Social and economic factors, such as increased life expectancy and lack of resources, raise the risk of efficient management (Augusto & Tortorella, 2019; Crema & Verbano, 2019; Henrique et al., 2020). Added to this the design of processes that do not completely eliminate environmental threats (Singh, 2019), hospital infections, medical and medication errors, problems with occupancy rates and length of stay, high operating costs, stress level of health professionals and patient dissatisfaction (Hicks et al., 2015; Tortorella et al., 2019). Aggravated situation in the period of crisis and coping with the Coronavirus (COVID-19) pandemic. For the World Health Organization (WHO) even failure to identify during a service can somehow cause harm to the patient (WHO, 2020), here understood as one who receives medical care (Slawomirski et al., 2017). The harms are related to implications of the structure or function of the body, including diseases, injury, suffering, death, disability or dysfunction, physical, social or psychological level (Ministério da Saúde, 2014). This fact points to the importance of patient safety, where the probability of an incident occurring during the medical care process must be minimized (WHO, 2020). In this sense, it is a priority for health organizations to design an operating unit capable of overcoming such difficulties and continuously improving patient safety (Borges et al., 2019; Crema & Verbano, 2019; Hicks et al., 2015; Sales Coll et al., 2024; Tortorella et al., 2019).

The Lean management model has been applied to promote waste reduction and performance improvement (Bortolotti et al., 2015; Camargo et al., 2018), both in manufacturing (Da Cas et al., 2015; De Freitas & Da Silva, 2017) and service operations (Ferreira & Da Silva, 2018), including the health area (Fournier & Jobin, 2018; Hicks et al., 2015; Lindsay & Aitken, 2024; Tortorella et al., 2019; Toussaint & Berry, 2013). The Lean approach in healthcare organizations is entitled Lean Healthcare (LH) (Henrique et al., 2016), where sustainable implementation requires adaptations of Lean's natural actions developed in other environments, especially in manufacturing (Augusto & Tortorella, 2019; Borges et al., 2019; Fournier & Jobin, 2018). The Lean transformation of processes into value-adding flows in the enterprise is supported by changes in mentality, behavior and structure (Da Silva, 2016). The objective of LH is to reduce or eliminate waste in health operations (Tortorella et al., 2019), as well as to add value to the patient (Fournier & Jobin, 2018; Siqueira et al., 2019; Toussaint & Berry, 2013). Among the possibilities of Lean in the health area, advances are presented in topics such as quality, cost, time of care, team satisfaction and patient safety (Costa & Godinho Filho, 2016). However, the application of HL is challenging due to the complexity of health services (Fournier & Jobin, 2018; Lindsay et al., 2020), involving medical professionals, technical and social aspects centered on the patient (Hicks et al., 2015) and the high impact that small changes can have on final care (Borges et al., 2019; Saurin & Gonzalez, 2013). An LH project goes beyond the simple adoption of Lean principles and tools (Fournier & Jobin, 2018; Leite et al., 2024; Toussaint & Berry, 2013).

Studies on LH in emerging countries are suggested (Borges et al., 2019; Singh, 2019; Tortorella et al., 2019), especially in the Brazilian context, which are still few and deserve attention (Costa & Godinho Filho, 2016). Although there are health care units in the country recognized for

excellence, most face structural restrictions, management delays or inadequate operation model (Marciano et al., 2019; Mendes & Mirandola, 2015). These factors compromise their performance evidenced by queues and patient dissatisfaction (Marciano et al., 2019). Describing the evidence of Lean use in healthcare and its implications is desirable to expand benchmarking opportunities with other applications and research (Augusto & Tortorella, 2019). In this sense, the objective of this paper is to present the introductory journey of a Brazilian healthcare organization in a project to increase patient safety from the fundamentals of LH. The research deals with a health service that operates with diagnostic medicine by image and aims to improve patient identification, as well as internalize in its structure the culture of continuous improvement.

THEORETICAL FRAMEWORK

HEALTH SERVICES SYSTEM AND PATIENT SAFETY

Because they present a large number of elements interacting simultaneously and with high variability, health services are categorized as complex systems (Marciano et al., 2019; Saurin & Gonzalez, 2013). Often, due to the different interactions between their actors, such as suppliers, legal regulators, health plans and patients, health service providers cannot establish equal gains, that is, the different needs of each actor interfere with business models in this sector (Lopes et al., 2019). Even health organizations tend to have boundaries and diffuse roles (Augusto & Tortorella, 2019; Leite et al., 2024), how to provide services and research, technical and operational leadership, public and private care, social and customer value, and still act with the uncertainties of demand in health, available resources and the legal and political pressures of the sector (Fournier & Jobin, 2018). Healthcare operations involve interactions between physicians, patients, visitors, supplies, equipment, medicines and information (Hicks et al., 2015; Marciano et al., 2019). These elements added to processes planned in stages, without a systemic view of the organization (Bopp & Da Silva, 2017), cause waste of material and human resources (dos Santos et al., 2024; Slawomirski et al., 2017; Toussaint & Berry, 2013). In addition, numerous problems are found in the management of health services (Marciano et al., 2019; Tortorella et al., 2019), from social to economic problems, where obtaining an efficient management model is challenging (Fournier & Jobin, 2018; Henrique et al., 2020; Siqueira et al., 2019) and fundamental (Hicks et al., 2015; Sunder M et al., 2020; Tortorella et al., 2019).

Inherent to the type of service, the search for continuous improvement in the health area is constant and required by standards of various organs that value the quality of health care activity, such as patient safety. In addition to waste factors found worldwide in the health sector (Slawomirski et al., 2017), the concern for the quality of care has gained ground (Hicks et al., 2015; Sales Coll et al., 2024; Singh, 2019; Toussaint & Berry, 2013). The WHO has expressed concern in this regard (WHO, 2020). In 2004, WHO created the World Alliance for Patient Safety. The Patient Safety Program was developed to improve the quality of medical care provision and patient safety from the reduction of risks and mitigation of adverse events during health care (Ministério da Saúde, 2014). It is estimated that 15% of hospital expenses in OECD member countries (Organization for Economic Co-operation and Development) are associated with adverse events in health services (Slawomirski et al., 2017). Since then, proposals for patient safety solutions have been stimulated and disseminated in different

fields, such as: patient identification; medication control; patient movement; internal performance of health units; risks in medication and infections in health care (WHO, 2007).

Brazil, as a member of the World Alliance for Patient Safety, established the National Patient Safety Program (PNSP) with Ordinance MS/GM No. 529/2013. This agenda established the national strategic objective of qualifying health care with the reduction of risks in public and private health services in the country. The PNSP brings a set of protocols recommended by WHO focused on patient safety solutions, including the issue of patient identification (Ministério da Saúde, 2014). In this context is the DRC Resolution 36/2013 of the Ministry of Health, with policies to promote patient safety and actions to improve quality in national health services (Resolução - RDC Nº 36, de 25 de Julho de 2013, 2013).

To support the quality of health services, DRC nº 36/2013 defines as adverse event any incident that has as effect health damage (Resolução - RDC Nº 36, de 25 de Julho de 2013, 2013). The incorrect administration or prescription of medications, the incorrect planning or execution of procedures are examples of risks for the patient that can cause irreversible or even fatal damage to the care provided. Adverse events can occur within the scope of administrative or care processes, resulting from a poorly designed health system and/or that responds unsatisfactorily (Ministério da Saúde, 2014). Consequently, they are responsible for increasing the waste of resources in health service units (Slawomirski et al., 2017).

But, many of the incidents causing harm to patients and losses of the health system are preventable (Slawomirski et al., 2017). At this point the Lean thinking applied in health services management has the potential to contribute.

LEAN HEALTHCARE

Building efficient processes in healthcare is a journey of a lot of effort (Fournier & Jobin, 2018; Tortorella et al., 2019). Lean carries a socio-technical approach (Bortolotti et al., 2015; Da Silva, 2016) consistent with needs in health care operations projects that seek impact on patient experience, quality of healthcare, and efficiency of care (Hicks et al., 2015; Toussaint & Berry, 2013).

Lean principles have already supported everything from new medical facility design stages (Hicks et al., 2015) to improvement initiatives in existing units (Sunder M et al., 2020). Research shows the range of possibilities with the LH (Augusto & Tortorella, 2019; Borges et al., 2019; Costa & Godinho Filho, 2016), including on environmental issues (Singh, 2019). The LH implementation can serve both public (Fournier & Jobin, 2018) and private institutions (Henrique et al., 2020). There are tools to evaluate (Tortorella et al., 2019) and sustain lean practices in health organizations (Crema & Verbano, 2019), supporting decision making. However, there are barriers in the operationalization of LH (Leite et al., 2024; Lindsay et al., 2020; Lindsay & Aitken, 2024).

Traditional Lean emphasizes standardized work (De Freitas & Da Silva, 2017) and its applicability as a tool for organizational learning (Henrique et al., 2020). In auxiliary service routines, repetitive activities, information exchange and communication in health systems, standardized work offers potential gains (Costa & Godinho Filho, 2016; Toussaint & Berry, 2013). But with the singularities in personal care, other tools need to be developed to serve autonomous health professionals (Fournier & Jobin, 2018). Standardizing clinical, therapeutic

and nursing practices tends to imply resistance of the medical team (Costa & Godinho Filho, 2016; Hicks et al., 2015; Siqueira et al., 2019). To improve acceptance of new philosophies and procedures it is suggested to start LH projects in workflows with less interface with the medical team (Henrique et al., 2020). The proposal is to develop an LH program around health professionals considering their involvement and not about them (Lindsay et al., 2020).

In the healthcare environment, the patient's workflows, materials and information are highlighted. In general, LH applied to the patient's flow involves actions in bed management, improvements in facilities and processes of clinical interventions. When it acts on the flow of materials, it refers to the management of inventories, auxiliary procedures and logistics of instruments and medicines. Lean transformations in the flow of information are related to authorization, billing, registration, information technology, payment and purchasing processes (Henrique et al., 2016). LH pilot projects should privilege initiatives on the flow of materials or information to achieve lasting changes that inspire the progress of new Lean insertions over time (Henrique et al., 2020).

The quality and costs of medical care are dependent on the processes of delivering value to the patient (Hicks et al., 2015) and in an LH project the participation of the medical workforce has a great impact on the results (Fournier & Jobin, 2018; Henrique et al., 2020; Lindsay et al., 2020). With LH it is expected to integrate safe operational processes, without waste and from the perspective of employees (Tortorella et al., 2019), in order to develop a care focused on patient care (Costa & Godinho Filho, 2016; Hicks et al., 2015; Toussaint & Berry, 2013). Ignoring the sociocultural aspects of the health area, such as professional identity and the hierarchical structure of decisions in health systems, tends to inhibit the dissemination of continuous improvement plans or the sustainability of LH (Lindsay et al., 2020).

The losses in the health system that motivate managers to redesign organizations may be linked to the wrong medication (Augusto & Tortorella, 2019; Costa & Godinho Filho, 2016), transportation and unnecessary movements (Borges et al., 2019; Hicks et al., 2015), waits during the service (Augusto & Tortorella, 2019; Hicks et al., 2015), dispensable treatments (Borges et al., 2019; Costa & Godinho Filho, 2016), poorly managed inventories (Henrique et al., 2020; Toussaint & Berry, 2013), or else, underutilized resources (Hicks et al., 2015) or not qualified (Costa & Godinho Filho, 2016). In the LH journey towards the elimination of such problems, often with invisible origins or not explained by the organization's managers (Crema & Verbano, 2019), it is common for leaders in the health area to be subject to the unpredictability of demand and process times, the difficulty in defining value-added activities and conflicting or disconnected management metrics (Young & McClean, 2008).

In this sense, Value Stream Mapping (VSM) emerges, emphasized as a Lean tool widely used in LH (Costa & Godinho Filho, 2016; Hicks et al., 2015; Tortorella et al., 2019; Toussaint & Berry, 2013). To overcome the health operators' deficiency in identifying waste in their daily activities that the use of VSM is justified, being strongly considered as an initial practice in an LH implementation process (Borges et al., 2019) and to support continuous improvement actions (Henrique et al., 2016, 2020). The VSM guides the reflection and development of new procedures, helping to achieve improvements in the process from the mitigation of waste (Camargo et al., 2018; Ferreira & Da Silva, 2018).

A number of benefits are reported with the adoption of LH (Table 1), although implementations tend to limited and departmental practices rather than applications on the system as a whole (Augusto & Tortorella, 2019; Costa & Godinho Filho, 2016). Therefore, LH should be understood as a management system (Siqueira et al., 2019; Tortorella et al., 2019) in a long-term strategy (Borges et al., 2019; Henrique et al., 2020).

Table 1. Benefits with Lean Healthcare adoption

| | Toussaint & Berry (2013) | Hicks et al. (2015) | Costa & Godinho Filho (2016) | Singh (2019) | Henrique et al. (2020) | Sunder et al. (2020) |
|---|--------------------------|---------------------|------------------------------|--------------|------------------------|----------------------|
| Reduction in stay and wait times at the facilities | X | X | X | | X | X |
| Reduction of process steps and bureaucracy | | X | | | | X |
| Shorter cycle times | X | | X | | X | X |
| Shorter setup times | X | | | | | |
| Better use of the multifunctional workforce | | X | X | | | X |
| Better use of resources for service | | | | X | X | X |
| Reduction in mortality | | X | X | | | |
| Reduction in medication distribution errors | X | X | X | | | X |
| Reduction in infection rates | X | X | X | | X | X |
| Reduction of the distance traveled by patients and/or employees | | X | | | X | |
| Improved hospital/outpatient flow and safety | | X | | | | X |
| Improvement in internal communication | X | | | | | |
| Improvement of the patient's well-being | X | X | X | | | X |
| Improved staff satisfaction | | | X | | | X |
| Improvement of financial performance | | | X | | X | |
| Cost reduction | X | | X | | X | X |
| Increased service capacity | X | | X | | X | |
| Reduction of occupied area | | | X | | | |
| Inventory reduction | | | X | | X | |
| Reduction of rework | | | X | | | |
| Reduction of negative environmental impacts | | | | X | | |

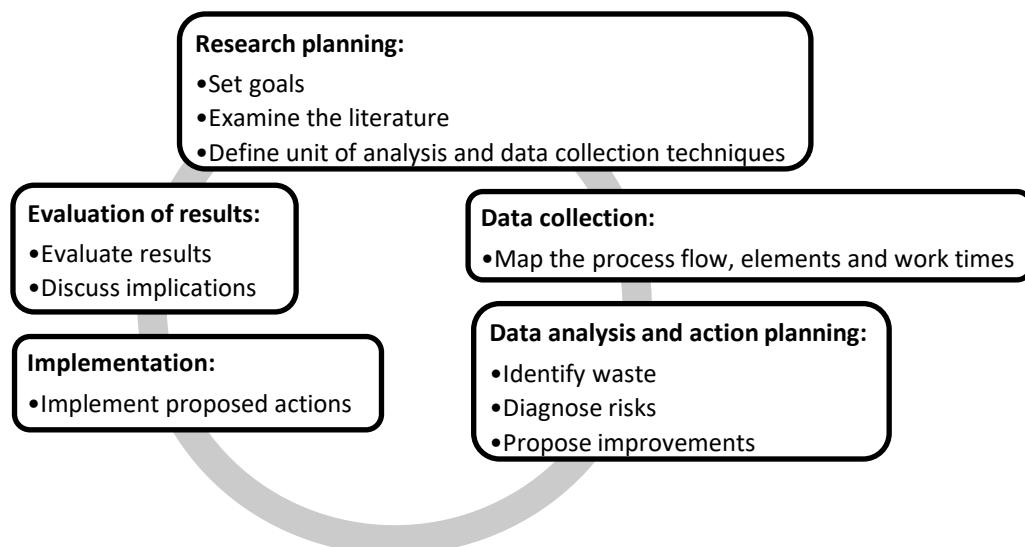
Source: Authors.

METODOLOGY

The healthcare organization studied is in Southern Brazil. The institution is considered a reference in its segment, serving clients with clinical emergencies and elective episodes. It is aware of the reference document for the National Program of Patient Safety, developed by the Agência Nacional de Vigilância Sanitária (ANVISA), where errors in health care are pointed out due to failures in the identification of patients, which, consequently, cause numerous waste of material and human resources, such as the application of incorrect medication, the performance of wrong surgeries, the performance of examinations performed unnecessarily and even the incidence of fatal cases (Ministério da Saúde, 2014). Still, in face of the inherent difficulties in the management of the health services provided and the constant demand for the search for excellence in medical care and satisfaction of the patients, the following research question was raised in this reality: how to improve patient safety from the fundamentals of LH? Thus, the investigation was centered on the identification and tracking process of the patients' information at the organization under study, from the entry of their personal data to the delivery of the exam report.

To meet this purpose, an action research was conducted (Anselmo et al., 2020; Coughlan & Coughlan, 2002; Ferreira & Silva, 2018). The development of the action research was distributed in five stages: research planning; data collection; data analysis and action planning; implementation; and results evaluation (Figure 1).

Figure 1. Detail stages of methodologic development of the research



Source: Authors.

DEVELOPMENT OF ACTION RESEARCH

RESEARCH PLANNING

Given the complexity of health systems, especially in emerging countries, and the concern of several health agents with patient safety, this study is investigative in the face of waste and failures arising from activities related to the process of identification of patient. The research context deals with a health service that operates with diagnostic medicine by image of a Brazilian health organization.

Among the exams performed at the study unit are Ultrasonography/Echography (US), Nuclear Magnetic Resonance (NMR), the X-Ray (XR), the Computed Tomography (CT), the Mammography (MAMO) and the Bone Densitometry (BD), in which, consequently, there are doctors from different clinical specialties to welcome the adult and pediatric public. The service operates from Monday to Saturday, subject to prior appointment to reserve a room, equipment and schedule with the specialist. In addition, extra appointments are offered for customers with medical emergencies.

Over time (more than a decade since the opening of the clinic) the health organization noticed numerous problems associated with patient identification, such as the similarity of names in the database, the lack of standardization in the insertion of records, the presented diversity of patients' personal documents, lack of information verification and, sometimes, resulting in the exchange of patients in care. And the more patients are seen, the greater the potential for patient safety failures. The set of internal facts strengthened and prioritized the search for improvements in health organization.

In addition to the researchers as guides of the Lean project, the working group included: two care operators and three imaging assistants, performing the routine of receiving and preparing the patient in the study unit; two managers weighing in from the perspective of the healthcare organization's management and responsible for approving potential changes and

improvements; three radiology technicians, five physicians and five nurses supporting the information gathering and analysis of the findings.

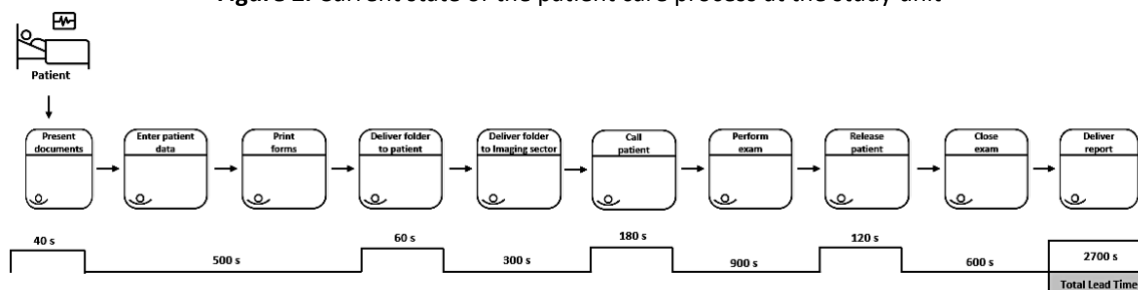
Expanding the sources of information from systematic meetings of the working group, for data collection it was defined the use of direct observation of patient care, verification of internal documents such as standard operating procedures (SOP) and indicators of non-compliance of the sector. Patient safety standards established by official health bodies were consulted (International Patient Safety Goals - WHO, National Resolution on Patient Safety, National Resolution on Good Practices in Health Facilities, National Ordinance on Patient Safety Protocols). The data collection strategy sought in different sources to triangulate evidence to adequately support the investigation and its referrals.

DATA COLLECTION

At this stage, the first step was to survey the patient care process in detail. The previous scheduling occurs in person or by telephone, except for clients with urgent exams that are fitted into the daily schedule. For all types of care, a medical prescription with the exam to be performed and the patient's official identification document is required. It is extremely important to present this documentation from the insertion of patient data to the delivery of the final product (examination report) to the patient. Once the examination has been performed, the patient will continue the clinical investigation with his/her assistant physician, who, in turn, will use the previous result of the examination as a basis for initiating or terminating drug treatment or even requesting surgical procedures.

Given the above, the patient care process at the study unit was mapped using the VSM. The survey of the current state in addition to allowing the structured learning of the working group on the process in question, serves as support for the analysis phase (Figure 2).

Figure 2. Current state of the patient care process at the study unit



Source: Authors.

The patient upon arriving at the health organization is identified and requests care based on medical prescription. From official identity document, the service operator opens the service by entering the respective patient data in the management system (ERP - Enterprise Resource Planning) of the health unit. The ERP assists in the registration by retrieving data from former patients, when appropriate. Soon after, internal care sheets are printed to form the patient documentation folder. The documents are conducted and accompany the patient to the imaging department. With the documentation folder of the patient in hand, the examination assistant calls and assists the patient as to its positioning in the room of carrying out the examination by image. The radiologist performs the examination and prepares the report. The patient is released from the imaging examination room with their official identity document plus a proof of care to withdraw the report. The imaging examination sector finalizes the procedures and forwards the report to the examination removal sector. Finally, in the examination withdrawal sector, the patient receives the report concluding the service.

DATA ANALYSIS AND ACTION PLANNING

Observing patient care in a diagnostic imaging health service, it was possible to understand the current process applied in the study unit. Guided by the Lean philosophy, the working group focused on finding waste throughout the care process, especially from the perspective of ensuring patient safety (Table 2).

Table 2. Waste and proposals for improvement in patient identification in the study unit

| Identification of Waste and Proposals for Improvement in Health Services | | | | |
|--|---|---|---|--|
| Stage | Description | Waste | Risks | Improvement actions |
| 1 | Patient presents official identity document and medical prescription | Inappropriate processing | Failure to interpret the patient's official identity document and/or medical prescription | Team training on the importance of correct patient identification throughout the process |
| 2 | Attendance operator opens the service and enters the patient's data in the ERP system that lists a selection of similar names for the operator to locate the patient's record or enter new data | Patient waiting Inappropriate processing | Typing of the patient's name with incorrect characters Incorrect patient name selection in the suggestions tab | Adoption of the CPF as the input data for patient registration and increase from five to thirteen characters of mandatory typing for the system to offer the auto selection of names |
| 3 | With the registration in the ERP system, the service operator prints 3 different internal sheets with patient data (proof of service, clinical data for the radiologist and a sheet with care data for the nursing staff) at a remote printing center | Inappropriate processing Operator motion | Sheets exchanged, as several operators move to use the same printing center | The printing of the internal attendance records takes place in the imaging sector by the local assistant |
| 4 | Attendance operator hands the documentation folder to the patient (official identity document, medical prescription and the 3 internal files) and directs him to the imaging exam sector | Patient waiting | Patient in queue or does not deliver documentation folder | Registration data identifying the patient in the care process is consulted directly in the ERP system by the imaging sector |
| 5 | Patient delivers documentation folder to imaging sector | | | |
| 6 | With the patient documentation folder in hand the examination assistant (nursing) calls the patient by name | Inappropriate processing | Mistaken patient call with similar or equal name to another patient | Examination assistant makes the call of the patient by full name and performs double checking, confirmation of date of birth and the name of the patient's mother |
| 7 | The examination assistant assists the patient in the exam room; the medical radiologist performs the image examination and prepares the report | Step not analyzed in the initial round | Step not analyzed in the initial round | Step not analyzed in the initial round |
| 8 | Patient is released from the exam room with his official identity document and the proof of service for withdrawal of the report | Step not analyzed in the initial round | Step not analyzed in the initial round | Step not analyzed in the initial round |
| 9 | The examination assistant finishes the procedures and delivers the report to the exam retrieval department | Inappropriate processing | Exchange of documentation for identification limited to the patient's full name and the date of the examination | Internal care records must contain the patient's full name, date of birth and the full name of the patient's mother |
| 10 | Patient requests and receives the report in the exam withdrawal sector | Operator motion Patient waiting | Inadequate activity by searching for patient's personal data among those seen | Local attendant calls the patient by full name and performs a double check, confirming his date of birth and the name of the patient's mother |
| Patient in a queue | | | | |

Source: Authors.

Among the activities analyzed, were perceived non-value-added activities to the flow of care and that need improvement, especially when eliminating possible patient identification errors. In the analysis round, primaries wastes were associated with inappropriate processing, patient waiting and employee motion.

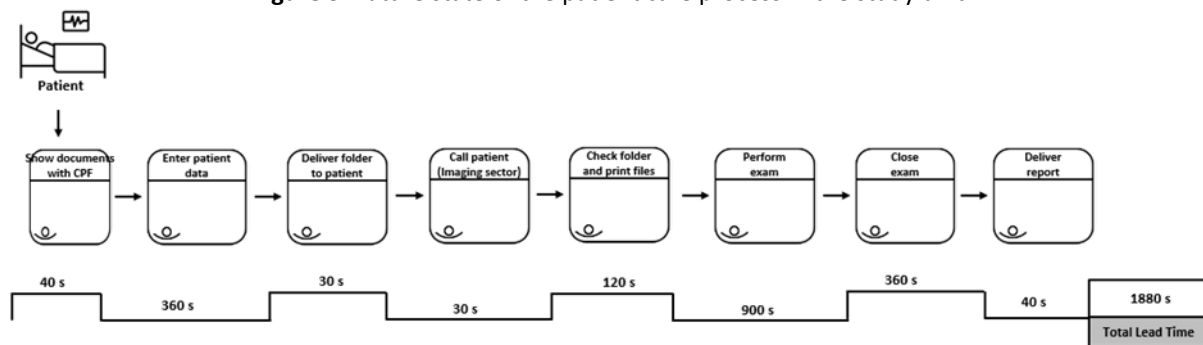
The waste due to inappropriate processing or failures was verified in the incorrect filling of the patient's registration data, the exchange of printed documentation of patients throughout the service and the forwarding of the wrong report to the patient. Waste of waiting occurs waiting for the patient at the time of arrival and initial registration, in the queue to perform the imaging examination and during the period of release and delivery of the report to the patient. The waste of motion was evidenced in the locomotion of the service operator to the printing center and in the search for patient data by the examination assistant.

Activities with the respective waste were also related to risk factors for failures in patient identification. The working group guided by the Lean management model proposed corresponding improvement actions seeking to contribute to patient safety. The improvements proposed in this stage of the project aim to minimize the risk to patient safety and raise the quality of the diagnostic imaging service. Following the order of execution of the activities, the first change was the adoption of the Cadastro de Pessoa Física (CPF), a unique record established by the Brazilian Federal Revenue, as the initial data in the ERP system for the opening of the service for the patient by the care operator. The proposal seeks to act on the risk of incorrect patient identification at the source of care with the application of individualized registration with poka-yoke support via an ERP system supported by Brazilian Federal Revenue. Also, it was increased from five to thirteen characters of mandatory typing for the ERP system offer auto selection of names avoiding identification error by database duplication. Linked to the previous and fundamental action for the next steps of the plan, the entire care team and contact with the patient should be trained on the value to the patient in the health area and the relevance of safety actions to the same the proposal addresses the multiplication and awareness of the work team to the Lean perspective.

In the process of printing sheets for the composition of documentation, which consumes unnecessary time for service operators and patients, as an opportunity for improvement, it was verified that the printing of sheets can be carried out by imaging operators during the exam. In view, the patient information will be available in the ERP system and the printer already installed in the sector can be used. With the action, the flow and waiting time of the patient will be reduced with the elimination of motion waste of the care operator and will minimize errors of exchange of patient records, since the image sector is restricted to internal personnel and without attending to the external public. Physicians and radiology technicians will benefit in their routines by receiving patients and their data/ records suitable for execution. Another advance proposed to minimize the error of patient identification and failure in the process, is the implementation of double checking via confirmation of date of birth and name of the patient's mother throughout the care, at the time of examination and in the delivery of the report. Patients with equal names will be discriminated by the aid of the new fields of registration and form of treatment.

The final planning for implementation of the actions was synthesized by the visualization of the proposed future state. Figure 3 shows the projected VSM.

Figure 3. Future state of the patient care process in the study unit



Source: Authors.

IMPLEMENTATION

The management of the healthcare organization throughout the Lean project, left open the communication channel about the progress of the work and promoted improvements in the process by involving all employees in the initiative. It even encourages patient participation in satisfaction surveys, which are analyzed as opportunities for improvement. This is thought to cover the tracking of problems hidden from the eyes of managers.

However, it should be noted that the unit under study does not have a clear and well-defined routine for analysis and generation of preventive action plans for cases of failures in patient safety. Occasional meetings are held to evaluate the results of patient satisfaction surveys, but without a formal structure and continuous work. The non-conformities evidenced throughout the days are taken, discussed and dealt with by the managers, and corrective actions are implemented. However, the current model seems to respond more by provocation of stakeholders than by proactive manifestations of the organization. Internally, the improvement project under execution was approached by management as a pilot initiative aimed at creating an evolving way of thinking and acting in health service delivery.

The expectation with the modifications, besides improving the patient's safety as to his identification, was to promote a service time reduction. This is what happened, a total lead time (makespan) reduction of 30.37%, from 2700 seconds (45 minutes) to 1880 seconds (approximately 31 minutes), from the input of the input data to the delivery of the report to the patient. But the fundamental work was to produce results in the light of the Lean philosophy in an environment of improvement cycles.

During the implementation of the improvements, specific resistance to the actions on the part of the staff was perceived, largely due to fear of assuming or being the justification for the changes. However, as the results were positive, improving the performance of the service provided, employees were reacting in a more welcoming and participatory way. In addition to behavioral resistance of employees, another limitation was in terms of operational resources in information technology (IT). This was very critical, either due to the delay or the difficulty in understanding the requests. The management's active participation in the project's leadership role as a strategic move for the organization was imperative in minimizing difficulties and providing responses to implementation problems and staff engagement.

EVALUATION OF RESULTS

The advances made in mitigating issues of inappropriate processing, waiting and motion, resulting in better patient care due to the reinforcement of safety conditions and reduction of

service time, were praised by the health organization. The project analyzed in addition to illustrating the application of LH in a restrictive environment of developing economics (Borges et al., 2019; Singh, 2019; Tortorella et al., 2019), shows that the Lean management model contributes to the elimination of waste in health systems, corroborating with other studies (Fournier & Jobin, 2018; Siqueira et al., 2019; Toussaint & Berry, 2013). In addition, the LH provides effective operationalization to health organizations, and as seen, it can also contribute to the follow-up of their protocols and patient safety goals.

The results evidenced throughout the LH project led to the consideration that initial changes tend to occur in bureaucratic processes of the health unit. Indications about improvements in repetitive activities, such as in information and communication flows, are suggested for leveraging LH pilot projects (Henrique et al., 2020). Health services systems are classified as complex (Marciano et al., 2019; Saurin & Gonzalez, 2013) and the degree of maturity of management and organization of processes seems to influence this occurrence of priority performance in administrative activities. As in the case investigated, where the domain of developing efficient and effective operational and administrative flows remains at an early stage. However, these are conditions that do not prevent the exploration of technologies for the digitization of processes, supporting the addition of value to the patient.

Another learning from the study is related to the actions of a first cycle of improvement focusing on the service's care process, without including operational functions directly related to patient's health care. The management of the health unit did not demonstrate willingness to address medical activities during the research. The option for this path reflects the difficulty of health managers in overcoming the low sensitivity of physicians with improvement projects that seek to detail and review the clinical and diagnostic operational activity (Costa & Godinho Filho, 2016; Hicks et al., 2015; Siqueira et al., 2019).

Even the local leadership having established the Lean project as strategic to establish a culture of continuous improvement in the health organization, the formation and medical paradigm of the Board does not find sufficient arguments to justify facing such resistance. Indifferent to the LH program valuing people and their interests (Lindsay et al., 2020), the activities of the medical team did not enter the scope of the project of improvement of the moment.

Undoubtedly, the particularities in patient care need to be respected, therefore, direct autonomous practices on patients performed by physicians must be subjected to rigorous analysis when judging the conduct and ways of proceeding. On the other hand, the alternative with LH may be to involve facility re-layout plans and clinical, surgical, diagnostic or therapeutic bed management (Henrique et al., 2016). In the trajectory of consolidation and maturity of the Lean management model in the studied unit, with the continuity of the project in new rounds, the mentioned points need to be investigated. It is now up to the leadership of the healthcare organization to find ways to accommodate the diversity of views and personal preferences of its staff and find ways to achieve staff commitment and engagement with the challenge of implementing LH (Mendes & Mirandola, 2015), both to improve patient safety and to make the healthcare organization sustainable. As well, investments will be required, and a cost-benefit analysis should be forwarded. The realities between healthcare organizations are different and LH projects must be contextualized.

CONCLUSION

Different from what is found in manufacturing companies, in the health area it is unusual for service providing organizations in Brazil to have an organizational arrangement supported by activities and resources dedicated to the study of processes and systematic improvement projects. This article presents the preliminary trajectory of a Brazilian healthcare organization in an LH project aiming at increasing patient safety and internalizing in its structure the culture of continuous improvement.

The research demonstrates that LH provides a practical framework for healthcare organizations to enhance patient safety, improve operational efficiency, and reduce waste. These outcomes are achieved through systematic process improvements and the cultivation of a culture of continuous learning. In the LH project conducted within the study unit, it was possible to identify opportunities for improving the identification and traceability of patient information throughout the care process, thereby mitigating processing errors, as well as waiting and motion losses during referrals and on-site testing. The proposed changes have a direct impact on reducing the risk of patient safety failures.

The findings of this case corroborate previous statements about LH's properties, particularly its capacity to add value to patients throughout the care process and to enhance the quality of health services. Consequently, this study may encourage researchers and health managers to explore LH more deeply as a foundation for management decisions—especially in emerging countries, where the complexity of health systems makes this approach particularly relevant.

To minimize the potential for patient safety failures, the work team did not make exhaustive use of traditional Lean tools. Only VSM and poka-yoke were applied to address the problem situation. The choice of VSM is not surprising, as it is extensively cited in LH applications for its ability to support improvement actions, particularly in the early stages of implementation. However, the practice of Jidoka is less evident in research and remains scarce in the LH literature, making the use of poka-yoke in healthcare services a distinctive element worthy of observation in this study.

In the pilot project conducted within the health organization, emphasis was placed on the appropriation of Lean principles rather than on the indiscriminate and superficial application of its methods and techniques. The leadership's objective was to collaboratively develop the conditions for delivering healthcare services while fostering a mindset of continuous improvement grounded in Lean Thinking.

The paper contributes by presenting a real-world case of LH implementation in a challenging environment. Due to the sample size and the nature of the field results, certain limitations emerge. Nevertheless, the findings open opportunities for further advances and learning. The study did not address direct operational functions related to patient healthcare, suggesting new avenues for research within the same organization or in other healthcare contexts.

Moreover, Jidoka deserves greater attention in health services, as its potential application to patient safety represents a promising theoretical and empirical frontier. The integration of Lean management in healthcare with the ongoing digital transformation of organizations also presents an opportunity to strengthen performance in patient care and safety. Finally, a comparative analysis between public and private organizations, regarding care capacity and Lean-based responses to quality challenges, may enhance the sustainability of such initiatives in the sector and lead to improved solutions for healthcare system users.

REFERENCES

Anselmo, R. B., Da Silva, M. G., Silva, R. M. da, & Bianchini, V. U. (2020). Avanço de desempenho produtivo com a implementação do trabalho padronizado em uma célula de manufatura. *TECNO-*

LÓGICA, 24, 289–299.
<https://doi.org/10.17058/tecnolog.v2i0.15623>

Augusto, B. P., & Tortorella, G. L. (2019). Literature review on lean healthcare implementation:

Assessment methods and practices. *International Journal of Services and Operations Management*, 32(3), 285–306. <https://doi.org/10.1504/IJSOM.2019.098351>

Bopp, B. W., & Da Silva, M. G. (2017). Ações de melhoria em uma agência de marketing digital através do pensamento sistêmico: uma pesquisa-ação. *Espacios*, 38(44), 7. <http://www.revistaespacios.com/a17v38n44/17384407.html>

Borges, G. A., Tortorella, G., Rossini, M., & Portioli-Staudacher, A. (2019). Lean implementation in healthcare supply chain: a scoping review. *Journal of Health Organization and Management*, 33(3), 304–322. <https://doi.org/10.1108/JHOM-06-2018-0176>

Bortolotti, T., Boscari, S., & Danese, P. (2015). Successful lean implementation: Organizational culture and soft lean practices. *International Journal of Production Economics*, 160, 182–201. <https://doi.org/10.1016/j.ijpe.2014.10.013>

Camargo, A. de O., Da Silva, M. G., & Simões, W. L. (2018). Contribuições de um evento kaizen para a produção de painéis eletrônicos automotivos: um estudo de caso. *Brazilian Journal of Production Engineering*, 4(4), 24–43. http://www.periodicos.ufes.br/BJPE/article/view/V04N04_02

Costa, L. B. M., & Godinho Filho, M. (2016). Lean healthcare: review, classification and analysis of literature. *Production Planning and Control*, 27(10), 823–836. <https://doi.org/10.1080/09537287.2016.1143131>

Coughlan, P., & Coughlan, D. (2002). Action research for operations management. *International Journal of Operations & Production Management*, 22(2), 220–240. <https://doi.org/10.1108/01443570210417515>

Crema, M., & Verbano, C. (2019). Simulation modelling and lean management in healthcare: first evidences and research agenda. *Total Quality Management & Business Excellence*. <https://doi.org/10.1080/14783363.2019.1572504>

Da Cas, F., Da Silva, M. G., Luz, D. F. Da, & Pacheco, D. A. de J. (2015). Implicações da redução de setup na produtividade da indústria farmacêutica. *Revista GEINTEC*, 5(1), 1764–1779. <https://doi.org/10.7198/S2237-0722201500010014>

Da Silva, M. G. (2016). Jidoka: Conceitos e aplicação da autonomia em uma empresa da indústria eletrônica. *Espacios*, 37(2), 17. <http://www.revistaespacios.com/a16v37n02/16370218.html>

De Freitas, E. S., & Da Silva, M. G. (2017). Pesquisa-ação sobre a implementação do trabalho padronizado em uma célula de manufatura de uma fábrica de tratores. *Espacios*, 38(46), 21.

<https://www.revistaespacios.com/a17v38n46/17384621.html>

Ferreira, R. S., & Da Silva, M. G. (2018). Lean office: uma aplicação no planejamento de ordens de manutenção. *Revista de Iniciação Científica Da ULBRA*, 16, 187–203. <http://www.periodicos.ulbra.br/index.php/ic/article/view/4682>

Fournier, P.-L., & Jobin, M. H. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, 38(1), 37–44. <https://doi.org/10.1080/09540962.2018.1389505>

Henrique, D. B., Godinho Filho, M., Marodin, G., Jabbour, A. B. L. de S., & Chiappetta Jabbour, C. J. (2020). A framework to assess sustaining continuous improvement in lean healthcare. *International Journal of Production Research*. <https://doi.org/10.1080/00207543.2020.1743892>

Henrique, D. B., Rentes, A. F., Godinho Filho, M., & Esposto, K. F. (2016). A new value stream mapping approach for healthcare environments. *Production Planning and Control*, 27(1), 24–48. <https://doi.org/10.1080/09537287.2015.1051159>

Hicks, C., McGovern, T., Prior, G., & Smith, I. (2015). Applying lean principles to the design of healthcare facilities. *International Journal of Production Economics*, 170(Part. B), 677–686. <https://doi.org/10.1016/j.ijpe.2015.05.029>

Leite, H., Williams, S., Radnor, Z., & Bateman, N. (2024). Emergent barriers to the lean healthcare journey: baronies, tribalism and scepticism. *Production Planning and Control*. <https://doi.org/10.1080/09537287.2022.2054386>

Lindsay, C. F., & Aitken, J. (2024). Using Programme Theory to evaluate Lean interventions in healthcare. *Production Planning and Control*. <https://doi.org/10.1080/09537287.2022.2139778>

Lindsay, C. F., Kumar, M., & Juleff, L. (2020). Operationalising lean in healthcare: the impact of professionalism. *Production Planning and Control*, 31(8), 629–643. <https://doi.org/10.1080/09537287.2019.1668577>

Lopes, C. M., Scavarda, A. J., de Carvalho, M. N. M., & Korzenowski, A. L. (2019). The business model and innovation analyses: The sustainable transition obstacles and drivers for the hospital supply chains. *Resources*, 8(1), 3. <https://doi.org/10.3390/resources8010003>

Marciano, M. A., Vaccaro, G., & Scavarda, A. (2019). Quality of the public health system: A systemic comprehension in Brazilian southern region. *Gestao e Producao*, 26(1), e1626. <https://doi.org/10.1590/0104-530X1626-19>

- Mendes, G. H. D. S., & Mirandola, T. B. D. S. (2015). Hospital accreditation as an improvement strategy: Impacts and difficulties in six accredited hospitals. *Gestão & Produção*, 22(3), 636–648. <https://doi.org/10.1590/0104-530X1226-14>
- Resolução - RDC Nº 36, de 25 de Julho de 2013, (2013). https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2013/rdc0036_25_07_2013.html
- Ministério da Saúde, B.-. (2014). *Documento de referência para o Programa Nacional de Segurança do Paciente* (M. da Saúde, F. O. Cruz, & A. N. de V. Sanitária (eds.); p. 40). Ministério da Saúde.
- Sales Coll, M., De Castro, R., Ochoa de Echagüen, A., & Martínez Ibáñez, V. (2024). Economic Impact of Lean Healthcare Implementation on the Surgical Process. *Healthcare* (Switzerland). <https://doi.org/10.3390/healthcare12050512>
- Santos, B. M., Fogliatto, F. S., Saurin, T. A., & Tortorella, G. L. (2024). Modeling help chains in health services as social networks: moving from linearity to complexity. *International Journal of Production Research*. <https://doi.org/10.1080/00207543.2023.2298486>
- Saurin, T. A., & Gonzalez, S. S. (2013). Assessing the compatibility of the management of standardized procedures with the complexity of a sociotechnical system: Case study of a control room in an oil refinery. *Applied Ergonomics*, 44(5), 811–823. <https://doi.org/10.1016/j.apergo.2013.02.003>
- Singh, P. (2019). Lean in healthcare organization: an opportunity for environmental sustainability. *Benchmarking: An International Journal*, 26(1), 205–220. <https://doi.org/10.1108/BIJ-04-2018-0104>
- Siqueira, C. L., Siqueira, F. F., Lopes, G. C., Gonçalves, M. de C., & Sarantopoulos, A. (2019). Enteral diet therapy: use of the Lean Healthcare philosophy in process improvement. *Revista Brasileira de Enfermagem*, 72(1), 235–242. <https://doi.org/10.1590/0034-7167-2017-0746>
- Slawomirski, L., Auraen, A., & Klazinga, N. (2017). *The economics of patient safety: Strengthening a value-base approach to reducing patient harm at national level* (No. 96). <https://doi.org/https://doi.org/10.1787/5a9858cd-en>
- Sunder M, V., Mahalingam, S., & Krishna M, S. N. (2020). Improving patients' satisfaction in a mobile hospital using Lean Six Sigma – a design-thinking intervention. *Production Planning and Control*, 31(6), 512–526. <https://doi.org/10.1080/09537287.2019.1654628>
- Tortorella, G., Augusto, B. P., França, S. L. B., & Sawhney, R. (2019). Assessment methodology for Lean Practices in healthcare organizations: Case study in a Brazilian public hospital. *Production*, 29. <https://doi.org/10.1590/0103-6513.20180080>
- Toussaint, J. S., & Berry, L. L. (2013). The promise of lean in health care. *Mayo Clinic Proceedings*, 88(1), 74–82. <https://doi.org/10.1016/j.mayocp.2012.07.025>
- WHO. (2007). *World Health Organization - Patient safety solutions preamble*. <https://www.who.int/patientsafety/solutions/patientsafety/Preamble.pdf>
- WHO. (2020). *World Health Organization - Patient safety*. <https://www.who.int/patientsafety/en/>
- Young, T. P., & McClean, S. I. (2008). A critical look at Lean Thinking in healthcare. *BMJ Quality and Safety*, 17, 382–386. <https://doi.org/10.1136/qshc.2006.020131>