

Improvements through Lean Thinking: a case study in a health insurance company

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Abstract: The Brazilian private health system has experienced an increase in the costs of providing services due to the current economic and political crisis, amid the multiple impacts of COVID-19 pandemic. In this context, this study aims to identify the existing waste in two departments of a Health Plan Insurance Provider (Audit and Customer Service & Authorization departments), as well as to propose improvements in the respective processes with the help of Lean Thinking. To do so, a descriptive case study was conducted as a research method, in which researchers gathered data and mapped processes through SIPOC matrices, followed by training and workshops to the employees. As a result, waiting and overprocessing were the most recurrent types of waste. Additionally, it was also observed that the employees' training was essential for identifying critical types of waste and developing the SIPOC matrices. The proposal for improvements included digitization and changes in the parameterization of the systems, which positively reduce employee's interference in the process hence avoiding mistakes and delays in the process. These actions will help reduce expenses with printed documents, reanalysis of procedures and errors in analyses.

Keywords: Lean Healthcare; Lean Office; Waste; Processes map; Improvements

1. Introduction

Health expenditures represent about 10% of the global gross domestic product (GDP) (WHO, 2019), which comprise government spending, direct payments and other sources, such as voluntary health insurance, health programs provided by employers, and health activities of non-governmental organizations. In Brazil, government spending represents only 3.8% of its GDP, while private spending corresponds to 4.4% (Brasil, 2018).

Although spending on private health exceeds government spending due to the economic and political crisis that has taken place in Brazil over the last four years, it is estimated that during this period, the private department lost about three million customers, resulting in the closure of 100 health plan operators across the country (Gavras and Brandão, 2018). This situation may have been intensified by the soaring monthly fees (from 20% to 25%) of health plans in 2021 as a result of the Covid-19 pandemic (Lara, 2020). According to the operators, the increase in the costs of providing services (medical tests and procedures) is due to technological advancements in the department, as well as the aging of the population (Gavras and Brandão, 2018).

Given this scenario, seeking to reduce administrative costs may be one of the ways to deal with moments of crisis such as these. According to Tapping and Shuker (2003), about 60% to 80% of the costs spent are related to attending customers' demands. One way of dealing with the administrative costs is by applying Lean Thinking. Initially, Lean Thinking was designed for the manufacturing environment (Lean Manufacturing), however since the 1990s, Lean Thinking has been extensively used in the most diverse environments, which resulted in approaches, such as Lean Office, Lean Healthcare, Lean Construction and Lean Service (Womack et al., 2007).

In the health department, mitigating waste in the administrative activities is a key factor to reduce overall service cost. The Royal Bolton Hospital (United Kingdom), for example, was able to directly save £3.1 million and diminish the percentage of patient deaths by one third by reducing the processing time of important blood test categories, which ranged from two days to two hours. It was done by applying simple tools as process mapping through Supplier, Input, Process, Output, Customer (SIPOC) (Radnor et al., 2012). Other example of the Nebraska Medical Center in the United States portrays a reduction of employees' walking around the

workplace by approximately 168 kilometers per year by adopting Lean principles to redesign the work area in the sterile processing center and in the clinical laboratories (Radnor et al. 2012).

In many cases, approaches (such as Lean Office and Lean Healthcare) need to be combined to achieve the desired results. When applying Lean Thinking in a hospital, for example, one must consider that this business model has processes consisting of administrative and service steps, such as issuing and approving guides for carrying out procedures and executing them properly. Thus, both Lean Office and Lean Healthcare can be used, respectively.

In this context, this study aims to identify the existing waste in two departments of a Health Plan Insurance Provider (Audit and Customer Service & Authorization), as well as to propose improvements in their processes through the concepts of Lean Thinking. The research method used consists of a case study in order to study in depth the selected unit of analysis and generate insights to contribute not only to the local provider, but also spread the benefits that simple Lean Thinking tools can provide to these departments.

The article is divided into five parts. The first part presents a brief theoretical approach of Lean Office and Lean Healthcare. The second and third, consecutively, present the research method and data collection. The fourth corresponds to the analysis of the results, and finally, the fifth highlights final considerations of this research.

2. Literature review

2.1 Lean Office and Lean Healthcare

Toyota Production System, also known as Lean Thinking, appeared in Japan around 1945 - at the end of World War II (Ohno, 1988). Defeated, Japan needed to find a way to rebuild itself and make its industries prosper again, especially the automotive ones. Based on some American management techniques, such as Quality Control (QC), Total Quality Control (TQC) and Industrial Engineering (IE) methods, Lean emerged focusing on eliminating as much waste as possible in order to increase production (outputs) and reduce resources and consequently operating costs (inputs) (Ohno, 1988).

Initially, Lean concepts and tools were developed and mainly applied in the manufacturing context. However, Ohno (1988) has already defended that this production

system represents a management concept that would work for any type of business, which hence resulted in the Lean Office and Lean Healthcare approaches.

Basically, Lean Office consists of identifying waste in any office environments (Rüttimann et al., 2014), while Lean Healthcare intends to increase the customers' value added by understanding what the patient desires and needs (Filser et al., 2017). Although both environments have different characteristics, the types of waste found in them are quite the same. Table 1 highlights the seven wastes recognized by Lean Thinking along with some examples of how they are presented in different types of business.

Table 1 - The Seven Wastes of Lean Thinking

WASTE AND THEIR CHARACTERISTICS	MANUFACTURING	HEALTHCARE	OFFICE
Overproduction: consists of producing items that is not demanded by customers.	To produce excessively or in advance, resulting in inventory excess.	Requesting unnecessary pathology tests or blood test before further diagnoses.	Generate more information, either electronically or on paper, in addition to what is necessary or before the correct moment.
Waiting: this corresponds to all idle time of workers, which can be caused by lack of stock, delays in processing, equipment shutdown, among others.	Long periods of idleness of people and/or parts, due to, for example, a machine under maintenance or in preparation (setup), resulting in a long lead time.	Waiting for: patients, operating assistants/nurses, test results, prescriptions and medications, or doctors to discharge patients and patients waiting for beds.	Periods of inactivity of people and information (e.g. signature approval, waiting for photocopies, waiting on the phone).
Transportation: this represents all movement of materials, by-products or finished products.	Excessive movement of people or parts resulting in unnecessary expenditure of capital, time and energy.	Transporting samples from laboratories, transporting patients, transporting laboratory tests due to non-optimized physical arrangement.	Transportation of notes, documents to central equipment stores for commonly used items instead of locating items where they are used.
Overprocessing: this consists of performing unnecessary activities to produce by-products or products, or even inefficient processing due to the poor quality of tools and product design.	Producing more byproducts or products than it is demanded.	Duplicate information, repeatedly asking the patient for details, archiving information from the same patient several times; intravenous application when oral medication would be sufficient and multiple bed and service changes; excessive	Duplicate information and/or archiving duplicate information which will not be used.

WASTE AND THEIR CHARACTERISTICS	MANUFACTURING	HEALTHCARE	OFFICE
		processing of health insurance and documentation; use of strong antibiotics to treat mild inflammation.	
<i>Inventory</i> : this refers to all types of existing inventory (raw material, in process or finished products).	Excess of raw material, parts in process and final stock.	Excess of medicines or health supplies in warehouses that are not being used, patients waiting to be discharged, waiting lists, and patients waiting for diagnostic test results.	High volume of stored information (buffer overloaded) in hard disk computers or cloud storage.
<i>Motion</i> : any movement that employees make during their work period, which primarily intends to add value to the piece.	Poor design of the work environment, resulting in poor performance of ergonomic aspects and frequent loss of items.	Unnecessary movement of employees looking for documentation or patients through the hospital, storing syringes and needles at opposite ends of the room, not having basic equipment in all rooms where tests are carried out.	Excessive movement of people to find information. For example, clicking multiple times on folders to find the needed information.
<i>Defects</i> : this consists of the production and/or correction of defective parts.	Product or service quality issue. Wrong use of tools, procedures or systems which results in non-standard products that will have to return to the process or be discarded.	Readmission due to mistaken discharges, adverse reactions to the medication, repetition of tests due to incorrectly provided information.	Incorrect use of inadequate procedures or systems which results in frequent errors in documentation, problems with service quality or poor delivery performance.

Source: author's elaboration on the basis of Tapping and Shuker (2003), Liker and Meier (2005), NHS (2007), Simões (2009), Aherne and Whelton (2010), Radnor et al (2012).

In addition to these, Womack and Jones (2003) identified the eighth waste, which is the non-utilized talent, or the waste of talent that treats the misuse of human capital, not making full use of its capacity or skills.

To help identify types of waste and eliminate them, Lean Thinking has some basic application tools. Once the waste is identified, some Lean tools and methods can be used and applied by health institutions. A brief description of tools according to the Lean Lexicon (Shook and Marchwinski, 2003; Hanashiro, 2007) is as follows:

- **5S**: it originates from 5 Japanese words, which are related to the sense of disposal, organization, cleanliness, standardization and self-discipline. The application of

these senses seeks to improve organization practices within the work environment through visual management and process optimization;

- **Standardized Work:** development of precise procedures to guarantee that all workers perform the production operations in the same way. There are three main elements to achieve it: takt time, standard inventory and operations' sequence. This therefore helps to keep operations quality in the desirable level;
- **Kaizen Events:** it literally means "continuous improvement". The search for continuous improvement must be based on quick implementation actions, with low costs, short-term projects focused on improving a process and emphasizes the use of human effort in teamwork and training;
- **Continuous Flow:** the production of a product or by-product without interruption in the flow of processes, avoiding overproduction, buffers and waiting. It is also known as one-piece flow;
- **Visual Management:** way of displaying production information, such as performance indicators, so that the real situation conveyed to and accessed by workers and managers;
- **Cellular Layout:** arrangement of machines or processes in a grouped way by product's families, applying a continuous flow and multifunctional workers (depending on the demand) that aim to achieve greater efficiency;
- **Value Stream Mapping (VSM):** a systemic way to map the flow of materials and information during the production of a product or service, in order to identify activities that add or not value to the process, allowing the prioritization of implementations improvements after identifying the sources of waste;
- **Line Balancing:** distribution of tasks among employees, leveling workloads and adapting to the production rhythm in order to meet the customer's demand;
- **Kanban:** it is a system composed of cards that hold product information and demand. It uses visual patterns, so that the information can be understood by everyone, including the use of colors for such transmissions. It aims to coordinate production without daily intervention of production planners.
- **Poka Yoke:** also known as "fault detection" or "error detection". It consists of a way to detect errors and eliminate situations of non-compliance and that the errors proceed through the value chain. Poka yokes are made of simple devices and are normally developed and supported by employees.

Additionally, the following tools are key to help understand the basis of processes. SIPOC consists of a method of describing processes where Suppliers, Inputs, Process, Outputs and Customers are detected, after identifying the data, they are inserted in a table where these components are related (Andrade et al., 2012). Similarly, BPMN (Business Process Model and Notation) provides a graphical notation for visualizing and understanding the flow of administrative activities (Chinosi and Trrombetta, 2012).

Focusing on Lean Healthcare, Table 2 highlights practical examples following the corresponding key tools and results.

Table 2 – Practical application of Lean Healthcare

Hospital	Tools	Results
Virginia Mason Medical Center, USA (Bush, 2007)	Continuous Flow, Visual Supply Management, External Setup of Medical Tasks (adapted TRF), Cellular Layout and Kaizen Event	Reduced patient waiting time from 10 to 5 minutes; 57% reduction in patient referral time to other departments; Reduction in time from diagnosis of breast cancer to initiation of treatment reduced from 21 days to 11 days; Reduction in patient waiting time for chemotherapy from 240 to 90 minutes; From 2001 to 2006, 4700 actions were taken; Patients feel safer and staff have taken proactive roles of vigilance and immediate error attack; 50% increase in service capacity; Reduction of the waiting time from 15 to 7.5 days; Patient lead time in the process dropped from 2.5 to 1.5 hours; Increased profit margin for each endoscopy room by 48% by reducing processing time from 35 to 18 minutes (savings of \$2,000,000 that would have been invested in expanding the structure).
Bolton Hospitals, United Kingdom (Fillingham, 2007)	Kaizen Event, 5S, VSM	Reduction of 38% from 2.3 days to 1.7 days in the start-to-finish time of treatment for patients with hip fractures; 33% reduction in patient lead time and 36% reduction in mortality rate.
Michigan University Hospital, EUA (Kim et al., 2006)	VSM and SMED	Increase of 36% in catheter placement time.
Flinders Medical Centre, Australia (Kim et al., 2006; Ben-Tovim et al., 2008)	VSM and process mapping	Number of patients in the waiting queue (about 8 hours) dropped from 21% to 19.6%; the average length of stay of the patient in the emergency department dropped from 5.8 to 5 hours of inpatients from 8.5 to 7 hours and of outpatients from 3.7 to 3.4 hours, all these results were achieved even with an increase demand that went from 140 patients/day to 210 patients/day.

Hospital	Tools	Results
Kingston General Hospital, Canada (Grabar and Lefteroff, 2008)	5S and standardized work	Reduction of 120m ² of space needed in the laboratory and 25% reduction in the preparation time of laboratory utensils; 44% reduction in operating room preparation time; 50% reduction in the time to return the instruments to the sterilized material center; release of 68m ² in the hospital pharmacy, a 54% reduction in the preparation time of pharmacy instruments, a 16% increase in employee productivity and a 20% reduction in medication returns.

3. Research Method

The research method used to help achieve the previously defined objectives was a descriptive case study. According to Yin (2014), a case study consists of investigating a contemporary phenomenon within a real-life context, which uses experiments and multiple sources of evidence to understand the relationship between the phenomenon and the context in which it is embedded. Therefore, this method seeks to answer the questions of "how" and "why" such a phenomenon occurs.

The following steps in Figure 1 are in accordance with the five steps proposed by Miguel et al. (2008): developing literature review, planning data collection, data gathering, data analyses and producing a final report.

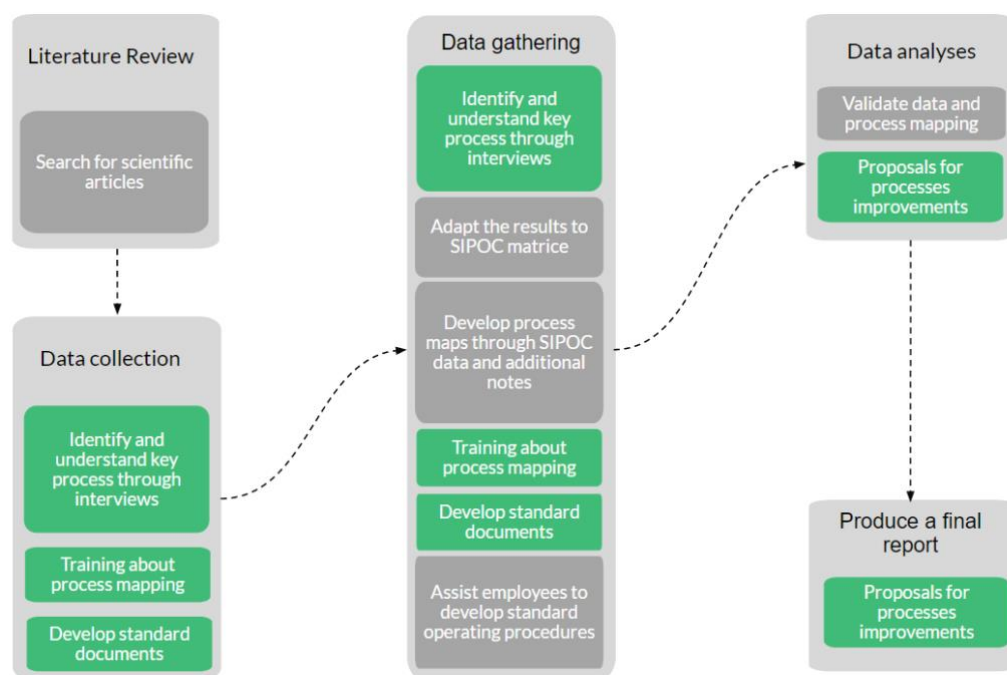


Figure 1 - Case study steps

Source: author's elaboration on the basis of Miguel et al. (2008).

Firstly, a literature review on the Lean philosophy approach (focusing on health (Lean Healthcare) and administrative (Lean Office) areas) was developed to understand particularities of each department and identify the main types of waste and their characteristics. Secondly, a data collection protocol was developed to guide researchers through all the steps of the case study. According to this protocol, data were documented from three sources: interviews with managers and staff, standard training and through the development of standard processes.

Thirdly, the process of data gathering consists of seeking information from the available sources of evidence. All data were gathered from November 2018 to May 2019 through 2-hour week visits to the Healthcare Insurance Provider. For the purposes of this article, the Customer Service & Authorization - CSA (16 employees) and Audit (seven employees) departments will be addressed, as they are both linked to the Healthcare Insurance Provider's Regulation and Service and have critical processes that hindered the management and monitoring by employees, such as:

- a) Lack of process standardization carried out by the peers responsible for the sub-processes and activities in the areas.
- b) Difficulties in charging and identifying process failures due to a lack of a general and complete overview of the macro process.
- c) Coordinators who have been working for less than 6 months in the job and do not have knowledge and understanding of the whole insurance process.
- d) Absence of indicators or metrics for measuring data and monitoring processes.

Interviews were conducted in a collective way so as to identify and understand the main internal processes. At the same time, tasks routine was mapped in order to understand the activities and their flows, and hence identifying types of wastes afterwards. As a result, macro maps of the flow of both departments were developed (SIPOC's), which resulted in nine processes from the CSA department and eight from the Audit department (Table 3).

To get more details into the macro processes map, a training in Lean Thinking was conducted with staff. According to Dennis (2007), it is important to select the right individuals to help in the process of understanding and improvements. In this case, questions, such as the following, need to be thought about: how to involve team members, what kind of skills people will need to have in order to get involved, what will be done to support and maintain engagement, how engagement will be measured and what is the role of management. These

questions were designed to bring greater control over the training and achieve engagement from the selected team members so as to build effective SIPOCs and process maps.

Table 3 – Mapped processes in each of the departments

Department	Process
Customer Service & Authorization	Request Management Revalidation Return of Authorizations Authorization of Exchange Exams Authorization of Exchange Surgery Procedures in the local hospital Anticipation/Triangulation Negative Analysis Letter of Non-Coverage
Audit	Prior Audit Competing Audit Medical Audit Nursing Audit Medical Audit – Exchange Nursing Audit – Exchange Audit – AJIUS Nursing Audit - Providers (in loco)

Thus, a dynamic training (aligning theory and practice) was conducted with 22 members of the staff. First, there was an introductory session of Lean concept, highlighting the types of waste and process mapping tools. After that, team members applied the knowledge in practical activities, from which they built SIPOC maps related to their activities, followed a discussion to align their SIPOC maps with the corresponding supplier and customer and finally the creation of support documents, such as checklists, flowcharts, and Standard Operating Procedures (SOPs). On top of that, they were asked to think about the final outputs of these activities and raise existing wastes in the environment they operate.

Therefore, to have a clear picture of the service flows and learn about the SIPOC tool to assist the process mapping in detail, follow-up interviews were conducted with the 22 employees. The aim was to understand the activities by each singular process within each department (CSA and Audit) and developed standards documents. The last step of data gathering was assisting employees of each department to develop the standard operation documents of their departments.

After finishing the process of mapping, analysis was conducted in order to identify the current types of waste within the Healthcare Insurance Provider, followed by the most

appropriate tools to be implemented to mitigate and/or eliminate waste, and finally, to build a list of suggestions for further improvements.

4. Findings

4.1 *The Health Insurance Company*

Health Insurance Company is known as “companies and entities that operate, in the supplementary health market, health care plans” (Brazil, 1998). According to Article 1 of Law No. 9.503 of September 23, 1997, healthcare insurance plans are:

“continued provision of services or coverage of assistance costs at a pre- or post-established price, for an indefinite period, with the purpose of guaranteeing, without any financial limits, health care through the faculty of access and assistance by health professionals or services, freely chosen, members or not of an accredited, contracted or referenced network, aiming at medical, hospital and dental assistance, to be paid in full or in part at the expense of the contracted operator, through reimbursement or direct payment to the provider, on behalf of the consumer ” (Brazil, 1998).

The Health Insurance Company (HIC) under study consists of a Medical Cooperative, operating in the city of Joinville (Brazil) since 1971, with more than 755 cooperative doctors and 114 accredited clinics serving around 85 thousand clients. In terms of structure, the provider has more than 1,132 employees, one hospital and one affiliated hospital. This study focused on the area of Service & Regulation, which includes the Customer Service & Authorization, Audit and Regulatory Affairs departments.

Aiming to provide services to the local community by analyzing medical guides and authorizing exams/tests, the Customer Service & Authorization (CSA) department is the main channel of communication with customers. Medical exams that are not directly approved by this department are then sent (through an IT system) to the Audit department for a second screening and further approval or non-approval service. The Audit department, in turn, aims to ensure that the medical exams to be performed (e.g. surgeries or blood tests) by health care providers and their corresponding medical bills are in compliance in terms of values, treatment and regulations. The Regulatory Affairs department is responsible for ensuring that the entire operation of the Health Insurance Company is in accordance with the criteria and guidelines established by the National Supplementary Health Agency (ANS). To this end, this department follows and monitors ANS requests, submitting the necessary documents and taking the appropriate internal measures to keep the HIC in compliance with existing laws and regulations.

4.2 Process Mapping

SIPOC maps were built according to a model made available by the HIC as a way to maintain a standard template. In total 17 SIPOC's were built, nine from CSA and eight from Audit. One of the SIPOCs is illustrated in Figure 2.

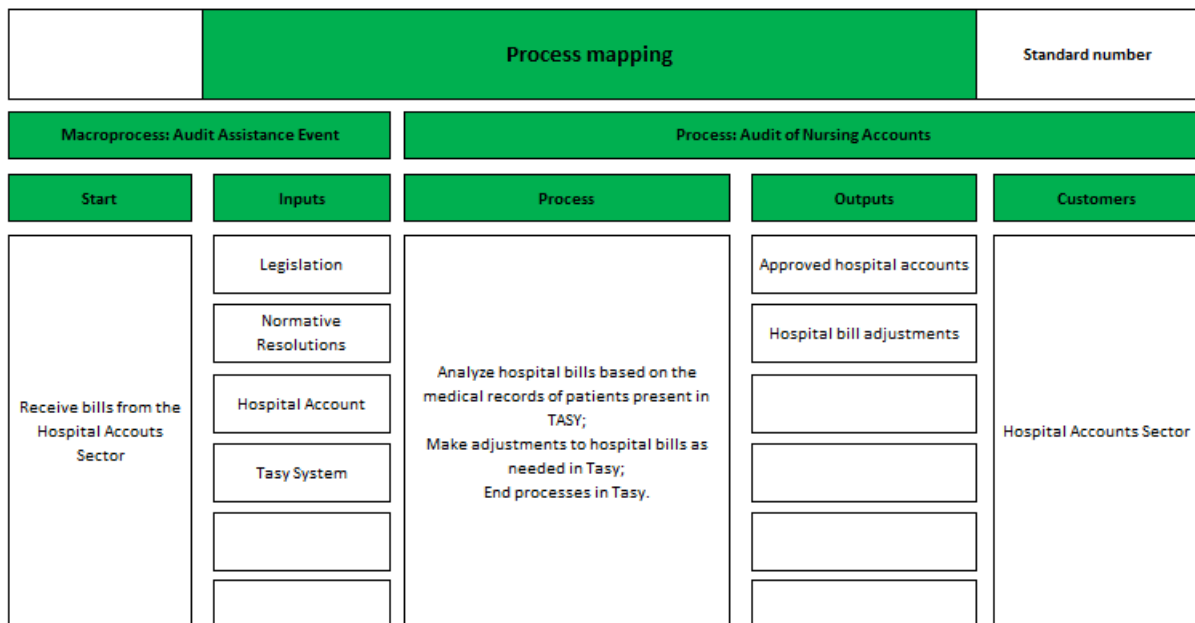


Figure 2 - SIPOC Model

Source: author's elaboration on the basis of Andrade et al (2012).

After building SIPOCs, the HIC's 17 processes were mapped into the BPMN (Business Process Model and Notation) structure, using the Bizagi software (version 3.3.0.076). Figure 3 shows one example of the mappings (rectangular box shows an activity; diamond represents decision making; green and red circles represent, respectively, the beginning and the end of the process; and the pools represent different departments or levels of responsibilities that comprise the process to carry out each activity). All maps were validated by employees, coordinator, and manager of each department.

The search for waste in the 17 processes under analysis occurred through the validation of the developed SIPOCs. In each of the departments, meetings were held with managers to understand the activities and their flows for each process, and the brainstorm technique was used in order to identify existing wastes in each process. In the following sections, two of these processes are discussed in depth, as they were the ones with greater volume (about 20%) of activities and they depended only on internal resources from the studied departments (CSA and Audit).

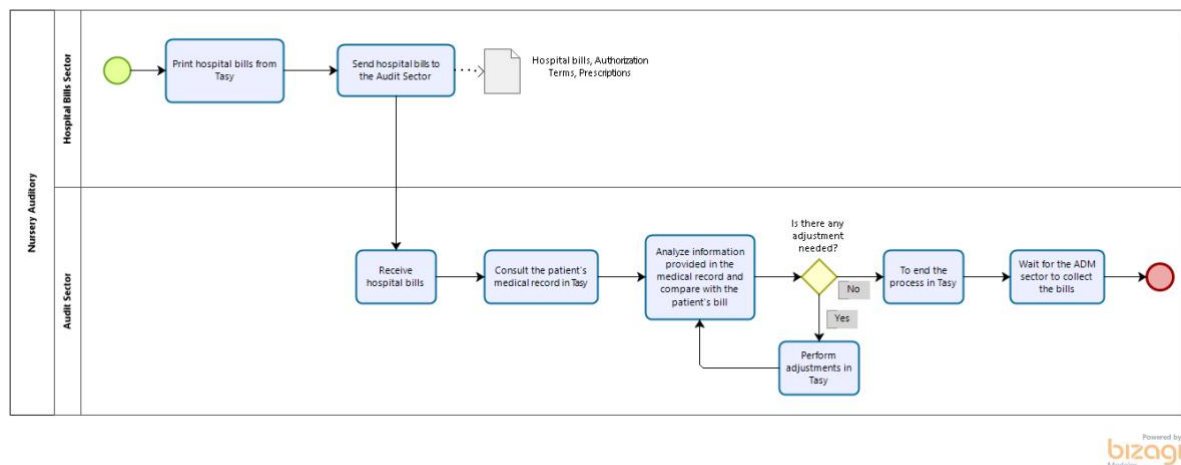


Figure 3 - Nursery Auditory Map
 Source: author's elaboration (2008).

4.3 CSA Process: Request Management

The Request Management needs an administrative assistant who manages requests made by beneficiaries, companies of the same network or by establishments in the provider network. These requests are made through the HIC's online portal or by phone. The requests can serve two purposes:

- *Revalidation*: this procedure is done when a beneficiary requests the revalidation of a password for a medical exam that has already been authorized and for some reason was not performed by the beneficiary. In this case, the assistant will analyze and can only revalidate the password or send a request for analysis of the procedure again.
- *Return of Authorizations*: the return is given via email, SMS (Short Message Service) or call when the medical exam is authorized. Therefore, the beneficiary is informed of a protocol password so that he/she can follow the procedure, and thus be able to schedule his/her test or surgery.

In the Request Management process, the administrative assistant uses code notes to enter the Authorization system (an HIC state permit management system). When an error is identified in the code, it is necessary to search for the correct codes; these mistakes can occur in many types of information, such as procedures codes, kind of materials, or types of plans. The system automatically points out the error codes only after sending the registration of the request, therefore, for correction, the order needs to be canceled and the entire process redone. When the procedure is not automatically approved, and it is the responsibility of the exchange processes, the administrative assistant prints the guides, and the request is separated into an

accordion folder in alphabetical order to direct the exchange team to follow it up. When the password revalidation is requested, it is analyzed whether it is inside or outside Santa Catarina State; if the extension is made inside or if the authorized procedure is canceled outside, a new request is made.

Based on this process, the following types of waste were identified:

- *Inventory and Overprocessing*: printing out the interchange guides that are in the system and the act of writing down the request code for use in other systems.
- *Overprocessing*: inclusion of requests without the certainty that they all have the necessary documents or that the codes are correct, generating rework by canceling the order, having to redo the entire inclusion procedure and the procedure codes wrongly provided by doctors or the network requesting provider.

Table 4 shows the types of waste identified in the nine processes of the CSA department.

Table 4 – Types of waste identified in the CSA department

Process	Type of waste	Description
Request Management	Inventory and overprocessing	Printing of exchange guides that are already in the system. Getting note of the request code in a separate paper so as to input in other systems.
	Overprocessing and defects	Requests without being sure if they have all required documents or right codes to proceed the exam – this therefore generate rework due to often order cancellation. Procedure codes incorrectly provided by the requesting physicians or provider network.
Procedures in the local hospital	Inventory	Customers are not immediately informed about the approval or disapproval of the exams, which generates a long queue of calls to be made daily.
	Waiting	Wait for the nurse to budget the materials needed to carry out the surgical procedures and exams.
Procedures in the local hospital	Waiting and overprocessing	All surgical procedures are transported to the audit department to be analyzed, instead of being analyzed locally by the CSA department. In this case, the CSA department needs to wait for the Audit's return, in which they take the risk of missing the deadline of the ANS.
	Overprocessing	Lack of standardization and parameterization of the health insurance plans. Non-regulated plans, which require a particular analysis for each of the established contracts.
Authorization of Exams / Exchange of Surgeries	Waiting	It is necessary to wait for a positive response from the HIP to proceed with the steps for the exam, and because of that there are often delays in the process.
Process	Type of waste	Description

Anticipation/ Triangulation	Waiting	It is necessary to wait for a positive response from the HIP to proceed with the steps for the exam, and because of that there are often delays in the process.
Negative Analysis	Overprocessing	This procedure is composed by the repetition of the analysis of the request, which is considered a rework due to lack of reliability in the parameters of the system and in the analysis previously performed by the department. It is normally performed by a specific person (analyst in the area).
Letter of non- coverage	Waiting	It requires waiting for the digital signature and has a period of twenty-four hours to be sent to the customer.
	Overprocessing	After analysis from both departments, a new analysis is carried out to write the negative letter.

In this department, two types of waste were the most recurrent: a) overprocessing, which indicated rework to be done due to tasks that have not been done correctly in the first time; and b) waiting, due to the lack of knowledge to carry out the task or being performed by a hierarchical level of the chain that does not have the power to make the decision. Having identified these points, the study of the improvements will be presented in topic 5.

4.4 Audit Process: Audit Accounts - Nursing

The nursing process consists of analyzing hospital accounts in terms of medical procedures and materials used by HIP patients, as well as private patients, public employees, and other existing contracts at the HIC. In this case, those patients were attended to at the HIC hospital located in Joinville.

This process is carried out by two nurse auditors and begins with sending closed accounts (patients who have already been discharged) by the Hospital Bills department to the Audit Department. If inconsistent points in the Account are identified, the adjustments are made by the auditors themselves in the TASY system, which contains all the procedures that were carried out and the materials used.

Regarding beneficiaries of other network operators, such auditing avoids/reduces the emission of disallowances by the patient's operator, streamlining the process of charging and receiving the service provided. The main highlight of this process is the fact that it uses physical channels to carry out the analysis and that the auditors themselves make the adjustments to the system, reducing the possibility of disallowances due to the lack of adjustments in the accounts. About 819 hospital accounts are audited in this type of audit. Thus, the types of waste found were:

- *Waiting*: this type of auditing depends on sending printed copies of hospital bills so that it can be paid. The delay in sending these documents implies delaying the audit analysis, and consequently payment.
- *Transportation*: printed Hospital bills and accountabilities are taken from one department to another (Hospital Accounts, Audit and Clerks) so that activities of both departments can be carried out.
- *Inventory*: use of printed documents and forms to carry out the audits, accumulating documents on the tables and also in the HIC's files.

Table 5 presents all the waste identified in the eight processes mapped in the Audit department.

Table 5 - Types of waste identified in the Audit department

Process	Waste	Description
Prior Audit	Overprocessing	The same procedure is applied to several analyses and even so, in some cases, the analysis is not considered in the final decision making.
Competitive Audit	Waiting	During the execution of the audit, the auditors often must wait for the return of the nurse (the person responsible for the sector being audited) to ask questions about the patients' situation.
	Overprocessing	Many reports are generated to obtain information, which delays the process and increases the chances of errors. In addition, at the end of the audit, the nurse auditor must retype all the information collected into Google Forms.
Nursing Audit and Medical Audit	Waiting	These two types of audits depend on sending physical copies of the hospital bills so that they can be performed.
	Transport	The Hospital bills are printed and transported from one department to the other (Hospital Accountability and Audit) so that the activities of both departments can be carried out.
	Inventory	Use of printed documents and forms to carry out the audits, accumulating documents on the tables and also in the HIP's files. In the case of Medical Audits, there is also a requirement to fill up forms manually.
Nursing Audit – Exchange and Medical Audit	Waiting	To finalize the audit, the auditors must wait for the HIP involved to take a position, causing a disruption in the flow of activities and make procedures to keep waiting in the system until getting approvals.
Audit of AJIUS Systems	Waiting	The auditors must wait for a positive or negative response from the HIP involved so as to finalize the audit.
	Overprocessing	Some refusals remain for a long period of time under analysis among HIPs, being constantly reviewed.
Nursing Audit – in loco providers	Overprocessing	Medical bills are printed and later scanned again with/without issuing refusals.
	Inventory	Use of printed documents and forms to carry out the audits, accumulating documents on the tables and also in the HIP's files.
	Motion	Auditors have to travel to other locations (HIPs), visiting different HIP's setting across the city, to carry out the audits.

Overprocessing and waiting wastes stood out during the analysis in the Audit department. The former is related to analyses performed by the auditors based on requests for

refusals and the need to print them out and later digitize them. Regarding the waste of waiting, this is linked to the delay of the other departments to provide information which causes disruptions in the system until a solution can be given.

5. Improvement Proposal

Acknowledging the types of waste previously identified, improvements were proposed, which were brainstormed by researchers and the CSA and Audit team members. The improvement proposals sought to tackle root causes to mitigate the identified types of wastes. The proposals for the CSA department can be seen in Table 6.

Table 6 - Improvement Proposals for the CSA department

Process	Types of waste	Improvement proposals
Request Management	Inventory and overprocessing	System parameterization allows the traceability of exchange requests, as already done for procedures in Joinville, eliminating the need to print them out and separate guides and procedures.
	Overprocessing and defects	Implementing locks in the system for receiving requests, accepting only requests when all documents are correctly provided. Implementing an online platform for doctors and provider networks to fill guides with parameterized codes in. Flexibility in changing the request without canceling the procedure.
Procedures in the local hospital	Inventory	Implementing a system to get automatic returns from the exams' approvals in addition to SMS, which could be Corporate WhatsApp and/or email.
	Waiting	Get ready a parameterized list of materials for each procedure, thus generating the data linked to the procedure code.
	Waiting and overprocessing	System parameterization and training of admin assistants for greater security in the analysis of procedures of less complexity and value.
	Overprocessing	Standardization and parameterization of procedures as defined and specified in each contract.
Authorization of Exams / Exchange of Surgeries	Waiting	Sign an agreement and penalty before the deadlines, established by the ANS, between the HIPs belonging to the network to reduce delays in the returns of requests under analysis.
Anticipation/ Triangulation	Waiting	Sign an agreement and penalty before the deadlines, established by the ANS, between the HIPs belonging to the network to reduce delays in the returns of requests under analysis.
Negative Analysis	Overprocessing	Establishing a standard for filling in the history in the Authorizer, in order to make the points of view raised during the analyses clearer, including, for example: excerpts from legislation and contracts, List of ANS, among other considerations. Speeding up the understanding of the refusal to pass on to the beneficiaries, extinguishing the need for a new analysis.
Letter of non-coverage	Waiting	It is proposed the signature be done by the Service/Authorization department itself, not needing to redirect the document to another department.

Table 7 lists a couple of proposals for improvements that can be implemented in order to minimise different types of waste; some of which needs the support of Information Technology (IT) department from the HIC.

Table 7 - Improvement Proposals for the Audit department

Process	Waste	Improvement Proposals
Prior Audit	Overprocessing	Parameterization in the TASY system, performing auditing automatically.
Competitive Audit	Waiting	Create a schedule with predefined times for visits to hospital floors or sectors. Automatization the process of checking the reports issued, reducing the time that the auditor spends to check and understand where the patients are.
	Overprocessing	Conducting the competitive Audit directly in a virtual environment.
Nursing Audit and Medical Audit	Waiting	Accessing Hospital bills digitally.
	Transport	Filling online forms.
	Inventory	Use of process management software/application that allows filling out forms.
Nursing Audit – Exchange and Medical Audit Audit of AJIUS Systems	Waiting	Develop an indicator to check which procedures generate more disallowances for other operators.
	Waiting	Align strategies with other HIPs to solve the identified problems.
Nursing Audit – in loco providers	Overprocessing	Use of an electronic device (a Tablet, notebook) to carry out the audit.
	Overprocessing	Use of a digital signature platform so that providers can sign the refusals and audited bills.
	Inventory	Use of software such as Team View, VPN (Virtual Private Network), among others that allow remote access to other computers.

Thus, HIC's IT department would be called in again to implement the proposed improvements. The proposals focus on eliminating the likely errors, and streamlining activities through the use of digital platforms, digital signatures and the use of electronic and virtual devices.

It is understood through the Lean Thinking tools that the parameterization of the systems can act as a Poka Yoke and hence reduce the waste of overprocessing. This is the case, for example, of the Prior Audit process in which a parameterization can be performed by the TASY system, allowing the audit to be carried out automatically. The parameterization consists of the insertion of blocks (Poka Yoke) of procedures according to the specifications in the patients' contracts and procedures authorized by the ANS (National Supplementary Health Agency - Federal Government). Only exceptions would be directed to audit, as evaluated by the Service department. Such improvement would have to be carried out by the IT department and in

collaboration with the Commercial department. This improvement could potentially reduce the volume of audits performed, which would focus on cases that are relevant in terms of complexity and severity.

Still related to the Audit department, another proposed improvement considers the use of a virtual Kanban system on the Medical Audit process. In addition to the proposed improvements in the computerization of the forms used in the process, it is also suggested the use of process management software/application that allows the completion of such forms. The software works as a virtual Kanban, in which the demand is entered into it by the purchasing department, attaching hospital accounts to the program and submitting them for audit analysis. The form is made available in the auditing stage, it is filled in online and submitted to the next stage for data entry by the clerks. Some software/applications integrate with other systems, so the final release can be done automatically.

Furthermore, the eighth waste (non-utilized talent), identified by Womak and Jones (2003) in manufacturing and addressed by Graban (2009) for the health department, was also identified in this case. This waste can be seen in the poor orientation and distribution of tasks, as it was mentioned by the managers in the first meetings regarding the project. This type of waste has also been addressed in the development of the process flow maps of each department and also during employees' training under the lean thinking methodology.

In fact, for the implementation of the suggested improvements, several joint actions in the areas of Regulation, Service and IT would be needed as most of the proposals are related to the parameterization of systems and the use of electronic devices. This proposal is in line with a study carried out with 567 American hospitals, in which it was found that the use of IT resources contributes to improving hospital processes, such as in diagnosing, scheduling and coordinating patient care (Devaraj et al, 2013).

Through studies, such as Ker et al. (2014), it is possible to affirm that the use of technologies can help to reduce the time of task execution and consequently speed up the completion of the process. In this regard, although the steps taken in Ker et al. (2014) were different from what this study took, the Nursing Request and Audit Management processes may have a similar reduction in timing considering their digitalization.

6. Conclusion

This article aimed to identify the existing waste in two departments (Audit and CSA) of a Health Insurance Provider, as well as to propose improvements in their processes with the help of Lean Thinking. Through mapping the current status of the 17 processes, it was possible to understand the processes in detail and identify the most recurrent types of waste and how they impacted the system. In the two studied departments, there was no formal or standard process. Thus, by analyzing the flows of the mapped processes two main and most recurrent types of waste stood out: 1) overprocessing (indicating rework as the processes were not being performed correctly the first time) and 2) waiting (due to the need for waiting dispatch documents from other departments and the lack of knowledge to proceed).

After analyzing the built SIPOCs and mappings, and based on the identified wastes, improvements were proposed so as to help reduce and/or eliminate as much as waste as possible. Such improvements consist of process digitization and, in some cases, their automatization, which consequently reduces the costs and resources spent in printing out copies of documents as well as the reanalysis of procedures. In addition, we suggest that the current systems should be integrated in order to standardize procedures, clarifying lists and rules per existing contract plan, formalizing budget packages by procedures, and creating an online guide platform for requesting surgeries and exams available to the registered medical and service provider network.

In terms of Lean Thinking applied to the studied processes, there is a need to adapt the tools to be used in processes from other departments with specific activities. It was noticed that employees had no understanding about Lean philosophy, and therefore were not used to apply tools, such as Kaizen events, Poka Yoke and Kanban. Despite this, it was possible to apply some tools in the studied context, such as process mapping and standardized work procedures.

As a limitation, we identified that the administrative assistants had insufficient knowledge causing additional difficulties and delays in training them based on Lean Thinking concepts and their tools. It also hindered the study, the lack or non-availability of current indicators to outline objective metrics for measuring results. It is important to emphasize that mitigation of identified waste can be achieved if the suggestions presented are applied, as well as the continuation of the standardization of processes through SOPs. Therefore, it is suggested that continuous improvements should be made, in addition to carrying out the proposed improvements.

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