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Original article

Lean Healthcare in A Brazilian Hospital: Application of the Ishikawa Diagram in the Processes Management of an Operating Theater

Flávio Vilela *[1], Kam Cheong Wong [2], Guilherme Bócoli [3], Maria Fernanda Junho [3], Mariana Dias [3], Poliana Zampollo [3], Lucas Henrique Machado [3]

[1]Applied Reasearch Centre, Faculty of Enginnering, Universidade do Vale do Sapucaí, Minas Gerais, Brasil.
[2]Applied Research Centre, Faculty of Medicine and Health, University of Sydney, NSW, Australia; Bathurst Rural Clinical School, School of Medicine, Western Sydney University, NSW, Australia.
[3]Applied Reasearch Centre, Faculty of Medicine, Universidade do Vale do Sapucaí, Minas Gerais, Brasil.

*Corresponding author: Flávio Vilela; flaviofvilela@univas.edu.br

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Abstract

Patient safety has been gaining prominence since the beginning of the 20th century, as it is a fundamental component of quality in health. This way, the application of Lean Healthcare (LH) can offer patient-focused care, achieving better results for patients, institutional management, operational management, greater customer and employee satisfaction. In this context, the present study aims to apply the LH, through the Ishikawa Diagram, to look for the possible causes of delays in surgical procedures in a regional hospital. The research used a cross-sectional, retrospective and quantitative study to survey the prevalence and nature of errors and their causes. After that, visits were made to the surgical center to explain the application of Ishikawa Diagram and its practical importance. Then, using the Ishikawa Diagram tool, the professionals were asked about the possible causes of the situation presented, participating in the elaboration of cause-effect diagrams together with the researchers through the use of a digital technology conceived in VBA (Visual Basic Application). After analysing 32 surgical procedures, four root main causes and twelve specific causes were identified for the delays in the surgical procedure. Workforce is the main cause of delays in the operating room (51%), followed by methods (22%). These causes resulted in financial losses for the hospital. However, these causes could be identified and prevented.

Keywords: ***Ishikawa diagram; Total quality management; Lean health; Surgical Center; Quality improvement.***

Introduction

The application of Lean Healthcare (LH) requires a cultural transformation that changes the way an assistance service works, as it demands new habits, skills and, often, a new attitude throughout the organization. Case studies in the literature report the benefits obtained with the implementation of Lean Healthcare in health organizations, including reduction of waiting time, improvement in the quality of care, elimination of redundant processes, better work environment, greater motivation for improvement of communications between departments [4,14]. Therefore, LH can offer patient-focused care, achieving better patient outcomes, institutional management, operational management, greater customer and employee satisfaction, and also with less waste and cost [16].

The "fishbone" or Ishikawa diagrams, known for their appearance like the skeleton of a fish, are models of cause and effect that were advocated in the 1960s by Professor Kaoru Ishikawa, a pioneer of quality management. Such diagrams are graphical representations of the causes of specific effects under investigation.

They allow the potential causes of an issue to be broken down into basic elements and direct a troubleshooter to the possible causes of the issue.

The diagram employs graphical means, combining brainstorming with a type of concept map to diagnose potential causes of a problem. Ishikawa diagram is one of the seven basic quality control tools [6]. We adapted this approach to identify causes of delays in surgical procedures in a regional hospital. In examining the surgical procedures, we explored the complexities of the processes involved such as workforce (including clinicians, surgeons, and cleaners), administrative process (planning of surgical procedures and coordination of the timetable with support teams such as the operating theatre cleaners), and availability of instruments including sterilization of instruments and availability of operating theatre). These could be broadly categorized into

"workforce", "methods", "materials/ instruments", and "environment".

The inter-relations between these categories and the processes in each category can be further structured and analyzed using the Ishikawa diagram [23]. This article illustrates the application of an Ishikawa diagram in a surgical centre to identify the main failures and root causes of delays in surgical procedures.

Materials and Methods

Research, according to Gil [3], is defined as a rational and systematic procedure that aims to provide answers to the proposed problems, and according to Marconi [8] applied research is characterized by its practical interest, that is, in the solution of problems that occur in reality.

In this way, the present research is therefore classified as of an applied nature, as it is characterized by its practical interest, that is, that the results are applied in the solution of real-world problems [18]. Specifically, the problems of an emergency center will be identified through the Failure Modes and Effects Analysis (FMEA) tool. The method used will be the case study, because according to Turrioni and Mello [18] the investigation through the case study is based on several sources of evidence and benefits from the previous development of theoretical propositions for the collection and analysis of data. In this research, the preposition initially used was that failures in the emergency room management process occurred due to several factors.

About the object of study, the present method was applied in a Brazilian hospital that has a large population coverage, being part of a foundation that encompasses both the educational activity and the hospital part. It currently serves 16 micro-regions, corresponding to 191 cities, with an estimated population of 3,500,000 inhabitants. This hospital has only one general emergency room in the region that is part of the referral public health system for urgent and emergency care. In addition, it has elective care, care for high-risk pregnant women (grade III), highly complex neurosurgery level II, traumatology, orthopedics, corneal transplantation, kidney transplantation, adult, neonatal and pediatric intensive care unit type II.

The ability to perform surgeries is quite variable, as it depends on several factors, however, it can be estimated that the referred hospital performs an average of 16 hospital surgical procedures per day, and has a team that can handle low, medium and high complexity procedures. Therefore, in this context, the Ishikawa Diagram tool was applied in the surgical center of this hospital. This way, to apply the method, three steps were applied: (1) presentation of the Ishikawa Diagram tool present in the Failure Modes and Effects Analysis software [19], (2) data collection and (3) data analysis.

In step 1, the Ishikawa Diagram tool was introduced to the medical care team through software that was installed on each of the computers in the operating rooms. It is worth mentioning that the simple interface made it easy to use and understand. Thus, to use this tool, each of the 6Ms (method, machine, measure, environment, material, workforce) must be analyzed to define the causes.

In step 2, data were obtained by digitally filling in information about the root cause, clinical sector, cause of delay, patient record, room, team name and effect. In step 3, a report is designed indicating how failures were found, and the structured finding of failures enabled a better perception of what was happening in the emergency center with regard to delays in procedures. It is worth mentioning that the failures that occurred before the application of the tool were only transmitted and verbally scored by the nurses.

The researchers observed how some professionals were surprised that their attitudes and situations could impact the efficiency and effectiveness of surgery planning. It was evident that the identified errors can directly influence patient safety and the quality of the service provided. In addition, it is of great value that health professionals have been able to identify the root causes, by doing so, they can avoid repetition of errors.

Results and Discussion

Lean healthcare

The application of Lean Production (LP) in health services received the name of Lean Healthcare, and its first studies were simultaneous from the 2000s, especially in emergency and surgery departments in the United States, a country that has stood out since then in the number of publications on the subject [1]. According to Robinson [11], in the last decade there has been a significant increase in the implementation of Lean Healthcare (lean concepts and tools in hospital environments), bringing improvements such as decreasing patient waiting time for care, and increasing quality through the reduction of costs and errors.

Even when not systematically and comprehensively implemented in the organization, LH can provide a number of benefits for health services [1]. Among these benefits, the authors highlight increased productivity, quality in service delivery, safety and satisfaction, both for patients and the team. However, implementing Lean Healthcare is difficult and it requires hard work, especially in the health areas [17]. Lean Healthcare transforms the organizational culture from the inside out, thinking that managers and leaders become facilitators, mentors and teachers and that employees take initiative in making improvements.

Therefore, the lean principles applied to health or LH have as a strategy to prioritize patients, identify the value for them, eliminate waste and minimize the execution time of processes [16]. In addition, LH aims to serve customers in the shortest possible time, with the highest quality and lowest possible cost. For this, it is necessary to concentrate efforts on activities that add value to the customer.

Furthermore, according to Rother and Shook [12], in the context of lean production, activities can be classified into three large groups: first, activities that effectively create value for customers; second, activities that do not create value but are still necessary; and third, activities that do not create value and are also not necessary. In this way, the activities of the second and third groups, as they do not create value, are considered dismissed. In addition, waste, or losses, are classified into seven groups: defects, waiting, transport, employee non-engagement, overproduction, inventory, movement, and overprocessing.

LH is based on lean production to improve the organization and management of health services. Therefore, the application of lean tools in the health area has become a prominent activity and international interest in this operation has grown considerably [20]. Above all, case studies in the literature report the benefits obtained with the implementation of LH in health organizations, including a reduction in waiting time, improvement in the quality of care, elimination of redundant processes, better work environment, greater motivation of improved communications between departments [4,14].

Then, the application of LH can offer patient-focused care, achieving better outcomes for patients, institutional management, operational management, greater customer and employee satisfaction, and also with less waste and lower operational cost [16]. Finally, it is worth noting that Lean principles can be effectively combined with various process improvement and analysis tools,

such as Discrete Event Simulation (DES) [15]. However, in this research, we applied the Ishikawa diagram because it is a structured and in-depth approach that allows examination of the complexities of the processes involved in an operating theatre.

Application of Ishikawa diagram

The main problem that we are investigating is "delays in surgical procedure" which is identified as the "head" of the fishbone / Ishikawa diagram. We applied several methods to gather information about the main causes and root causes of the problem [23]. The methods include brainstorming with the team involved. The Ishikawa diagram approach is particularly ideal for a multifaceted problem because the cause-effect graphical representation provides a comprehensive and holistic view of the problem under investigation [2]. Werkema [21] suggested studying and examining the process involved through observation and documents, exchanging ideas with people involved, meeting people involved in the process and discussing the problem to explore ideas. The gathered information are to be organized into main, secondary, and tertiary causes, and eliminating unimportant information. Wong [22] demonstrated how to apply the Ishikawa diagram to identify causes of a major clinical presentation in a clinical setting and advocated that the Ishikawa diagram can be applied in problem-based learning or self-directed learning environments.

After applying the aforementioned method, it was possible to construct the Ishikawa diagram (**see Figure 1**).

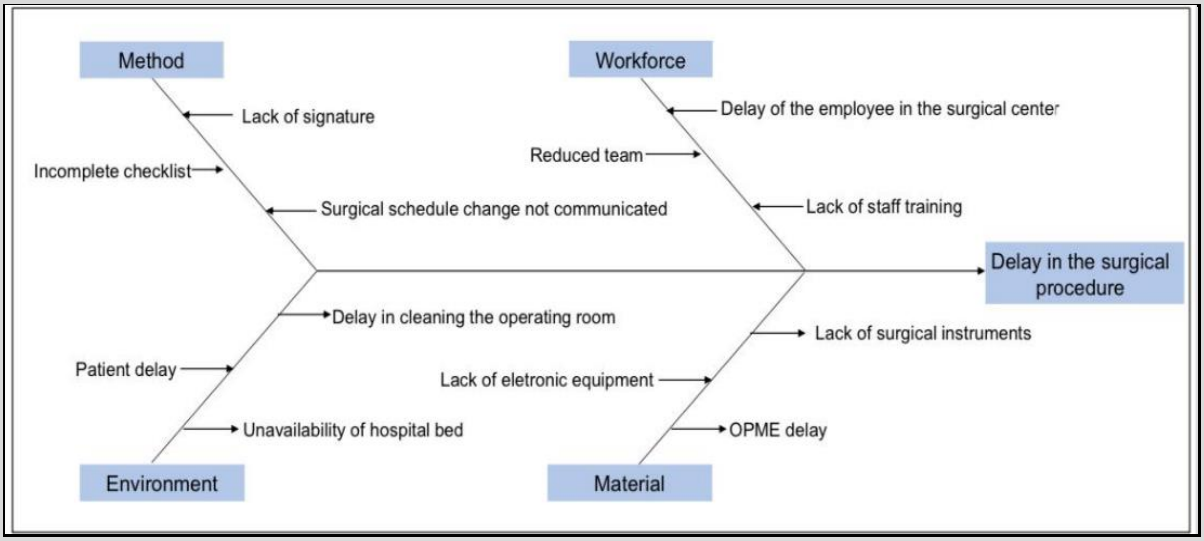

Figure 1: Ishikawa diagram

There are four root causes and twelve specific causes for the delayed surgical procedure effect. In this way, they are described below:

1- Method: the incomplete checklist concerns the lack of some important information for the surgical procedure to be performed correctly and safely. The lack of signature is when the patient's documentation was not approved by the collaborator. Finally, the non-communicated alteration of the surgical schedule is due to the lack of communication between the planning and operational sectors.

2- Environment: the unavailability of beds in the wards or ICU will impact the performance of surgeries, which is one of the most serious problems faced by Brazilian hospitals. The cause of the patient's delay is attributed to delays and failures that occurred due to a direct or indirect attitude of the patient. For example, patients did not comply with the bowel preparation protocol to get ready for their surgical procedure.

3- Workforce: the lack of training of the team occasional cases in which there is an error due to an employee who ignores a step or condition for the execution of the procedure, and concerns about the lack of a document, signature or release of any information that is necessary for the process in question with respect to the emergency act. The delay of the employee at the surgical center refers to the case in which an employee is late, justified or not, and a process cannot be started, as it is conditioned to the presence of this employee. Finally, staff shortage is another major cause, as many procedures are postponed or cancelled due to a lack of manpower.

4- Material: OPME delay, refers to cases in which a procedure is delayed due to the lack of this specific material. The lack of medical tools is also a critical point. This often occurs due to an overload of work at the Sterilized Material Center, which is unable to deliver the kits as planned. Finally, the lack of electronic equipment is related to equipment that is moved in the hospital sectors and the difficulty of locating it.

It is noteworthy that in this study, the survey was conducted with professionals involved in different stages of the process, with the aim of avoiding biased responses. Regarding the barriers encountered, the lack of correct completion of the data required for the detection and prevention of failures and delays was remarkable. It is observed that the factors of the Ishikawa diagram of "Machine" and "Measurement" were not prioritized in this study. Regarding the kaizen events that should start after the construction of the diagram, it is worth mentioning that the Method and Material categories have room for improvement in terms of process standardization. Using the aforementioned software report (see figure 2), which indicates the prevalence in the percentage of the four root causes. It is possible to note that the cause workforce is the main cause of delays in the surgical center, followed by methods. That is, they are perfectly identifiable, predictable and avoidable causes. The occurrences of these failures generated losses for the hospital since they are directly related to delays in procedures.

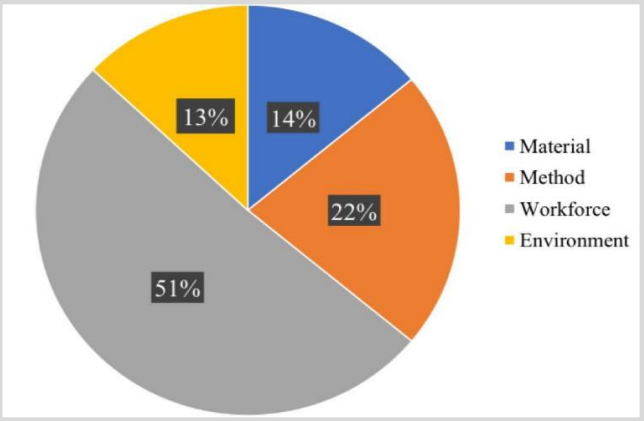

Figure 2: Percentage of failures by type of root cause

Conclusions

Reported failures and delays in the surgical center sector were described textually and qualitatively, which made it impossible to correctly and quickly identify the root causes of failures and delays. To mitigate such intercurrent cases at the emergency center, it is of paramount importance, both the identification of the root causes, by consulting the Ishikawa diagram, and the identification of the follow-up effects of failures. The quantitative understanding (Figure 2) of the causes of failure serves as a basis for the application of continuous improvement tools and attitudes that were implemented to reduce recurrent and chronic failures. The detailed understanding of all reported delays will be used in the future for registration, database analysis and proposition of improvements to avoid failures and delays in such a critical location. Finally, it is worth noting the paradigm shift that must occur in order to use the presentation tool continuously. The problem is that changing mindsets in this environment is challenging, and while the practices themselves are simple tasks, but breaking the habits that lead to chronic mistakes is not. Therefore, new behaviors coming from Lean Healthcare must be consistently reinforced, otherwise, hospital employees will quickly go back to working the way they always have.

Ethics approval and consent to participate

Not applicable.

List of abbreviations

LH: Lean Healthcare
VBA: Bisual Basic Apolication
FMEA: Failure Modes and Effects Analysis
LP: Lean Production
DES: Descrete Event Simulation
ICU: Intensive Care Unit
OPME: Orthoses, Prostheses and Special Materials
SMC: Sterilized Material Center

Data Availability

Not applicable.

Conflicts of Interest

"The authors declares that there is no conflict of interest regarding the publication of this paper."

Funding Statement

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Authors' contributions

"FFV interpreted and analyzed the results, in addition to guiding the other participants during the writing of the work throughout its process. KCW implemented lean health care in healthcare and was instrumental in correcting and translating this work, making it more appropriate to the general context. MFJ, MD, PCZ and LHCM participated in structuring the article and worked on the search for bibliographic references. GMB worked on bibliographic adaptation, translation, article formatting. All authors read and approved the final manuscript."

Supplementary Materials

Not applicable.

Conflicts of Interest

The authors declares that there is no conflict of interest regarding the publication of this paper.

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