Journal of
Engineering Research

ANALYSIS OF TWO PROCESSES OF A PHARMACY IN A HOSPITAL OF THE PUBLIC HEALTH NETWORK THAT IS BASED ON THE APPROACH OF THE LEAN MANUFACTURE

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Abstract: Lean Manufacturing is a philosophy inspired in the Toyota Production System that objectives to stablish a management capable to promote a continuous flow and stability of the process by reducing wastes. Disseminated and consolidated in the industry, nowadays the Lean Manufacturing is widely used in different areas, like offices, banks and hospitals. When applied in healthcare areas, this management model is called Lean Healthcare, and could help the healthcare systems overcome challenges presented in their reality, such as elevated operational costs and poor resource usage, that could be found everyday as long queues and lack of financial and human resources. Looking to facilitate the improvement in those scenarios, the present work aims to analyze and propose improvements for the process of a pharmacy in a hospital from the Brazilian Public Healthcare System, based on Lean Manufacturing by applying the Value Stream Mapping tool (VSM) and analyzing the process using the waste logic, resulting an action plan. The main results of this research were to identify 15 wastes along value stream, where 5 different Lean tools could be used in 17 opportunities. It is estimated that those actions could transform 53% of the activities of the value stream, 18% of that by eliminating activities and 48% by improvements, what could represent more than 561 minutes per month. This research concludes that the VSM could contribute for the process improvement of a pharmacy of a hospital from the Brazilian Public Healthcare System, by facilitating the identification of the process and activities, as well supporting the identification

Keywords: Lean, Lean Healthcare, Value Stream Mapping (VSM), Process Improvement, Hospital Pharmacy.

INTRODUCTION

Lean is a set of management concepts inspired by practices of the Toyota Production System, developed in Japan between the 40s and 80s (LEAN INSTITUTE BRASIL, 2019). This philosophy is based on the analysis and prevention of 7 basic wastes in production, aiming to create value for the final customer (OHNO, 1997), through the institution of a management capable of promoting the continuous flow and stability of the processes.

Originally developed in the automobile industry, this philosophy has been used over time in companies in different segments, such as hospitals (WOMACK & JONES, 1990). The term coined for the study and application of Lean in healthcare is Lean Healthcare, which aims to transform the way institutions see and act in their processes (GRABAN, 2009).

In public hospitals, long waiting times, queues and lack of resources are just some of the problems encountered (POLIGNANO, 2010). Within these organizations, hospital pharmacies are points of centralization of information, responsible for the care and dispensing of medicines to patients, as well as the management and conciliation of the same to hospitalized patients. Because they have complex operations that involve several areas, pharmacies can present various weaknesses along their value chain, such as lack of reliability in information (MAZUR & SHI-JEI, 2008), lack of demand predictability (SILBERSTEIN, 2006) , high rework rates (LEFTEROFF & GRANBAN, 2008) and lack of work standards (JENKINS & ECKEL, 2012), which directly affect the quality of services provided. Research question: How to improve the processes of a pharmacy in a hospital of the public health network in Brasil?

To this end, it is proposed to analyze and suggest improvements to the processes of a pharmacy in a public hospital in Brasil based on the lean manufacturing approach, through the application of the value stream mapping tool (MFV) and analysis of its processes under the perspective of waste.

This is an applied research, qualitative approach and descriptive objectives, using a single case study as technical procedures. The presentation of this study is structured in 5 sections in addition to this one, which are Theoretical Framework, Methodology, Presentation of Results, Discussion of Results and Conclusions.

THEORETICAL REFERENCE

LEAN HEALTHCARE

Lean is a set of management concepts inspired by practices of the Toyota Production System, which aims to eliminate waste and ensure the stability of inherent processes (LEAN INSTITUTE BRASIL, 2019). In turn, Lean Healthcare is conceptualized as a philosophy that is supported by a set of concepts, techniques and tools that aim to improve the way hospitals are organized and managed (GRABAN, 2009). In general, Lean Healthcare is the application of Lean principles to the healthcare area with the objective of adding value to processes and eliminating waste through the adoption of lean management techniques (SIMÕES, 2009).

In the light of Lean Healthcare, the processes within a hospital are divided into three structures, material flow (drugs, exams, food, etc), information flow (schedules, approvals, prescriptions, etc) and patient flow (course of patients itself). By making these processes leaner, there will be a direct contribution to focusing on the patient and internal customers, allowing to reduce service delays, increase patient and employee satisfaction, as well as reduce operating expenses (DANAAPFEL et al., 2014). For this, Lean Healthcare proposes 5 basic principles: patient first; define what is value for the patient; identify Ohno's 7 wastes in the health sector; deliver more value using fewer resources; and stop doing with perfection what does not need to be done (GRABAN, 2009).

WASTEAGE

To apply Lean concepts, it is necessary to carry out an analysis of waste in processes, which are classified into 7 categories: overproduction; defects: waits; inappropriate processing; stocks; movement; and transport (OHNO, 1997). In the health area, these wastes are also exploited. Table 1 presents the classic definition and examples in the context of health.

In addition to these wastes, Amiirahmadi (2007) proposes two new categories in the context of health. These are presented in table 2.

The loss byreprioritization, occurs when there is a change of execution from one task to another before it is completed, and by human potential, which occurs when the potential of health workers is underutilized. The latter can also be characterized by the non-use of health professionals in the construction of improvement processes within hospitals (MARDEGAN, 2010).

VALUE STREAM MAPPING IN HEALTH CARE

The MFV is one of the key tools for the implementation of Lean in companies, a technique that is easy to use and understand, which allows the identification of waste and promotes the improvement of value flows (ROTHER & SHOOK, 2003). In healthcare, MFV has been applied in several sectors, such as in pharmacies (MAZUR & SHI-JIE, 2008), operating rooms (SELAU et al, 2009) and sterilization centers (TORTORELLA et al, 2015), being able to bring benefits such as leadtime reduction (GOUVEA, 2012), inventory reduction (GAUZE JR, 2016) and increased resource availability (ANDREOSI, 2018).

The MFV model developed by Henrique

waste	Classical Definition	Example of the Health Sector
1. Overproduction	Produce too much or too soon, resulting in excess inventory.	Perform diagnostic procedures unnecessary.
2. Defects	Frequent errors in information processing, product quality problems or poor delivery performance.	Support containing missing surgical instruments one item at the time of the procedure: Incorrectly administered dose or drug substance.
3. Waits	Long periods of inactivity of people, information or goods,	Employees waiting due to excess work on another level, patients waiting for care
4. Inappropriate Processing	resulting in poor flows and long cycle times.	Repeated requirements or no future use requested in forms
5. Inventories	Executing the process with inappropriate tools, procedures or systems at the expense of simpler and more efficient approaches.	Pharmaceutical industry supplies purchased in excess that reach their expiration date and must be despised.
6. Movement	Excessive storage of raw materials or products.	Laboratory workers walking several lcm's/day due to poorly planned layout.
7. Transport	Excessive movement of people, moving and storing parts, including unnecessary physical movement of operators.	Excessive transport of drugs, patients, laboratory tests.

Table 1 - Definitions and examples of waste

Source: The authors, adaptado de Bertani (2012) e Granban (2009)

Waste	Definition	Example
1.Re-prioritization	Moving from one task to another before even finishing the first one.	Stop preparing a medication kit for start another.
2.Human Potential	Underusing the potential of health workers.	Use experts for administrative operational tasks.

Table 2 - Definitions and Examples Amiirahmad's Losses

Source: Authors, adapted from Amiirahmad (2007)

(2014), contemplates the 3 types of flows found in hospital environments, materials, information and patients, and is divided into 3 phases. Table 3 presents the details of these stages.

The maps of the initial situation and final situation, should be represents in a specific arrangement, that contemplates the 3 explored flows in the Lean Healthcare. The figure 1 presents the layout of the proposed map by Henrique (2014).

In this methodology, the map is divided into 5 distinct lines, flow of materials, information, patients, timeline and problem identification. In this plan, the connections between the activities of the processes are traced, noting the inputs and outputs, queue times and the classification of activities that add and do not add value. In addition, demand data must be present in the upper right corner of the map so that facilitate in takttime calculations. Figure 2 shows the symbology used in Henrique's model (2014).

The symbols presented above, in addition to being used for representation, are used for reading and interpreting flows. Process boxes represent the places where value addition occurs, and data boxes present data related to the processes. This model is read from left to right, noting the activities and information of the mapped flow distributed among the 5 lines.

LEAN TOOLS

Over the years, several tools have been developed with the objective of reducing and eliminating the losses proposed by Ohno (1997). The application of these tools provides a better delivery of services, contributing to the improvement of the work of employees and a better use of resources, such as machines, materials and equipment (AHERNE & WHELTON, 2010). In table 4, Lean tools are presented. used in the application of Lean

Healthcare in hospital pharmacies:

The symbols presented above, in addition to being used for representation, are used for reading and interpreting flows. Process boxes represent the places where value addition occurs, and data boxes present data related to the processes. This model is read from left to right, noting the activities and information of the mapped flow distributed among the 5 lines.

The working method of this study was developed in accordance with Miguel's (2007) recommendations and includes the steps of defining the conceptual framework, case planning, conducting a pilot test, data collection, data analysis and final report generation. The first stage begins with the definition of the conceptual structure, which has as its delimitation the application of the MFV tool in the health area, specifically in a hospital pharmacy and using the approach proposed by Henrique (2014). The second step is case planning, where the case study is designed for its realization. The selection of the unit of analysis to carry out this single case study, adopts the following criteria: they are only qualified as a unit of analysis for this study. study pharmacies in public hospitals in Brazil. Data collection is done through three sources of evidence, combining data provided by people, documentation and observations. Table 5 explains the data collection techniques for this study.

Using multiple data collection techniques, it is possible to triangulate the three sources of evidence, in order to corroborate and complement the understanding of the scenario studied. The data analysis of this research is adapted from the steps established by Bardin (1979) and Minayo (2006) together with what was proposed by the MFV methodology. Table 6 presents a detail.

After the application of the proposed tool, analysis of the results through the

Pre-mapping	Moment where the flow to be mapped must be chosen and a macro view of the flow must be sought, identifying the departments and people involved, detailing all the activities present. In this phase occurs the gathering of data that will serve as a basis for the preparation of the map of the initial situation of the analyzed flow.
Mapping the initial situation	Moment of drawing and representing the flows (information, materials and patients) of a given product or service, or family of products or services. In this map the various information of the value stream are related, aiming at the integral understanding of the processes and problems in the analyzed system.
Mapping the Invoice Situation	Moment of design and representation of the flows of a particular product or service, or family of products or services in an optimal state, referring to the map of the initial situation (HENRIQUE, 2014). In this map are also punctuated the improvements for elimination of waste identified in the map of the initial situation that are proposed based on Lean principles.

Table 3-Stages of MFV proposed by Henrique (2014)

Source: Authors, adapted from Henrique (2014)
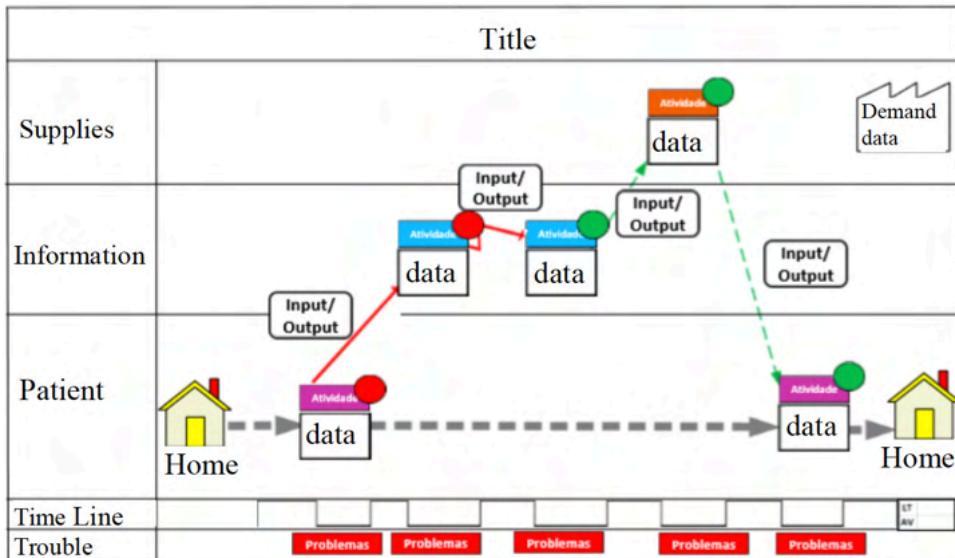
Figure 1 - Layout map proposed by Henrique (2014)

Source: Henrique (2014)
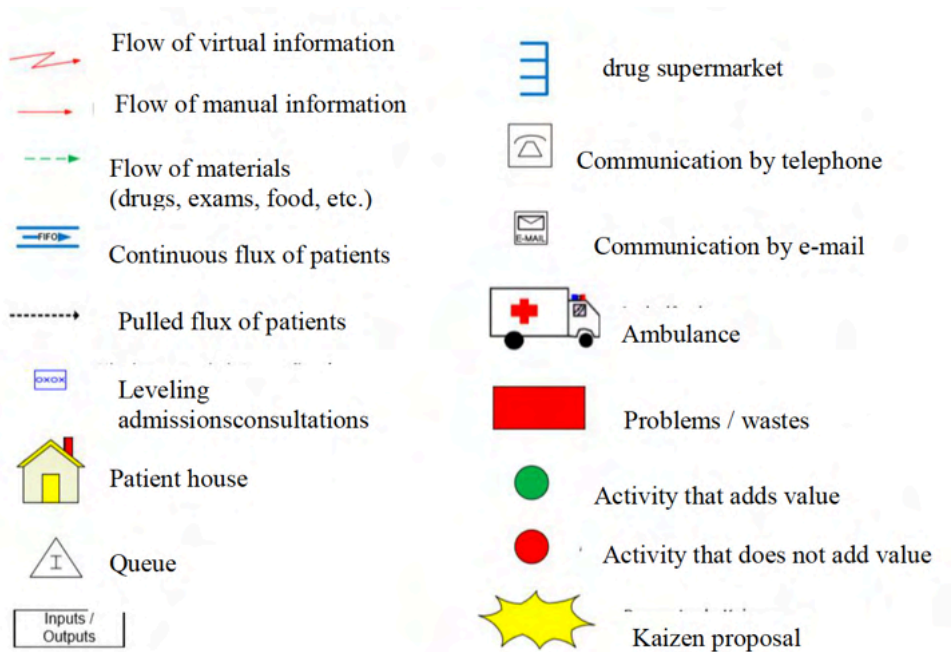
Figure 2 - Symbology used in Henrique's model (2014)

Source: Henrique (2014)

Tool	Description
Standard Work	Institution of procedures for each function within a production system. This approach is based on the exact sequence of an activity and the standard stock required in order to reduce deviations, increase quality and ensure continuous flow (LEAN LNSTITUTE BRASIL, 2019)
5S	Set of practices based on 5 Japanese philosophies, Seiri (niliraça o), Selim; (ordering), Seno (cleanliness), Seikenu (standardization) and Shitsuke (sustaining). These practices are the starting point for improving a process or work area, and aim to increase productivity and reduce waste through the organization of workstations (HOLDEN, 2011)
Visual Management	It makes it possible to synthesize and visualize information that express the real performance of the processes, facilitating their understanding. However, for this tool to achieve its objective, it is necessary that the information base for these controls is up to date, complete and correct (LEAN INSTITUE BRASIL, 2019)
Kanban	Sin2I■ndor device capable of coordinating a pulled system, its main function is to instruct the system to move and manufacture products, at the right time and in the right quantity. As a great advantage, the Embai: presents the ability to adjust the production level in order to produce only what has been requested by a "customer" (LEAN LNSTITUTE BRASIL, 2019)
Kaiten	Continuous improvement of a complete value stream or an isolated process, with the purpose of reducing waste and increasing the value delivered (LEAN LNSTTMTE BRASIL, 2019). Katen follows principles such as understanding the current situation, using fact-based data, acting on root causes, and working as a team to achieve the best result at the lowest possible cost (KAIZEN INSTITUTE PORTUGAL, 2019)

Box 4-Lean tools in hospital pharmacies

Source: Authors
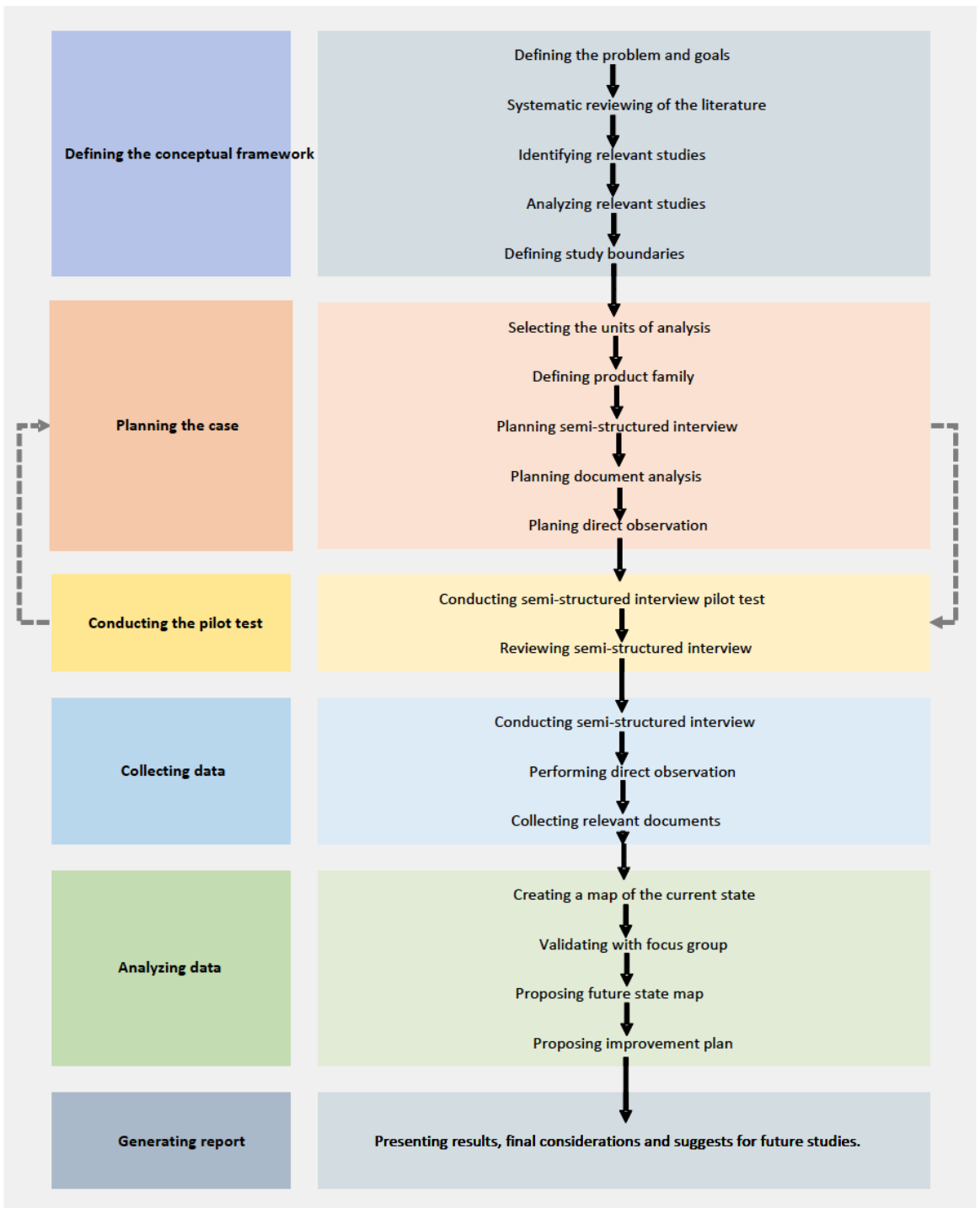
Figure 3 - Work method

Source: Authors, adapted from Miguel (2007)

Technique	Description
Interview	To conduct the interviews, a provisional script of semi-structured questions was developed, which were designed to address the data needed to develop the map of the initial situation of the scenario studied. This provisional script for the pilot test is presented in Appendix A. In order to guarantee the best alignment of the data collection method (YIN, 2001) my pilot test of the semi-structured interview was conducted with one of the people involved in the processes to be studied, which resulted in a revision of the initial questionnaire.
Document analysis	The analysis of documents inherent to the studied objects. Where information and evidence about the processes and procedures of the hospital's outpatient pharmacy are sought, aiming at identifying how the process happens, corroborating and complementing the understandings generated during the interview phase.
Direct observation	The direct and non-participant observation of the objects, in this case of the processes linked to the study scenario. Direct observation was chosen because the senses will be used to examine the phenomena of the environment (LAKATOS & MARCONI, 2011), and non-participant observation because the researcher is unaware of the processes studied, not being directly involved with the objects, only acting as a spectator (GIL, 2002). An observation protocol (adapted from Guerra, 2010) was applied in this study can be found in Appendix 8 of this article.

Chart 5-Data Collection Techniques

Source: Authors

Step	Description
Pre-analysis	The pre-analysis is the phase in which occurs the organization and systematization of ideas referring to the objectives as to the material surveyed and the indicators of interpretation (CAPPELLE, 2003).
Material Exploration	The exploration of the material is the phase in which occurs the codification of the material for the understanding of it.
Treatment and interpretation	The phase of treatment and interpretation of the obtained data follows the proposal of the MFV tool, specifically the model developed by Hemique (2014), where a critical analysis of the flows of materials, information and patients is made from the perspective of lean manufacturing, as well as the 9 types of waste identified in item "2.2 Waste - of the theoretical framework of this article.

Table 6 – Data analysis steps

Source: The authors

construction of the map of the initial situation and proposition of the map of the future situation, an improvement plan is elaborated to be carried out to achieve the new proposed flow. At the end, the conclusions will be developed and the final considerations about this study will be noted.

PRESENTATION OF RESULTS

Hospital C is an institution of the public network in Brazil that provides assistance to the population through various health services. One of the support areas for these services is the clinical pharmacy section. Figure 4 presents the structure of this section.

Under the umbrella of the clinical pharmacy, there is FAPE, which is responsible for dispensing special medicines, including cancer medicines for home treatment.

PRE-MAPPING

At this point, the product family is defined, as well as the departments involved, and activities present in the flow. For this study, the product family selected was the drug dispensing service for chemotherapy treatment. Table 7 presents the value stream to be studied and the reasons for its choice.

Under the umbrella of the clinical pharmacy, there is FAPE, which is responsible for dispensing special medicines, including cancer medicines for home treatment.

The macro view of the flow was designed based on information gathered through interviews and observations made during the study. Figure 5 shows this drawing.

Two departments involved in the flow of dispensing Capecitabine 500mg were identified. Figure 6 illustrates the relationship between the departments.

AFAPE is directly involved, as it is responsible for the dispensing process, and has the support of the pharmaceutical supply center (CAF), indirectly involved in the

replenishment of drug stock. The details of the flow activities are presented in table 8.

This framework supports the following mapping activities of the research and serves as a guide for the identification of notes made along the value stream studied.

MAPPING OF THE INITIAL SITUATION

In this phase, the value stream is described, and the problems and waste found in it are identified. Table 9 presents a detailed description of the value stream.

Based on the details, the preliminary initial situation map is drawn. Figure 7 presents the preliminary initial situation map as proposed by Henrique (2014).

From this map, problems and waste are identified: waste identification; identification of AV, NAV and NAVN activities; and other observations. Table 10 shows the waste found in the flow.

In total, 15 wastes were identified along the 17 activities of the flow, some of which are a consequence of the fluctuation in the occupation of resources, lack of prior identification of demand and the use of qualified professionals for activities that do not require expertise. When classifying activities into AV (activities in which the patient undergoes alteration), NAV (activities that do not add value) or NAVN (activities that do not add direct value to the patient but are essential to deliver value to the customer), the frame 11.

The value stream has only 2 activities that add value, one at the beginning, when the patient delivers the documents to retrieve the medication kit, and another at the end, when the patient receives guidance on the use of medication and the medication kit. The rest of the flow activities are divided into NAV and NAVN activities, the latter category representing most of the time spent, composed
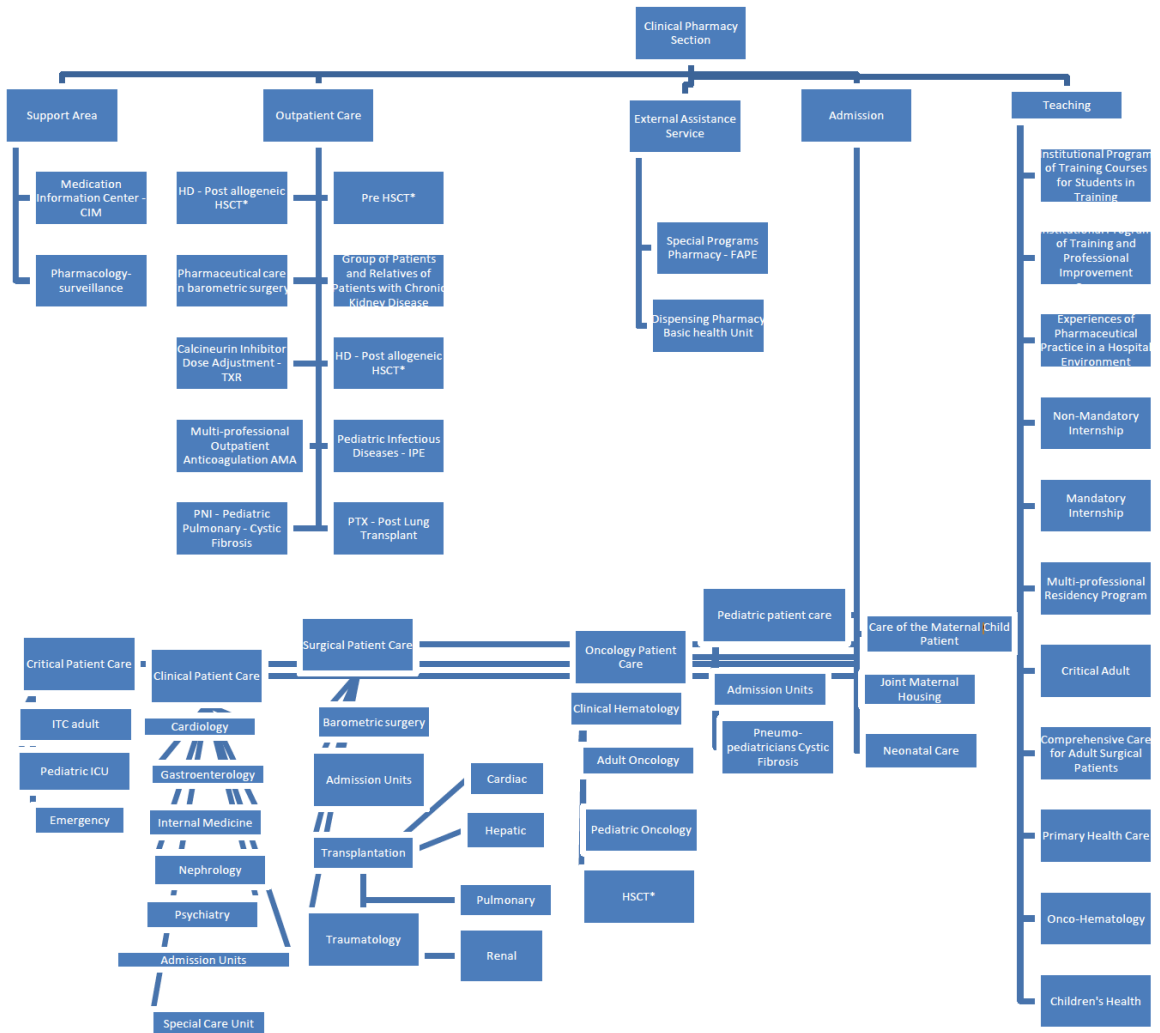
Figure 4–Clinical Pharmacy Hospital C

Source: Hospital C (2020)

		Reason
Product Family	Dispensing of medicines for chemotherapy	The dispensing of oncological drugs is one of FAPE's greatest demands, having a high degree of complexity. Besides this, these drugs are classified as "High Surveillance" (have a high risk of causing significant harm to patients due to a failure in the use process), requiring a high level of attention and quality in service delivery and, consequently, demand more time in the execution of activities related to their processes.
Producto	Dispensing of the drug Capecitabine 500mg in capsules	Capecitabine 500mg in capsules, widely used for the treatment of breast and colorectal cancer, is an example of a drug that has high demand, high cost, and is considered of high surveillance. FAPE currently sees an average of 80 patients per month looking for the drug Capecitabine 500mg in capsules, and this demand frequently reaches thousands of units, as was the case in February 2020, when 8,371 units of Capecitabine 500mg capsules were dispensed.

Table 7 – Product family selection details

Source: The authors
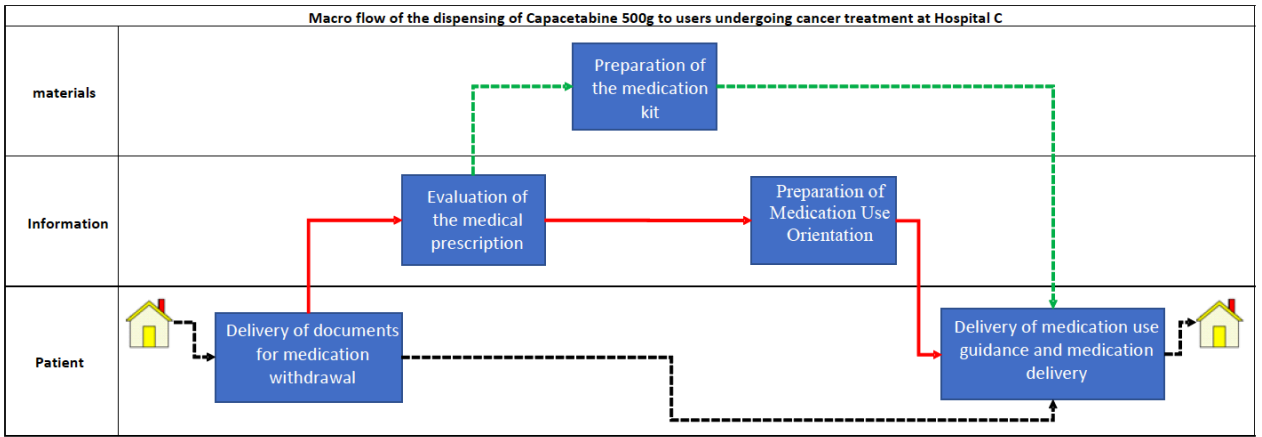
Figure 5 - Macro flow

Source: The authors
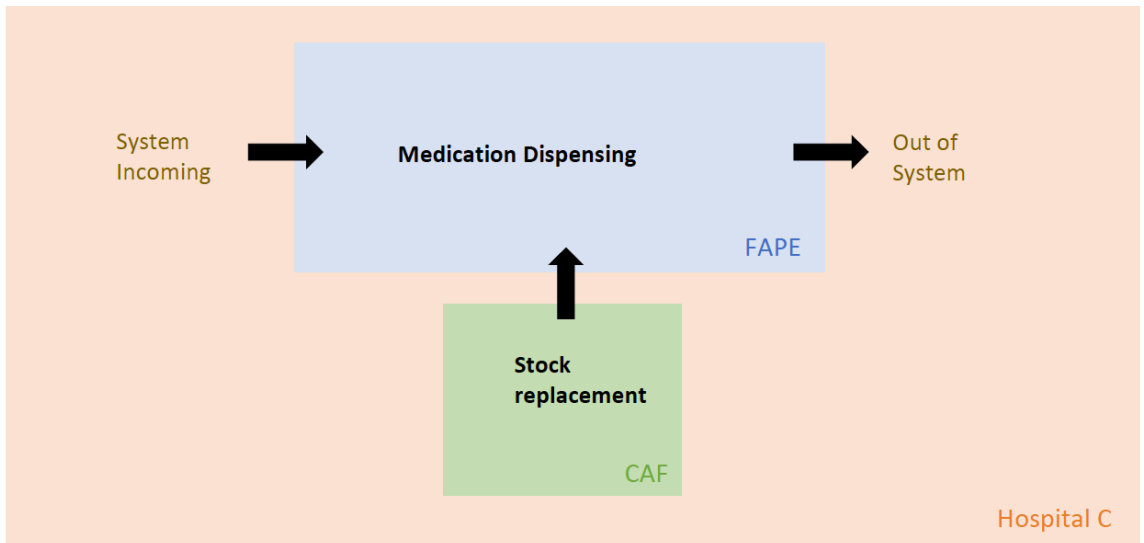
Figure 6–Departaments.

Source: Author

Activity Description	Activity Description	Processing Processing Time	Actor	Predecessor	Forerunner
	Check in at Hospital C	00 min 50 seg	Patient		B
3	Pick up a password for medical assistance	00 min 00 seg	Patient	A	C
C	Deliver documents for withdrawal of medication	00 min 10 seg	Patient	B	D
D	Receive documentation for medication withdrawal	00 min 33 seg	**Trainee** **Fellow** **Tech. Drug Technician** **Pharmacist**	C	E
E	**Check documents for the withdrawal of medications**	01 min 33 seg	**Trainee** **Fellow** **Tech. Drug Technician** **Pharmacist**	D	F
F	withdrawal Deliver medication withdrawal documents to the pharmacist	00 min 21 seg	**Trainee** **Fellow** **Tech. Drug Technician** **Pharmacist**	E	G
G	Evaluation of the medical prescription	02 min 02 seg	**Pharmacist**	F	H
H	Separation of medicine lit	01 min 01 seg	Pharmacist	G	I
I	Deliver prescription for drooling in the system	00 nin 30 seg	Pharmacist	H	J
J	Signaling need for dispensing by pharmaceutical frmaceutic	00 min 04 ser	Pharmacist	I	L
L	Carrying out a drug write-off	02 min 04 ser	Tech. Medication	1	M
M	Identifying medication batches in prescriptions	CO min 23 ser	Tech. Medication	L	N
N	Preparing written directions	01 min 00 see	Tech. Medication	M	O
O	**Put of medicament in the "Flow**	00 min 10 seg	Tech. Medication	N	P
P	**Bring a medication kit with directions to the service desk**	00 min 23 ser	Pharmacist	O	Q
Q	Receber **crientações de uso da medicamentos e kit de medicamentos**	02 min 39 seg	**Patiente Pharmacist**	o	R
R	**Sign medicine kit delivery**	00 nin 05 ser	**Patiente Pharmacist**	Q	S
Total	**15 activities**	12 min e 46 see			

Table 8 - Details of activities

Source: The authors

Macro Activity	Detailing
Delivery of documents for drug withdrawal	The dispensing flow of Capecitabine 500mg for users undergoing cancer treatment begins with the patient's entry into the system, when he/she enters the queue for registration at the reception of hospital C (waiting time 0 to 15 minutes). When his turn comes, he identifies himself as a patient who will get a medication kit for cancer treatment. To do so, the patient presents his identification document and is free to go to FAPE to collect his medication kit. Upon arrival at FAPE, the patient obtains a ticket at the counter and sits in the waiting room until his/her record number is called (the average waiting time for the call is between 0 and 20 minutes). When your password is called by the FAPE attendant (which can be an intern, scholarship holder, medication technician or a pharmacist) the patient goes to the counter and delivers the documents necessary for the withdrawal of the medication kit (patient's name and surname, attendance documents and medical prescription). In turn, the clerk receives the documents and checks them. In this conference process carried out by the attendant, the following items are analyzed: if the attendance document refers to the current month; and if the medical prescription is duly initialed/signed. After this conference, the attendant asks the patient to wait in the waiting room until he is called again and registers "OK" to follow the process, delivering the medical prescription to the pharmacist, or returns the documentation to the patient and provides guidelines on how to complete the documentation in case any of the analyzes mentioned above have a negative outcome.
Evaluation of the medical prescription	With the attendant's "OK", the medical prescription is delivered to the pharmacist so that he can start his evaluation of the case. The pharmacist's evaluation begins with the analysis of the medical prescription, when the information on dose, route, quantity and expiration date of the prescription (if it is valid) are verified. Soon after, the internal control for dispensing Capecitabine 500mg is accessed (Excel table), where the dispensing history for the patient in question is checked, and information such as the date of the last dispensation, how many units of medication were dispensed, which treatment cycle is and when should be the return date for the search for new drugs. With the information from the internal control raised, the pharmacist accesses the information from the patient's medical record in the electronic internal information system of hospital C (here called SISHC) to verify if it is already the right period for the patient to receive a new medication kit, the number of units prescribed in the last appointment and which treatment cycle the patient is in. In this way, the pharmacist is able to perform a reconciliation between the medical record information and the field information (FAPE's internal control) in order to certify that the medical prescription is in accordance.
Preparation of the medication kit	Once the medical prescription is approved, the pharmacist fills in the information on the new dispensation in the internal control and goes to FAPE's stock for the separation of the medication kit, where he separates the necessary quantity of prescribed units of Capecitabine 500mg, places them inside a package and delivers them together with the medical prescription to the medication technician when it also signals the need for dispensing by the pharmacist. Upon receiving the separate medication kit and prescription from the pharmacist, the medication technician identifies the manufacturing batch of the medication in the prescription and counts the quantity of medication by checking the prescription. Once this is done, the technician registers the output of the medication units in the SISHC system, writing them off in stock.
Preparation of drug use guidance	Still in the SISHC system, the medication technician accesses the medication protocol (drug routine) to prepare the written medication use guidance. With the conference carried out, medication write-off registered and medication use orientation prepared, the medication technician places the medication kit together with the orientation and medical prescription in the "flow", signaling to the pharmacist that everything is ready for delivery.
Medication use delivery and medication delivery	With everything necessary for the delivery of medicines to the patient, the pharmacist goes to the service counter with the kit and calls the patient's name, who goes to meet the pharmacist to receive the medicines and instructions. At this time, the pharmacist recounts the amount of medication together with the patient and delivers them. After that, the pharmacist explains the usage guidelines to the patient based on the guidance prepared by the medication technician, and in parallel with this he fills in a usage table which the patient should use to guide himself. At the end of the process, the pharmacist asks the patient to sign the medication delivery form, formalizing their receipt, ending the interaction with the patient, who is free to return to his residence.

Table 9 – Detailed description of value stream
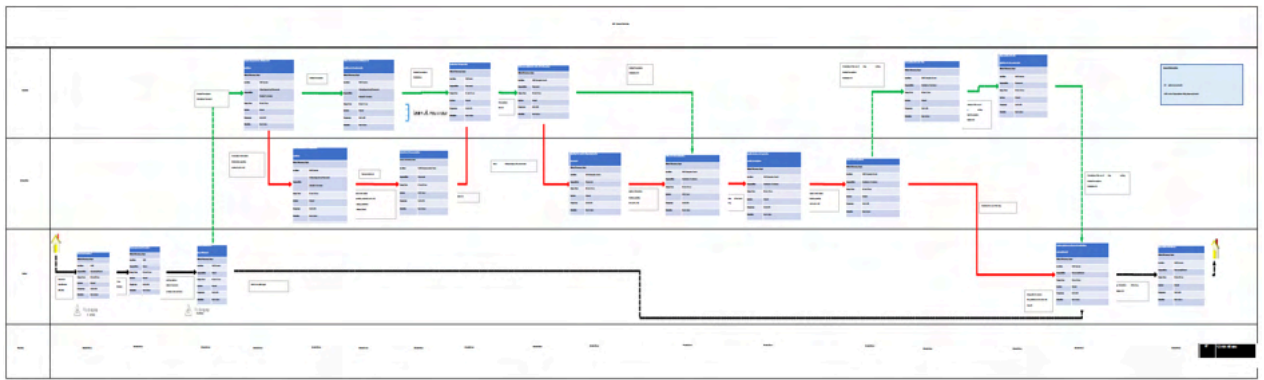
Source: The authors

Figure 7–Map of preliminary initial situation

Source:The authors

# Waste	Wasting	Waste category	Activity
1	FAPE professionals cannot identify in advance in the patient queue which type of dispensing will be necessary (oncology, HIV or others).	Improper processing	B
2	Sometimes pharmacists perform the initial care which could be performed by a professional without the expertise.	Human potential	D
3	It is not identified in advance if the patients attended have all the documents "OK" for the withdrawal of the medication kit, resulting improper processing.	Improper processing	E
4	Movement of the medical prescription from the counter to the pharmacist's room.	Transporting	F
5	Sometimes pharmacists are idle for lack of demand.	Waiting	G
6	Sometimes pharmacists record the output and input of medicines in an Excel file, which could be done by a professional without their expertise.	Human potential	G
7	Sometimes when there are no pharmacists available to evaluate the prescription, the order is to hold it until a pharmacist be available again (processing other orders, bathroom, lunch).	Waiting	G
8	Although FAPE has accurate medication demand forecasts, sometimes there is a need for emergency requisitions due to peaks in demand that occur on Thursday afternoons and Friday mornings (oncology consultations occur on Thursdays to afternoon) and on Mondays at the beginning of the month (beginning of the month).	Inventory	H
9	FAPE professionals have the need to travel to CAF to seek replacement of stock.	Movement	H
10	Since there are no records of defective medicines (broken, punctured, spoiled, etc.) it is not possible to evaluate the waste by defect.	Defect	H
11	As there are no records of incorrectly assembled medication kits or defective medications, it is not possible to assess the waste from inadequate processing.	Improper processing	H
12	Pharmacists carry out the separation of medicines, which could be performed by a professional without them expertise.	Human potential	H
13	Transportation of the prescription and the medications from FAPE stock to the medication technician's counter	Transportation	T
14	Sometimes medication technicians are left idle due to ack of demand and waiting for the processing of the pharmacist's activities.	Hold	L
15	Sometimes orders are waiting to be processed because there are no medicine technicians available to process them.	Hold	L

Table 10 - Identification of waste JULIANE 5

Source: The authors

Activity	Processing time	Activity classification		
		AV	NAV	NAVN
A	00 min 50 seg		x	
B	00 min 00 seg.			x
C	00 min 10 seg	x		
D	00 min 20 seg		x	
E	01 min 33 seg			x
F	00 min 21 seg		x	
G	02 min 08 seg			x
H	01 min 01 seg			x
I	00 min 30 seg		x	
J	00 min 04 seg		x	
L	02 min 04 seg		x	
M	00 min 23 seg		x	
N	01 min 00 seg.			x
O	00 min 10 seg			x
P	00 min 28 seg			x
Q	02 min 39 seg	x		
R	00 min 05 seg		x	
totals	17	2	8	7
	100%	12%	47%	41%
	12 min 46 seg	02 min 49 seg	03 min 37 seg	06 min 20 seg
	100%	22%	28%	50%

Table 11 - Classification of activities

Source: Authors

mostly of activities that involve the evaluation of the pharmacist and the separation of medicines. With regard to NAV activities, these in short are activities that involve the flow of information and materials. In addition to these analyses, a list of other observations was carried out under the FAPE environment. These are presented in table 12.

From the set of analyses, the notes made about the waste and classification of activities are represented, giving rise to the map of the initial situation. This is illustrated in figure 8.

Figure 8 shows the activity boxes, processing times and demand information, elements that are based on information gathered through interviews, analysis of relevant documents and observations. The classification of each activity in AV, NAV and NAVN, represented by green, red and yellow points respectively. The other observations are not present on the map because they are not inherent to the specific activities of the value stream, but to the environment.

MAPPING OF THE FUTURE SITUATION

At this stage, improvements based on Lean principles are suggested, to eliminate identified waste. Table 13 presents the proposals for improvements to reduce waste.

In total, 5 Lean tools were used as facilitators to reduce waste in the analyzed flow. Tools such as kanbane standardized work are versatile, helping to reduce up to 4 types of waste each, emphasizing that the latter was the most suggested. Regarding the classification of activities, suggestions for optimizing the value stream were proposed in table 14.

In addition to the improvement proposals and suggestions for optimization, recommendations are also made for the other observations. These are detailed in Table 15.

Topic	#	Notes	Description
Of the records	1	Error log missing	During the interviews, when asked, the participants did not report the practice of recording, which was also not noticed at the time of observation.
	2	Lack of registration of how many patients enter the system with all the correct documents for the withdrawal of the medication kit	The same occurred in relation to patients who enter the system without the necessary documents to withdraw the medication kit.
From planning	3	Lack of logical capacity planning of sector resources (people and professionals)	When asking the professionals responsible for managing FAPE during the interviews, it was reported that the capability and the resource planning in the sector is conducted without basing on data.
Of the metrics	4	Lack of evaluation of KPI's guiding the sector	During the interviews, those responsible for FAPE's management were asked if there was an evaluation practice on the sector's guiding KPIs, they revealed that currently there is no evaluation on the sector's guiding KPIs, thus occurring only the recording of some metrics such as number of patients treated, units of medication dispensed, which was endorsed by the analysis of relevant documents, when few KPIs were identified.
	5	Lack of knowledge of what to assess in the industry (KPIs)	It was also identified through interviews with those responsible for the management of FAPE, that the sector has lower-maturity in terms of monitoring metrics, which is not due to the lack of knowledge of those responsible but due to a lack of guidance on what exactly to evaluate in order of better performance or management.
Of the activities	6	Duplication in the inventory control procedure (one performed by the sector in Excel and another in the SISHC system)	Through the interviews and observations carried out, it was identified that FAPE has its own internal control of inventory in an Excel spreadsheet available in the virtual directory of the area, in the SISHC system that replicates all the information that is inserted.
	7	Duplication in the patient history control procedure (one performed by the sector in Excel and another in the SISHC system)	As well as for the stock, it was also identified that FAPE has its own internal control for the recording and controlling of patient history, which is stored and managed in an Excel table available in the virtual directory of the area. In that way, characterizing a duplication of activity in the procedure, as noticed in the previous item "7.
	8	Too many manual activities that could be automated	It was reported during observations and interviewees' narratives that, at FAPE, there are a high number of activities performed manually, and that these could possibly also be automated, such as the physical transfer of prescriptions between the receptionists, pharmacists, and medication technicians, signaling the need to dispense the medication and signaling the ready-to-deliver kit, and recording the manufacturing batch of the medications.
From the environment	9	Lack of privacy for patient care	It was also pointed out during the interviews a discomfort of both FAPE professionals and patients in carrying out the delivery of medicines and guidance on their use in public (conducted at the FAPE counter). During the observations, several interruptions by non-FAPE patients were also recorded, who asked questions not inherent to the services provided, such as "where is the bathroom?".

Quadro 12–Other observations

Source: The authors
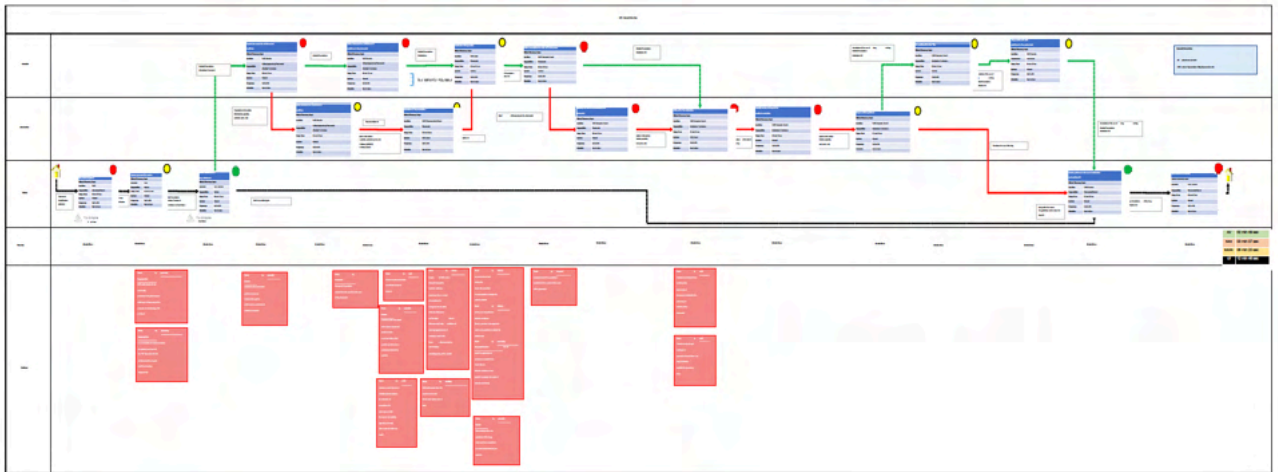
Figure 8–Map of the initial situation

Source: The authors

Proposal	Improvement proposal	Wasting	Waste category	Activity	Purpose	Tools	Justificative

Table 13 - Improvement proposals

Source: The authors

Activity	Description	AV	NAV	NAVN	Report	#Proposal	Justificative
A	Check into Hospital C		x		Keep activity.	-	Activity does not add value, but it is essential in a scope in which the look for medicines is only in person.
B	Get a service ticket			X	Enhance activity	1	Take a look at proposal #1 objective of the Waste Improvement Plan.
C	Submit documents for medication withdrawal	X			Keep activity.	-	The activity adds value to the flow.
D	Receive documents for medication withdrawal		X		Enhance activity	2	Take a look at proposal #2 objective of the Waste Improvement Plan.
E	Check documents for medication withdrawal			X	Enhance activity	3	Take a look at proposal #3 objective of the Waste Improvement Plan.
F	Deliver documents for medication withdrawals to the pharmacist		X		Exclude activity	4	Take a look at proposal #4 objective of the Waste Improvement Plan.
G	Evaluation of the medical prescription			X	Enhance activity	5, 6 & 7	See objectives for proposals #5, #6 and #7 of the Waste Improvement Plan.
H	Medication kit separation			X	Enhance activity	8, 9, 10, 11 & 12	See proposals #8, #9, #10, #11 and #12 of the Waste Improvement Plan.
I	Deliver medical prescription for write-off in the system		X		Exclude activity	13	Take a look at proposal #13 objective of the Waste Improvement Plan.
J	Signalize the need for dispensing by the pharmacist		X		Exclude activity	4	Take a look at proposal #4 objective of the Waste Improvement Plan.
L	Write off the medication		X		Enhance activity	14 & 15	See proposals #14 and #15 of the Waste Improvement Plan.
M	Identify batch of medicines in the medical prescription		X		Keep activity.	-	Activity does not add value but is necessary to deliver value to the customer.
N	prepare written guidance			X	Keep activity.	-	Activity does not add value but is necessary to deliver value to the customer.
O	Place med kit in the "Flow"			X	Keep activity.	-	Activity does not add value but is necessary to deliver value to the customer.
P	Take medication kit with guidelines to the service desk			X	Keep activity.	-	Activity does not add value but is necessary to deliver value to the customer.
Q	Receive guidance on the use of medications and medication kit	X			Keep activity.	-	No waste was identified in this activity.
R	Sign delivery of medication kit		X		Keep activity.	-	Activity does not add value, but it is essential for formalizing the delivery of medicines.

Table 14 – Suggestions for Optimization

Source: The authors

Topic	Suggestion
Of the records	Regarding the records, the lack of registration and control of errors in the number of patients with insufficient documentation for withdrawal of medicines and for errors in medical prescriptions was identified. In view of this, it is suggested to create controls for recording this information based on the checklist suggested in proposals #3 of the improvement plan. For these cases, quality reports can also be prepared based on the numbers and records collected. The purpose of these practices is to monitor the number of nonconformities in order to verify if actions are necessary to improve the process. Example: Trainings and guidelines.
From planning	Once the lack of logical capability planning of the sector's resources (people and professionals) has been identified, those responsible for managing FAPE are advised to carry out a study to identify the real need for resource capability and to dimension resources in a logical manner. This exercise aims to minimize idleness or overload of resources, in addition to avoid a drop in the quality of service in the sector
Of the metrics	With reference to the metrics of the sector, there was a lack of practice of evaluating the KPIs that guide the area, derived from the lack of knowledge of what exactly to assess the sector. Given this reality, it is recommended to carry out a survey in order to assess which metrics are interesting and necessary to have a real monitoring of the sector's performance, and subsequently institute a practice of reflection on them.
Of the activities	Regarding the flow activities in general, the performance of some activities was detected, such as the duplication of FAPE's internal stock control procedures and the control of medication withdrawal history from patients, performed both in Excel spreadsheets and in the system SISHC by medication technicians and pharmacists. In view of this, the area is encouraged to identify the reasons why procedures are duplicated, so that new practices are proposed and, as a result, reworks are avoided. In addition, regarding activities in general, there was an excess of manual activities along the flow. In order to reduce this number, a survey is supported to verify which manual activities can be automated.
From the environment	In reference to the environment in general, it was observed that the actors were uncomfortable regarding to the privacy at the time of patient care. As an alternative to this scenario, it is proposed to change the layout of the service area from counter to counters, in order to allow greater privacy in patient care.

Table 15 - Suggestions for Other Observations

Source: Authors

Based on the improvement proposals and suggestions for optimization, the map of the future situation is drawn. Figure 9 illustrates this map.

Through the proposed improvements and the elimination of activities, the value stream takes on a new format. Table 15 presents more details.

In order to make the transition from the initial situation to the future one, an action plan was developed. This is shown in table 16.

The proposed plan features 28 actions and was designed following the logical order of the value stream. Some actions are independent for each improvement proposal, such as actions that involve the preparation of checklists and reports. However, if this order is not followed, some restrictions may arise, such as the implementation of kanban's throughout the processes, which must be after the establishment of information systems.

DISCUSSION OF RESULTS

Based on the results presented, it is possible to identify potential gains resulting from the suggested actions. Such gains are associated with the definition of maintenance, elimination or improvement of activities, classified into AV, NAV and NAVN. Table 17 presents a detail.

Of the total activities present in the analyzed value stream, 53% of them have the potential to be transformed by Lean practices, which corresponds to 55% of their total processing time. Taking into account that the average monthly attendance of patients seeking Capecitabine 500mg in hospital C is 80.73 minutes per month, they could be saved with the elimination of NAV activities, which represents a reduction of 18%, and consequently an increase in the proportion of AV activities. Additionally, 48% of the activities could be improved.

Another potential gain would be the contribution that the use of Lean tools could bring to the improvement of processes and the construction of a Lean culture in the day-to-day of the sector. The use of 5S could be the starting point for the creation of this culture. The use of standardized work would facilitate the standardization of processes and activities, which in turn would allow for the predictability of processes and demands. Kanban tools and visual management can help both in the organization and in the functioning of the sector, through the possibility of controlling the progress of processes and demands. Finally, Kaizen, which in addition to being able to enable quick gains through the diagnosis and implementation of improvements, has the potential to bring team members closer to Lean initiatives if they are involved.

CONCLUSIONS

This research sought to understand how to contribute to improving processes in a pharmacy in a public health hospital in Brasil. By applying the method proposed by Henrique (2014) in a single case study, it was possible to identify waste associated with a value stream and outline a map of the future situation.

The discussions of this research indicate the possibility of transforming 53% of the activities of the flow in question, in the case of the implementation of the recommended action plan. These results cannot be generalized, being limited only to the value stream of dispensing Capecitabine 500mg to users undergoing cancer treatment at hospital C.

Finally, as future studies, it is suggested to apply the methodology used in this research in other units of analysis, such as in pharmacies in other hospitals, seeking results that can be compared with the objective of conceiving an analysis model for hospital pharmacies.
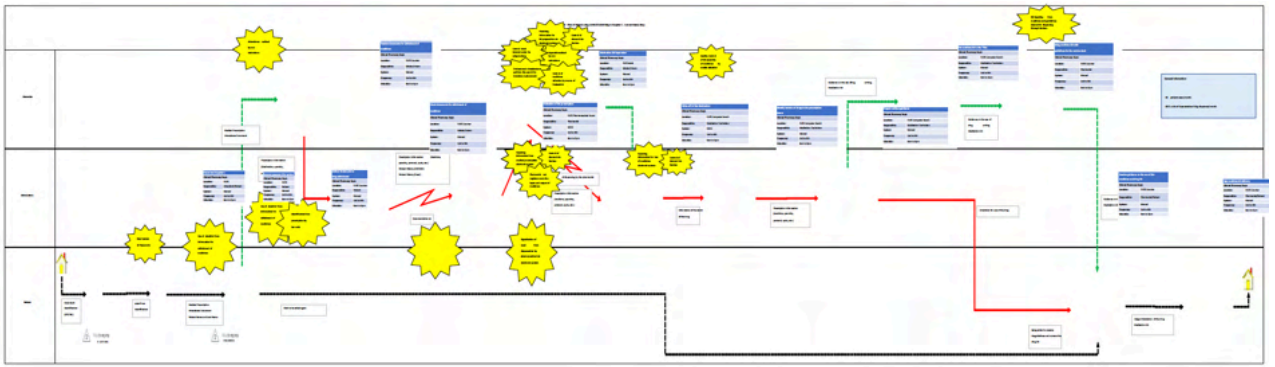
Figure 9-Map of the future situation

Source: The authors

Macro Activity	Detailing
Documents delivery for withdrawal of medicines	Initially, the patient is admitted to the reception of hospital C when he/she presents its identification document and receives an identification tag. After that, he/she moves to FAPE, where he/she take a password in the new password system, which allows FAPE professionals to verify that its demand is for the withdrawal of Capecitabine 500mg for oncological treatment. With the documents in hand, having used the information checklist for medication withdrawal as a guide, the patient is called by a FAPE attendant, who checks the documents for medication withdrawal through the checklist and identifies the medical prescription through the code of bars.
Medical prescription evaluation	The prescription code automatically appears in the pharmacist's *kanban*, who searches for prescription information in the system and gives its opinion.
Preparation of the medicines kit	As the pharmacist's "okay" in the system, information about a new demand for medication appears in the *kanban* of medication separation so that the kits can be prepared by a non-technical professional.
Preparation of the of medication use	This information is also sent through the prescription code that appears in the pharmacy technician's *kanban*, so that they are aware of the demand and carry out their low and conference procedure. As at the beginning of the flow the demand was identified as the withdrawal of Capecitabine 500mg for oncological treatment, the system already identifies the need for dispensing by the pharmacist himself, who receives the information of ready-to-delivery medication kits through the *kanban* system when there is "okay" from the medication technician
Medication Delivery and Use	In this way, the pharmacist collects the medication kit along with the medication use orientation in the flow, goes to the delivery and orientation of the patient, who in turn receives the value, the company that received the medication kit and orientations through your subscription and you are free to return home.

Table 15-Detailing new value stream

Source: The authors

# Action	Action	Responsible	Deadline	# Improvement proposal
1	Request an evaluation for the installation of a password system that makes it possible to differentiate the type of service required.	Head of the Clinical Pharmacy Section at Hospital C	to define	1
2	Install a password system that makes it possible to differentiate the type of service required.	to define	to define	
3	Guide FAPE professionals to redirect the performance of the initial care activity towards non-technical professionals.	Head of the Clinical Pharmacy Section at Hospital C	to define	2

4	Develop information checklist for medication withdrawal.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	3
5	Develop an information panel on the information conference process for withdrawing medication.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	
6	Request guidance from the oncology medical staff to use the checklist developed.	Head of the Clinical Pharmacy Section at Hospital C	to define	
7	Request evaluation for the implementation of a barcode reading system to identify medical prescriptions.	Head of the Clinical Pharmacy Section at Hospital C	to define	4
8	Request *kanban* utilization assessment for pharmacist by barcode system.	Head of the Clinical Pharmacy Section at Hospital C	to define	
9	Implement barcode reading system to identify medical prescriptions.	to define	to define	
10	Implement *kanban* for pharmacist use.	to define	to define	
11	Organize a *Kaizen* event with the relevant professionals to better understand the situation and calculate the real need for capacity in the sector and create a list of improvements needed for the pharmacy's processes.	Head of the Clinical Pharmacy Section at Hospital C	to define	5
12	Guide FAPE professionals to redirect the performance of the outbound and inbound medication registration activity to non-technical professionals.	Head of the Clinical Pharmacy Section at Hospital C	to define	6
13	Organize *Kaizen* event to diagnose the reason for flow breaks in the process of evaluating medical prescriptions as well as better understanding the behavior of the sector's demands.	Head of the Clinical Pharmacy Section at Hospital C	to define	7
14	Request evaluation for implementation of *Kanban* implementation for FAPE's internal stock control.	Head of the Clinical Pharmacy Section at Hospital C	to define	8
15	Implement *kanban* for FAPE's internal stock control.	to define	to define	
16	Develop a new inventory replenishment protocol.	Head of the Clinical Pharmacy section of the Hospital and FAPE professionals and Head of CAF	to define	
17	Evaluate the possibility of redirecting the performance of the activity of searching for replacement stock to non-technical professionals as well as logistics assistants or Hospital assistants.	Head of the Clinical Pharmacy section of the Hospital and Head of CAF	to define	9
18	Elaborate an evaluation checklist of the medications received and their conditions.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	10
19	Prepare a report on the evaluation of the medications received and their conditions.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	
20	Develop checklist for the assembly of medication kits.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	11
21	Prepare a report on the evaluation of the assembly of medication kits.	Head of the Clinical Pharmacy Section at the FAPE Hospital and Pharmacists	to define	
22	Guide FAPE professionals to redirect the performance of the medication separation activity to non-technical professionals.	Head of the Clinical Pharmacy Section of the Hospital	to define	12
23	Request *kanban* utilization assessment to view medication separation demands	Head of the Clinical Pharmacy Section of the Hospital	to define	
24	Implement *kanban* for visualization of medication separation demands	to define	to define	
25	Request *kanban* utilization assessment for medication technicians by the barcode system	Head of the Clinical Pharmacy Section of the Hospital	to define	13
26	Implement *kanban* for the use of medication technicians.	to define	to define	

| 27 | Organize a *Kaizen* event with the relevant professionals to better understand the situation and calculate the real need for capacity in the sector and create a list of improvements needed for the pharmacy's processes. | Head of the Clinical Pharmacy Section of the Hospital | to define | 14 |
| 28 | Organize *Kaizen* event to diagnose the reason for flow breaks in the write-off of medicines as well as better understanding the behavior of the sector's demands. | Head of the Clinical Pharmacy Section of the Hospital | to define | 15 |

Table 16 - Action Plan

Source: The authors

Activity	Processing time	Report			Activity classification		
		Maintain activity	Delete activity	Enhance activity	AV	NAV	NAVN
A	00 min 50 seg	X				X	
B	00 min 00 seg			X			X
C	00 min 10 seg	X			X		
D	00 min 20 seg			X		X	
E	01 min 33 seg			X			X
F	00 min 21 seg		X			X	
G	02 min 08 seg			X			X
H	01 min 01 seg			X			X
I	00 min 30 seg		X			X	
J	00 min 04 seg		X			X	
L	02 min 04 seg			X		X	
M	00 min 23 seg	X				X	
N	01 min 00 seg	X					X
O	00 min 10 seg	X					X
P	00 min 28 seg	X					X
Q	02 min 39 seg	X			X		
R	00 min 06 seg	X				X	
Overall:	17	8	3	6	2	8	7
	100%	47%	18%	35%	12%	47%	41%
	12 min 46 seg	05 min 45 seg	00 min 55 seg	06 min 06 seg	02 min 49 seg	03 min 37 seg	06 min 20 seg
	100%	45%	7%	48%	22%	28%	50%

Figure 30–Consolidation suggestions for activities

Source: The authors

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APÊNDICE 1 – ROTEIRO DE ENTREVISTAS

ROTEIRO DE QUESTIONÁRIO SEMI-ESTRUTURADO		
#	**Pergunta**	**Informações Objetivo**
1	Qual o seu nome?	Obter informações pessoais do entrevistado
3	Qual a sua formação acadêmica ou técnica?	Vislumbrar o grau de experiência do entrevistado.
4	Possui cursos, capacitações ou especializações que agreguem para a sua atuação na área da saúde?	Vislumbrar o grau de experiência do entrevistado.
5	Qual o seu cargo?	Vislumbrar o grau de experiência do entrevistado.
6	Quantos você tem de experiência nesta função e a quanto tempo você trabalha nesta instituição? Sempre com o mesmo cargo?	Vislumbrar o grau de experiência do entrevistado.
7	Como é o funcionamento do setor? Horário de funcionamento, quadro de funcionários, serviços, processos e atividades você conhece de uma maneira geral?	Obter informações básicas do setor.
8	Com relação à dispensação dos medicamentos oncológicos para tratamento quimioterápico, como funciona a a prestação deste serviço? Poderia descrever este processo? Como ele acontece?	Obter um panorama do processo.
9	Neste contexto, como é realizado Como ele é planejado para acontecer?	Obter informações sobre procedimentos, padrões e documentações do processo.
10	Como é realizado o planejamento de capacidade da área?	Obter informações sobre o dimensionamento da capacidade da área.
11	Como é feito o planejamento de demanda da área?	Obter informações sobre o o planejamento de demanda da área. Entender onde vêm os insumos e como são requisitados.
12	A área possui métricas? Quais são? Como são avaliadas?	Entender as métricas e KPIs da área.
13	Para finalizar, qual a sua percepção quanto ao funcionamento do setor? Como você o vê? E como se sente nele?	Entender percepção dos operadores com relação ao processo.

APÊNDICE B − PROTOCOLO DE OBSERVAÇÃO

Nome do Observador:
Orientador do Observador:
Objetivo da Observação:
Data da observação:
Horário da Observação:
- Início:
- Término:

Informações:

Geral do Processo
- Ponto Focal:
- Localização:
- Número de indivíduos envolvido
- Entradas de processo:
- Saídas de processo:
- Stakeholders:
- Expectativas:

Específica do processo

- Número de procedimentos:
- Atividades AV
- Quantidade de atividades AV:
- Atividades NAVN
- Quantidade de atividades NAVN
- Atividades NAV
- Quantidade de atividades NAV
- Métricas:

Desperdícios encontrados

- Superprodução:
- Defeitos:
- Esperas:
- Processamento Inapropriado:
- Estoques:
- Movimentação:
- Transporte:
- Re-priorização:
- Potencial Humano:

Fluxos

- Materiais:
- Informações:
- Pacientes:

Relatos do ambiente
- Relato do ambiente físico:
- Relato do ambiente social:

Descrição do Processo:
- Registro: