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Analysis of Time Waste in Healthcare Services Using Lean Healthcare and the 5 Whys Root Cause Analysis: Case Study Neurology Outpatient Clinic at Dr. Darsono Regional General Hospital, Pacitan

Prasetyo Mukti[1], Rochmoeljati[2]

[1,2] Department of Industrial Engineering Study Program, Faculty of Engineering and Science, Universitas Pembangunan Nasional Veteran Jawa Timur, Surabaya, Indonesia. Email: 22032010001@student.upnjatim.ac.id

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ABSTRACT
Health services require speed, accuracy, and quality in order to be able to meet expectations and increase patient satisfaction. However, in practice, problems in the form of waste are still often found in the service flow, such as long queues, long waiting times, data recording errors, and inefficient manual activities. This condition also occurs at the Nerve Polytechnic of dr. Darsono Pacitan Hospital, which is the main referral hospital in Pacitan Regency. This study aims to identify forms of waste in services at the Nerve Polytechnic and provide suggestions for improvements to improve service efficiency. The method used is a Lean Healthcare approach with the help of Root Cause Analysis (RCA) and the 5 Why technique to trace the root cause of problems. The results of the analysis using BPM show that the lead time of the initial service is 127 minutes. After the implementation of the improvement recommendations, non-value-added activities were completely eliminated, so that the lead time was reduced to 68 minutes, or equivalent to a time reduction of 46.5%. The improvement recommendations are focused on improving the efficiency of polyneural services through optimizing human resources, adjusting the work system, implementing 5S, utilizing information technology, digitizing medical records, and involving medical personnel in improving service quality.

Keywords: Lean Healthcare, Waste, Root Cause Analysis, Poly Neraf.

I. Introduction

The purpose of health services is to meet the needs of individuals and communities in overcoming, overcoming, or normalizing various problems and deviations related to health conditions in the community. (Devie and Subadi, 2023). Although health services continue to be developed, there are still several obstacles that arise, such as long queues in the outpatient registration process, the length of waiting time for examinations, and the accumulation of queues at the stage of taking drugs and completing administration. dr. Darsono Hospital is the largest hospital in Pacitan Regency and is the only government-owned hospital that provides advanced referral health services. This hospital serves as the main referral center for the people

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of Pacitan Regency. However, even though it has a very important role, in the services of the Nerve Polytechnic there are still various activities that do not provide added value (waste) so that they have an impact on the effectiveness and efficiency of services. Basically, health services are organized to meet the health needs of individuals and the community through efforts to handle, control, and recover various health problems that occur in the community (Devie and Subadi, 2023).

A hospital can be said to be able to provide optimal services to patients if it can manage and utilize all the resources it has effectively. However, the achievement of quality services is often hampered by activities that do not provide added value or waste, so that it can reduce the quality of services provided. Hospitals have various types of health service facilities, one of which is an outpatient installation that plays a role in providing medical services to patients without the need for inpatient care (Kania Rizqita Dewi et al., 2023). Health services are a complex process because they involve various types of resources, both human and other supporting facilities. In its implementation, various problems often arise due to inefficiencies in the process, such as errors in providing instructions, repetition of work activities, limited availability of equipment, and delays in services to patients. These problems have actually been a concern for a long time, even reported since 1944, and until now are still a challenge in the implementation of the modern health service system (Graban, 2016). Application Lean Help healthcare organizations understand value from a patient's perspective, so hospitals can identify activities that really matter and eliminate activities that don't contribute to value. Lean can improve the quality of health services while reducing inefficiencies (Earley, 2016).

Lean healthcare is an approach applied to improve the effectiveness and efficiency of health services through efforts to reduce or eliminate activities that do not provide added value, while still focusing on meeting the needs and satisfaction of patients (Kartika and Widayanti, 2024). Identification, analysis, and remedial efforts for failures in a system can be done using the Root Cause Analysis (RCA) method (Kencana and Iriani, 2025). The 5 Why's method is used by asking the "why" question repeatedly to trace until the underlying cause of a problem is found (Banjarnahor et al., 2025). The 5 Whys analysis approach is a method that uses simple questions to trace the cause-and-effect relationship until the root cause of a problem is found (Basuki et al., 2023). Through a study entitled "Analysis of Service Time Waste with Lean Healthcare Method and Root Cause Analysis 5 Why (Case Study: Poly Neural Hospital dr. Darsono Pacitan" is expected to contribute to dr. Darsono Hospital in reducing waste and increasing efficiency in the polyneural service process.

II. Literature Review and Hypothesis Development

2.1. Lean Concept

The Lean principle emphasizes that only activities that provide direct benefits to customers are considered value-added, while other activities are included in waste. By minimizing such waste, healthcare services in hospitals can become more efficient and more oriented towards patient satisfaction and needs (Astuti and Saskia, 2021). Lean is a Management System and Organizational Philosophy. Lean resting on two main pillars, namely Continuous improvement and respect for people (Graban, 2016). This system is designed with a primary orientation on customer satisfaction through the provision of optimal product or service quality, efficient operational costs, and shorter processing times. The core of the implementation of the system lies in the involvement of team members who are adaptive and have a continuous drive to find more effective working methods. In its application at Toyota, every element of the system is integrated with each other, and the main strength of the Toyota system lies in the continuous application and reinforcement of basic concepts (Firdaus and Wahyudin, 2023). In health services, this means that hospitals must continue to find ways to make services faster, safer, and more meaningful for patients. Respect for people This means that organizations must appreciate the contributions of all parties, from doctors, nurses, administrative staff, to the patients themselves. Everyone has the right to be involved in the improvement process (Earley, 2016).

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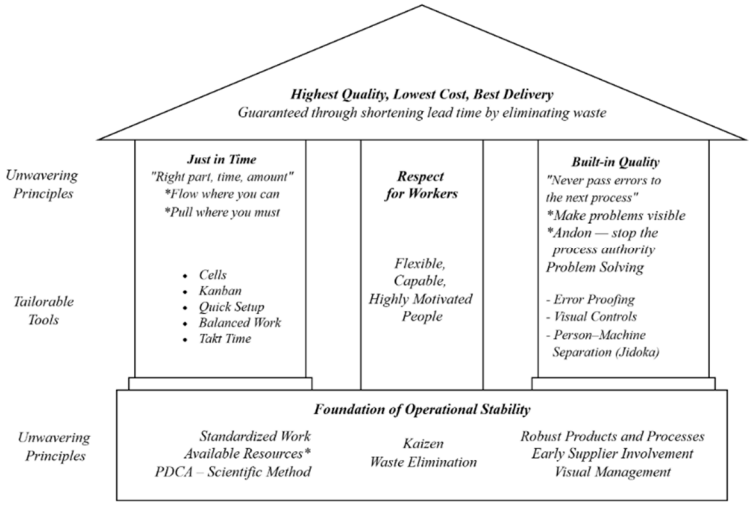

Figure 1. Lean Toyota Production System
Source: (Graban, 2016))

The Lean concept groups process activities into three main categories. One of them is value adding activity, which is an activity that provides direct benefits to customers and contributes to increasing the value of products and services so that they are considered worthy of payment by customers (Fhadillah et al., 2020). Non-Value Adding Activity is an activity that has no added value for consumers that must be eliminated because it causes waste so that production does not run effectively and efficiently such as waiting time, work in process (WIP), and others (Moengin and Ayunda, 2021). Necessary But Non-Value-Added Activity (NNVA), which is an activity where there is no added value of products or services, but the process carried out is still necessary (Baharudin et al., 2021). In the concept of lean there are 3 main types of activities, namely:

a. Value Added (VA) Activity

Value adding activity is an activity that is considered by the customer to provide added value to a product or service, so that the customer is willing to pay for the activity because it is considered to provide direct benefits (Fhadillah et al., 2020).

b. Non-Value Added (NVA) Activity

Non Value Adding Activity are activities that do not provide added value to customers and should be minimized or eliminated because they cause waste in the process. The existence of these activities can hinder operational effectiveness and efficiency, such as waiting times, accumulation of work in the process (work in process/WIP), as well as other forms of waste (Moengin and Ayunda, 2021).

c. Necessary but Non-Value Added Activity

Necessary but Non-Value Added Activity (NNVA) is an activity that does not provide direct added value to products or services, but is still needed in the operational process so that it cannot be eliminated (Baharudin et al., 2021).

According to (Baharudin et al., 2021) There are five basic principles on Lean, namely:

1) Specify value

Adding value from consumers. Identifying product value based on the customer's perspective, where customers want superior quality products, with competitive prices and on-time delivery.

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2) Value stream analysis

Knowing or understanding the value for consumers, and then evaluating the business process to determine the activities that add value, and those that do not add value are monitored or eliminated from the process. Identify the value flow process for each product.

3) Created Flow

The improvement strategy is directed at optimizing the process flow through structured improvement planning. At the same time, the identification and elimination of non-value added activities is carried out at each stage of the value flow to increase the efficiency and effectiveness of the system.

4) Pull on Demand

The planning that is prepared must be in line with the actual conditions in the field. In addition, it is necessary to organize so that the flow of materials, information, and products runs smoothly and efficiently throughout the value chain by implementing a pull system.

5) Created Perfection

Eliminate activities that do not provide added value (waste) and implement continuous improvement. Continuously apply various repair techniques and tools to achieve continuous excellence and improvement.

2.2. Lean Healthcare

The application of Lean methods in a hospital environment is known as Lean Healthcare. Lean healthcare is a management approach as well as a work philosophy that aims to change the perspective of hospital organizations to be more systematic and structured. This approach focuses on improving the quality of service to patients through efforts to reduce activities that do not provide added value or waste (Astuti and Saskia, 2021). Lean healthcare is an effective solution to increase efficiency in the company's operations, with a focus on increasing added value for customers. Concept Lean Healthcare, application Lean In health services, it can improve the quality of care and collaboration between departments and eliminate waste in the operational process. Implementation Lean Healthcare can save costs, eliminate unnecessary movements, reduce wait times, and improve customer satisfaction. Challenges such as long queues, service delays, and complex bureaucracy can be minimized with the principle Lean. Application Lean Healthcare, hospitals can provide faster, safer, and more meaningful services for patients (Earley, 2016). Application Lean In the healthcare sector, it has been proven to help reduce repetitive processes and unnecessary administrative procedures. This is done through more systematic management of patient data, more efficient management of waiting times, and increased coordination between health workers, so as to facilitate patient service flows and improve the overall quality of service (Kartika et al., 2021).

2.3. Waste

Waste or waste is an activity that does not provide value to the patient. Lean defines eight types of waste that often appear in hospital services, namely defects, overproduction, transportation, waiting, inventory, motion, overprocessing and Human Potential (Graban, 2016). Waste is any loss resulting from activities that incur costs but do not add benefits or value to the product from a consumer perspective. Waste also includes loss of materials, time, and costs due to work that does not add value to the product (Mukti et al., 2025). Waste can be defined as any form of activity that does not provide added value in a process so it needs to be minimized or eliminated. In health services, most of the operational time is often absorbed by activities that do not add value. These activities include excessive service delivery, lack of coordination between services, complexity of administrative procedures, overly complex regulations, and the potential for

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fraud. Meanwhile, only a small part of the time really provides added value for patients. Research shows that the time spent by nurses to interact directly with patients is relatively limited, which is around 31-34%, while most of the patient's time is spent waiting for the service process (Wati et al., 2021). According to Alfatiyah and Bastuti, (2022) Waste that often occurs in health services is patients who pay for drugs at checkout, confirmation officers to doctors, delays in taking medicines that are not done immediately, delays in taking empty medicines to warehouses and medicines waiting to be concocted.

2.4. Big Picture Mapping

Big Picture Mapping is a macro-level mapping method taken from Toyota's practice. This method aims to provide a comprehensive overview of the value stream (Value Stream) within the company, by emphasizing the actual process conditions that occur in the field. This tool makes it easier to identify waste by understanding and mapping the physical flow and the overall flow of information. Through a visual approach, this method is able to illustrate the relationship between the physical flow and the information flow as a whole. By understanding the two streams, the organization can recognize the existence of value-added activities and obtain a complete picture of the conditions in the ongoing process. In the early stages Big Picture Mapping, the first step taken is to describe the flow of materials and information that occurs, thus allowing monitoring of the movement of materials during the implementation of the project (Kulkarni, 2007). The following are the stages of Big Picture Mapping:

a. Customer requirements

The first phase (Customer Requirements), the focus is directed towards understanding customer needs. The information collected includes the type of product or product family mapped, the number and time of request, the frequency and volume of shipments, the type of packaging, the amount of inventory the customer has, to specific information related to the delivery point and delivery time window. This stage is an important basis in determining the direction of the mapping.

b. Information flows

The second phase (Information Flows) maps the flow of information from customers to suppliers. Information is recorded in detail, ranging from the form of forecasts and call-offs provided by customers, receiving departments within the company, the length of storage time before processing, to the flow of information forwarded to suppliers.

c. Physical flows

The third phase (Physical Flows) maps the physical flow from raw materials to finished products including shipping, packaging, processing time, key production steps, storage, quality checks, defect rates, cycle time, batches, machine availability, and bottlenecks.

d. Linking physical and information flows

The fourth phase is the connection between the information flow and the physical flow. The relationship arrow is added to the map to indicate the direction of communication and work instructions. This stage includes the type of scheduling information used, the work direction generated, the origin and purpose of the information, and how the company handles problems in the physical flow.

e. Complete map

The fifth phase (Complete Map) is a refinement of the map by adding a timeline at the bottom. This line shows the lead time and value adding time.

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2.5. Value Stream Analysis Tools (VALSAT)

VALSAT is a tool used to map waste in detail in the value stream, with a focus on value-adding processes. This Lean tool helps to know how to collect data quickly and efficiently, as well as how planning can be done based on the data. Basically, VALSAT is used as a detailed mapping instrument, with the focus on the value-adding process. Tools Lean This helps the data collection process quickly and efficiently, while supporting more structured data-driven planning. In principle, VALSAT is used as an instrument to conduct detailed value stream mapping, with a primary focus on identifying and evaluating activities that provide added value in a process (Ayunani et al., 2024). VALSAT has 7 Mapping Tools that will be used to analyze Waste existing tools. Tools with the highest value are used as analytical tools Waste in more detail. To specify the value of each Tools, weights of each type Waste multiplied by the correlation value between Waste with mapping tools to obtain their respective scores. The selection of mapping tools was carried out using Value Stream Analysis Tools (VALSAT) based on Waste the most dominant. Correlation between Waste and the mapping tool is categorized as H (High), M (Medium), and L (Low). The score of each mapping tool was determined by multiplying the percentage of waste by the value that represents the level of correlation, namely "L" = 1, "M" = 3, and "H" = 9. In this study, the selection of mapping tools was only based on the tools that obtained the highest score and had a correlation to the type of critical waste. Basically, Value Stream Analysis Tool used as a tool to perform detailed mapping of the value stream (Value Stream), with a primary focus on processes that provide added value (value adding process). This detailed mapping can then be used to identify and analyze the causes of waste (Waste). Selection stage Value Stream Mapping Using Value Stream Analysis Tools (VALSAT) is done by correlating the type of waste (Waste) against the mapping tool, which is expressed in the low (L), medium (M), and high (H) categories. In the study, the selection was based only on Tools with the highest score ranking that has a correlation to the type Critical Waste (Krisnanti and Garside, 2022).

2.6. Process Activity Mapping (PAM)

Process Activity Mapping (PAM) serves to provide more detailed details of what is shown in Value Stream Mapping, specifically to identify activities that take longer than other activities. PAM is used to explain in depth each stage in the production process. In addition, this method also allows the grouping of activities into three categories, namely value added activity (VA), non-value added activity (NVA), and necessary but non value added activity (NNVA). PAM is a diagram that describes the sequence of activities that occur in a process, including operation, inspection, transportation, waiting time, and storage. This tool provides visualization of the flow of materials, information, and time needed at each stage, including inventory levels and distance in the production process. Activities are divided into five categories, namely operation, transportation, inspection, storage, and delay. Operation and inspection activities are generally categorized as value-added activities if they contribute directly to products or services. Meanwhile, transportation and storage are necessary activities, but do not provide added value directly. Delay activities are a form of waste that should be minimized or eliminated because they are classified as non-value added (Firdaus et al., 2023).

2.7. Root Cause Analysis (RCA)

Root Cause Analysis (RCA) is an investigative method that aims to identify the potential causes of various factors underlying the occurrence of a problem. This process is carried out systematically to find the real root cause of the problem (Hezbollah and Wahyuni, 2023). RCA is an approach to finding the root cause of a problem. Without RCA, organizations tend to only treat symptoms without touching the root of the problem. This makes problems recurring and creates new waste (Earley, 2016). According to (Nurlaelah, 2023), Root Cause Analysis (RCA) is an analysis process that aims to define the problem, understand the cause and the root cause, so that the problem does not recur by following a structured procedure. This method is used

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to address the root of the problem, thus allowing the determination of corrective steps and preventive measures when the problem reappears. RCA is also a simple application that can be applied in a systematic, measurable, and documented manner to identify and understand the root cause of the problem.

Stages in Root Cause Analysis (RCA) according to Record, (2016) are as follows:

a. Clearly Defining the Problem

The process begins by formulating the specific issue, including what happened, when, where, who was involved, and the impact it caused. Clear definitions help the team focus on the core issue, not just the apparent symptoms.

b. Gathering Facts and Data

Objective data is collected through direct observation, interviews, and documentation. This approach emphasizes the importance of "go and see" to understand reality, not just based on reports.

c. Determining the Causative Factors

Various possible causes are analyzed using tools such as 5 Whys. The goal is to trace why problems occur, to find the underlying factors that are the root of the problem.

d. Analyzing the Root Cause

From the list of potential causes, the team screens and tests which ones are really the main causes. RCA emphasizes not stopping at individual errors, but rather looking at the systems, processes, training, work methods, or environments that allow errors to occur.

e. Formulating and Implementing Corrective Actions

Based on the identified root cause, corrective actions are designed aimed at preventing recurring problems. These actions can be in the form of changes to work standards, staff training, process adjustments, or improvements to support systems. Implementation must be clear with the person in charge, deadlines, and indicators of success.

f. Evaluation of Improvement Effectiveness

Once the action is implemented, the team evaluates the impact: whether the problem has been resolved and whether the risk of recurrence has been minimized. This evaluation ensures that the solution is not only temporary.

2.8. 5 Whys Model

The identification process is carried out to uncover the root cause of the most common types of waste, through a 5 whys analysis. The 5 Why's method is one of the simplest techniques in Lean to do Root Cause Analysis (RCA)(Vioni et al., 2025). By asking the "why" question repeatedly up to five or more times, this method helps organizations find the root cause of a problem. This technique is effective at uncovering hidden causes, so that improvements can be made to get to the root of the problem fundamentally (Earley, 2016). According to (Fansuri, 2018), effective ways in the implementation of method 5 Why's are as follows:

a. Define the problem and the limitations of the problem.
b. Gather teams to discuss (brainstorm) so that they can have a variety of different views, knowledge, experiences, and approaches to problems.
c. Perform gemba (go directly into the field) to see the actual place, the actual object, and the actual data.
d. Start asking questions using the 5 Whys method.

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e. Once you get to the root of the problem, test each answer from the very bottom to see if it can affect the answer above. Example: Can car service solve the problem of a damaged battery? Are there other possible causes as an alternative?

In general, the solution is not directed at blaming the individual, but rather how to improve the system or procedure.

2.9. Motion Study

The development of movement studies was introduced by Frank and Lillian Gilbreth. Movement studies is a basic knowledge to understand and reduce ineffective movements, so it is expected that work can be carried out more easily and quickly (Purbasari et al., 2023). Motion Study It covers several aspects, namely description, systematic analysis, and development of work methods. This method is used to determine the design of outputs, processes, work tools, work areas, and equipment needed at each step in a human activity that performs the work. There are two types of measurement methods, namely:

a. Live Time Measurement

It is carried out directly by observing the work done by the operator and recording the time required by the operator in doing his work by first dividing the work operation into work elements in as much detail as possible provided that the activity is still possible to be observed and measured. This direct measurement can be done using the Stopwatch Time Study or Work Sampling technique.

b. Indirect Time Measurement

This method is carried out indirectly, where the observer is not at the location of the measured work, by utilizing standard time data and information about the movements carried out. (Bestafirli and Saifuddin, 2024).(Brivan Ardhandy Studynka & Enny Aryanny, 2024) (Brivan Ardhandy Studynka & Enny Aryanny, 2024) (Brivan Ardhandy Studynka & Enny Aryanny, 2024) (Brivan Ardhandy Studynka & Enny Aryanny, 2024)

III. Research Methodology

This research was carried out at dr. Darsono Hospital located in Pacitan Regency. Lean Healthcare makes services faster, safer, and more valuable for patients. Meanwhile, 5 Why's is a simple technique in Lean to perform Root Cause Analysis (RCA) by asking "why" questions repeatedly (Earley, 2016). The data analysis method integrates Lean Healthcare with the 5 Why approach as a tool to determine the root of the problem. The analysis is carried out through Big Picture Mapping to map the process flow as a whole, both value-added and non-value-added activities. This mapping is supported by Process Activity Mapping to classify activities and identify waste, as well as Value Stream Analysis Tools (VALSAT) as a Lean tool used to map and analyze waste in detail in the value stream, both in value adding and non-value adding activities. Value VALSAT to analyze process efficiency and determine the right mapping tool. The application of this method results in a systematic, measurable, and relevant improvement plan in improving the quality of healthcare services

IV. Results and Discussion

4.1. Data Collection

The data collection in this study is focused on various data needed during the research process. The data source comes from the research location, namely the operational activities of the service in the Poly Nerve Hospital dr. Darsono Pacitan Hospital. The data collected includes Patient service flow data, Service time data at each stage of the process, data on the number of workers, data on the number of polyneural patients, and

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Data related to the causes of waste in services. All of this data is used as the basis for identify and reduce activity non–value added (NVA) and necessary but non-value added activiy and Eliminate Waste that arise in the process of service at the Nerve Poly, so that the flow of services can be more efficient and value-added for patients.

Data on the time of the polyneural service process was obtained from primary data from observations. The data includes the duration from the time the information is received to the completion of the entire service process. In addition, observations are made to find out the time of each existing activity. In detail, information about the service time can be seen in the following table:

Table 1. Poly Neural Service Time Data

No	Activities	Time (minutes)	Activity Type	Categories
Registration				
1	Patients queue for registration	8	Delay	NVA
2	Patients register at the registration machine or through the service admin	4	Operation	VA
Initial Inspection				
3	Heading to the Nerve Poly waiting area	5	Transportation	NNVA
4	Waiting For Initial Inspection	12,5	Delay	NVA
5	Officers prepare medical records and patient documents	7,5	Operation	NNVA
6	Initial patient summons	2	Operation	VA
7	Initial examination/consultation	6,5	Operation	VA
Advanced Inspection				
8	Waiting for further examination	50	Delay	NVA
9	Follow-up patient calls	2	Operation	VA
10	Advanced checks	7,5	Operation	VA
Neurological Injection				
11	Preparation of neurological injection action	1	Operation	NNVA
12	Neurological Injection Action	2	Operation	VA
13	Neurological motor	3	Operation	VA
Explanation of the Results				
14	Explanation of Examination Results and Action Plan	4	Inspection	NNVA
Control Schedule Explained				
15	Waiting for Control Documents	3,5	Delay	NVA
16	Last call	1	Operation	VA
17	Retrieving Control Documents	1	Storage	VA
18	Control schedule explained	6,5	Inspection	NNVA
Total		**127**		

4.2. The Big Picture Map

The observation data and hospital data that have been collected are the basis for the preparation Big Picture Mapping Beginning. Manufacturing Big Picture Mapping The initial was carried out based on the results of direct observation in the field, operational data from the hospital, and interviews with parties directly involved in the service process in Poly Nerve Hospital dr. Darsono. Big Picture Mapping This initial describes

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the overall flow of the patient service process at the Nerve Poly, starting from the registration stage to the completion of the process.

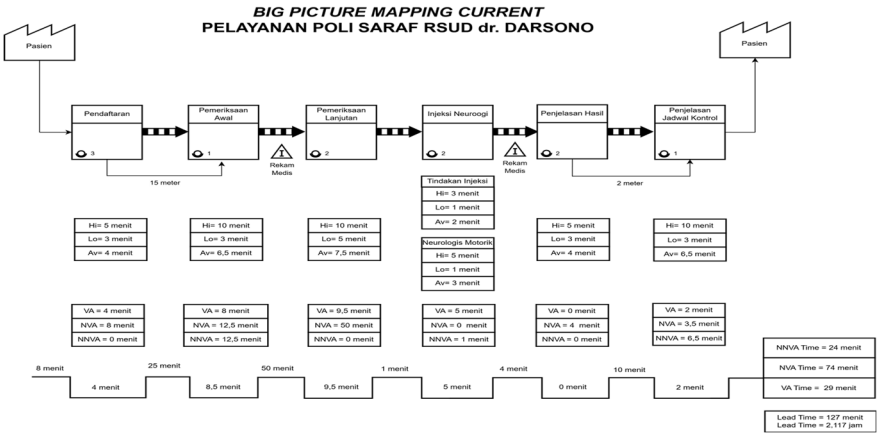

Figure 2. Current Big Picture Mapping

4.3. Value Stream Analysis Tools (VALSAT)

The VALSAT matrix is adjusted to the conditions of waste that occur in the service process at the neurological poly. Matrix VALSAT can be seen in the following table.

Table 2. Correlation *of Value Stream Analysis Tools* (VALSAT) with *Waste*

Waste	PAM	SCRM	PVF	QFM	DAM	DPA	P.S.
Overproduction	L	M	-	L	M	M	-
Waiting	H	H	L	-	M	M	-
Transportation	H	-	-	-	-	-	L
Overprocessing	H	-	M	L	-	L	-
Inventory	M	H	M	-	H	M	L
Motion	H	L	-	-	-	-	-
Defect	L	-	-	H	-	-	-
Human Potential	M	-	-	H	-	-	-

Sources: (Wibowo, 2021)

The assessment of the weight of waste that occurs in the polyneural service is carried out after direct observation or observation (Gemba) and through interviews with the hospital that is directly related to and understanding the process of polyneural services and the weight of each waste is obtained.

Table 3. VALSAT Score Calculation

Waste	Weight	PAM	SCRM	PVF	QFM	DAM	DPA	P.S.
Overproduction	2,2	2,2	6,6	-	2,2	6,6	6,6	-
Waiting	4,4	39,6	39,6	4,4	-	13,2	13,2	-
Transportation	1,4	12,6	-	-	-	-	-	1,4
Overprocessing	3,2	28,8	-	9,6	3,2	-	3,2	-
Inventory	1,2	3,6	10,8	3,6	-	3,6	3,6	1,2
Motion	2,6	23,4	2,6	-	-	-	-	-
Defect	1,6	1,6	-	-	14,4	-	-	-
Human Potential	2,4	7,2	-	-	21,6	-	-	-

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Waste	Weight	PAM	SCRM	PVF	QFM	DAM	DPA	P.S.
Total		119	59,6	17,6	41,4	23,4	26,6	2,6

Based on the calculation results in Table 4.9, the ranking of each VALSAT mapping tool was obtained . The highest score was obtained by Process Activity Mapping (PAM) with a total score of 119, so it ranked first. The second rank was occupied by the Supply Chain Response Matrix (SCRM) with a score of 59.6. Quality Filter Mapping (QFM) ranks third with a score of 41.4. Then Decision Point Analysis (DPA) ranks fourth with a score of 26.6. Furthermore, followed by Demand Amplification Mapping (DAM) in fifth place with a score of 23.4. Production Variety Funnel (PVF) is in sixth place with a score of 17.6. The Physical Structure Mapping (PS) ranks last (seventh) with the lowest score of 2.6. Based on these results, Process Activity Mapping (PAM) has the highest score so it was chosen as the main tool to be used in further analysis of the service process at the Neural Polytechnic of dr. Darsono Hospital. From the results of the selection of VALSAT tools, the method used is Process Activity Mapping (PAM). This method is used to identify various forms of waste that occur, both in the physical flow and the flow of information in the service process. The PAM approach aims to eliminate non-value-added activities, simplify processes, combine similar activities, and rearrange the order of activities to minimize waste.

Table 4. Current Process Activity Mapping (PAM)

Activities	Activities	Flow	Time (minutes)	VA	NVA	NNVA
1	Patients queue for registration	D	8		8	
2	Patients register at the registration machine or through the service admin	O	4	4		
3	Heading to the Nerve Poly waiting area	T	5			5
4	Waiting For Initial Inspection	D	12,5		12,5	
5	Officers prepare medical records and patient documents	O	7,5			7,5
6	Initial patient summons	O	2	2		
7	Initial examination/consultation	O	6,5	6,5		
8	Waiting for further examination	D	50		50	
9	Follow-up patient calls	O	2	2		
10	Advanced checks	O	7,5	7,5		
11	Neurological Injection Action	O	3	3		
12	Neurological motor	O	3	3		
13	Explanation of Examination Results and Action Plan	I	4			4
14	Waiting for Control Documents	D	3,5		3,5	
15	Last call	O	1	1		
16	Retrieving Control Documents	S	1	1		
17	Control schedule explained	I	6,5			6,5
Total Minutes			127	29	74	24
Total Hours			2,117	0,4,83	1,233	0,4
Present Total			100%	22,8%	58,3%	18,9%

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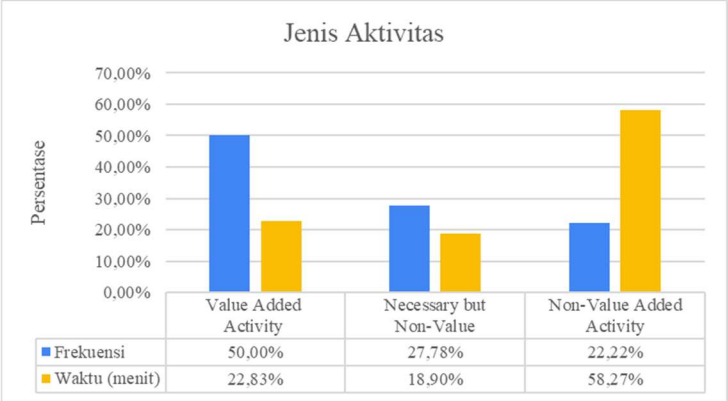

Figure 3. Percentage of Frequency and Time of Activity Type

Based on the table and figure above, the percentage of activity types value added activity frequency of 50.00% with a time of 22.83%. Necessary but non value added frequency of 27.78% with a time of 18.90%. Non value added activity of 22.22% with a time of 58.27%. From these results, there are activities No value added activity What needs to be reduced. Activity type value added activity In the polyneural service process, the patient registers (through the machine/administrator), the initial patient summons, the initial examination or consultation, the follow-up patient summons, the follow-up examinations, neurological injections, the motor neurology, the explanation of the examination results and follow-up plans, the final summons, and the collection of control documents. Types of activities necessary but non value added activity In the process of service at the Neural Poly, the patient goes to the Neural Poly waiting area, the officer prepares the patient's medical records and documents, waits for the control documents to be processed, and explains the control schedule to the patient. Types of activities No value added activity In the process of polyneural services, patients queue for registration, wait for the initial examination, wait for the follow-up examination, and wait for the control documents.

4.4. Root Cause Analysis 5 Whys

The analysis carried out in this study is an analysis of the factors that are the cause Waste in the service process at the Neurological Polytechnic of dr. Darsono Hospital. This analysis aims to find out the root of the problem so that appropriate corrective steps can be formulated and in accordance with the principles Lean Healthcare. To achieve this goal, this study uses Root Cause Analysis (RCA) as the main method in finding the root cause of waste. Analysis 5 Whys It is a question and answer technique that is used to trace the relationship between cause and effect to find the root cause of a problem. This method asks the question "why" repeatedly to a problem that occurs, until the most basic cause that triggers the problem is obtained. In this study, method 5 Whys applied to identify the reasons for problems in the service process at the Neural Polytechnic of dr. Darsono Hospital, especially related to waste (Waste) that appear in the service flow. Through this analysis, it is hoped that the root cause of waste can be obtained so that it can be used as a basis for the preparation of improvement recommendations. Cause analysis Waste presented in the following table:

Table 5. Waste Analysis with 5 Whys

5 Why's	Waste	Why 1	Why 2	Why 3	Why 4	Why 5	The Root of the Problem	Action Plan
Poly Neural Services of dr.	Waiting	The service process has not started	The arrival of medical personnel was	Medical personnel often arrive late due to	The schedule of visits and additional	Limitations in human resources make it difficult to	The lack of human resources in the neurologic	Addition of Neurologists & Schedule

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Darsono Hospital is too long (The standard waiting time for services at health services < 60 minutes)		when the polyneural service hours are opened.	not according to the schedule of the service process.	additional tasks in other units such as inpatient visits, surprise meetings, or administrative tasks.	tasks has not been synchronized with the schedule of poly services, so medical personnel often encounter time conflicts.	divide schedules. Because the number of medical personnel is small, small changes in one unit directly affect other units, including poly.	al poly has resulted in doctors not coming to the neurological poly.	improvements.
	Overprocessing	Repeated calls of the patient for several times.	The patient is doing other activities when called.	The patient does not know the estimated call time	There is no electronic queue system that displays sequence numbers and estimated times.	There has been no development in the service information system of dr. Darsono Hospital	There is no poly queue monitoring system on the application so that the patient leaves the waiting area when called	Implementation of real-time display for each poly on the SIPON application. Adding human resources for customer service in the waiting area of the polyclinic according to the service zone.
	Motion	Officers often move to look for files/tools.	Storage of files and equipment is not returned to its proper place.	The work area is limited so it is often mixed with service files.	The 5S evaluation has not yet been implemented.	5S training is not optimal.	The placement of files and supporting tools for 5S examination and training is less than optimal.	Apply the 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke) and pay attention to the layout of the workspace.
	Human Potential	Officers experience fatigue so that it can reduce the potentia	The workload does not correspond to the	The shift system has not been implemented in the service process.	The neurotic polytechnic officer has given complaints and inputs but has not been	There is a lack of involvement in proposals from service officers in	The opinion of medical personnel has not been fully considered	Consider shift division & labor addition.

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		l of the officer's ability to serve patients .	amount of labor.		followed up by the manageme nt.	policy making.		
	Overproductio	The officer prints out excess docume nts on the patient's complet e file.	Officers print excess docume nts due to the absence of automat ic controls or restricti ons.	The arrangem ent of printing document s is still entirely manual by medical personnel.	Automatic features to limit, regulate, or detect duplicate printing have not been implement ed.	Manageme nt informatio n systems have not been developed to support digital-based printing controls.	Digital-based printing controls have not been developed.	Improved document printing system automatical ly.
		Print patient control docume nts more than 1 time.	The patient requests a new control docume nt.	The patient wants to replace the previous control schedule.	Due to changes in needs or incompati bility of predetermi ned control time.	No prior schedule confirmatio n is done and the scheduling system does not allow patients to change the schedule independe ntly without reprinting documents .	Patient requests change of control schedule	Confirm the schedule before printing
	Defect	Data input errors occur.	Verificati on or re-checkin g has not been thoroug h.	The double check procedure is inconsiste nt.	The validation system is not yet automated .	Data quality monitoring is not routine.	Error at the time of patient data input.	Double-check & use automatic validation.
	Transportat ion	Certain files are still sent manuall y.	The digital system is not yet availabl e for the integrati on of	The files sent are not in accordanc e with the managem ent informatio	This type of file requires that it be submitted manually by a medical officer.	The digitization system is not yet available in its entirety for the delivery of certain files	Certain files (hospitaliza tion or poly transfer) cannot be sent through the hospital	Developme nt of an integrated medical record system that is adapted to all

			related services.	n system used.		(hospitalization or poly transfer) between services.	service system.	existing files.
	Inventory	Patient service documents or files pile up.	Digitization of archives has not been thoroug h.	Some document archives are still manual and have not been updated to electronic systems.	Electronic systems do not support some types of files such as brain records.	The paperless system has not been applied to all the files used.	There is a buildup in the patient's brain record files and the like.	Digitization of files & archive maintenanc e schedules.

4.5. Proposed improvements

Proposed improvements are prepared as an effort to solve problems that have been identified in the service process. This proposed improvement aims to address the root cause of the problem so that waste that occurs can be minimized or eliminated. The determination of improvement proposals involves the nursing services of dr. Darsono Hospital to consider the best and acceptable improvement recommendations by dr. Darsono Hospital, especially in neurological poly.

Table 6. Recommendations for Waste Repair

Waste	Activities	Recommended Improvements
Waiting	Waiting for polyneural services at the initial examination and follow-up examination	Addition of medical personnel, both doctors and other officers in the neurological polytechnic and improvement of the distribution of service schedules.
Overprocessing	Repeated patient summons	Implementation of real-time display for each poly on the SIPON application. Adding human resources for customer service in the waiting area of the polyclinic according to the service zone.
Motion	Medical personnel look for files and supporting equipment at the initial and follow-up examinations	Apply the 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke) and pay attention to the layout of the workspace.
Human Potential	The opinion of medical personnel has not been fully considered	Receive opinions or input from medical personnel in improving services. Establish an optimal work shift system and add medical personnel.
Overproduction	The officer prints excess documents during the preparation of patient documents.	Automatic improvement of document printing system.
	The patient requests a change of control schedule on the documents that have been provided.	Confirm the schedule before printing
Defect	Error at the time of patient data input.	Double-check and use automatic validation.

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Transportation	The officer sent certain files, thus leaving the neurological poly for a while	Development of an integrated medical record system that is adapted to all existing files.
Inventory	Stacking on specific files, for example Record the patient's brain.	Digitization of files & archive maintenance schedules.

Based on the initial activities and current PAM, time adjustments are made as a result of the improvement recommendations. The determination of time after improvement is carried out by taking into account the results of previous research and through consideration with the service. Time adjustments for both the examination process and the like are carried out with consideration and suggestions from medical personnel and adjusted to the provisions of health services. After the preparation of the proposed improvement recommendations, the next stage is the creation of the proposed Big Picture Mapping, which describes the design of improvements to the service process at the Neural Polytechnic of dr. Darsono Hospital. The Big Picture Mapping of this proposal was made from the results of the analysis of waste and improvement recommendations that have been identified previously.

Table 7. Future Process Activity Mapping (PAM)

No	Activities	Flow	Time (minutes)	VA	NVA	NNVA
1	Patients queue for registration	D	2		2	
2	Patients register at the registration machine or through the service admin	O	2	2		
3	Heading to the Nerve Poly waiting area	T	5			5
4	Waiting For Initial Inspection	D	10		10	
5	Officers prepare medical records and patient documents	O	3			3
6	Initial patient summons	O	1	1		
7	Initial examination/consultation	O	10	10		
8	Waiting for further examination	D	10		10	
9	Follow-up patient calls	O	1	1		
10	Advanced Inspection	O	10	10		
11	Preparation of neurological injection action	O	1			1
12	Neurological Injection Action	O	1	1		
13	Neurological motor	O	5	5		
14	Explanation of Examination Results and Action Plan	I	4			4
15	Waiting for Control Documents	D			0	
16	Last call	O		0		
17	Retrieving Control Documents	S	1	1		
18	Control schedule explained	O	2			2
Total Minutes			68,0	31	22	15
Total Hours			1,133	0,517	0,367	0,250
Present Total			100%	45,6%	32,4%	22,1%

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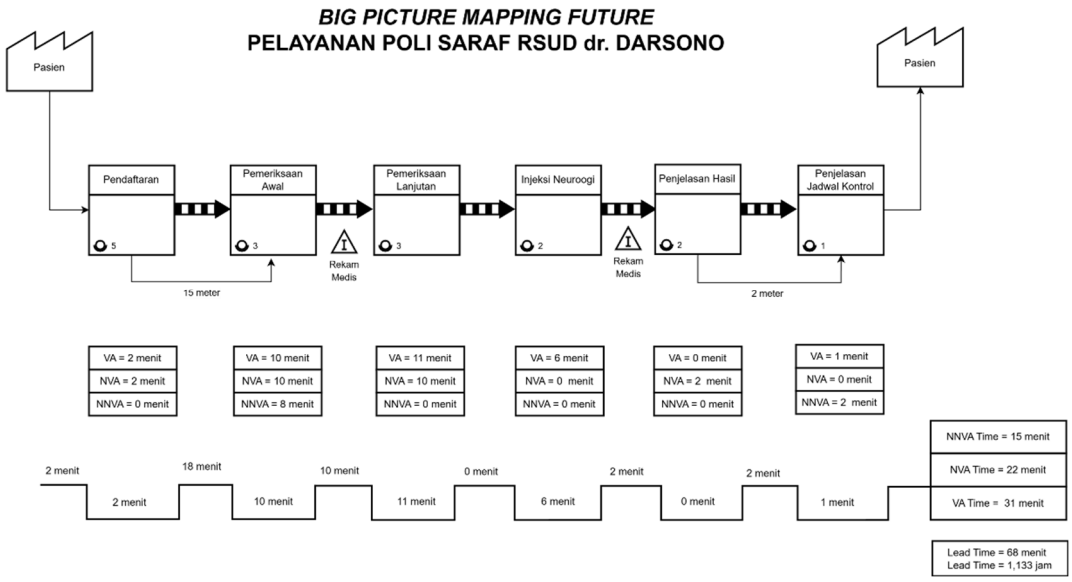

Figure 4. Future Big Picture Mapping

After obtaining the results of the calculation of the time after the repair, the next step is to make a comparison between the time before and after the repair to assess the effectiveness of the changes implemented. The comparison of the total time (leadtime) of the initial is 127 minutes or 2,117 hours with the total proposed time of 68 minutes or 1,133 hours. The initial activity time where VA is 29 minutes, NNVA is 24 minutes, and NVA is 74 minutes, with a total leadtime of 127 minutes and the time of repair or proposed activity where VA is 31 minutes, NNVA is 15 minutes, and NVA is 22 minutes, with a total leadtime of 68 minutes. VA time increased by 2 minutes, NNVA time decreased by 9 minutes and NVA time decreased by 52 minutes. Then leadtime decreased from 127 minutes to 68 minutes or decreased by 59 minutes.

V. Conclusion

Based on the results of the study, the polyneural services of dr. Darsono Hospital still contain various wastes that affect time efficiency and service quality, especially waiting, overprocessing, human potential, and motion. Analysis using Value Stream Mapping (VSM) and Process Activity Mapping (PAM) shows that the service lead time has been successfully reduced from 127 minutes to 68 minutes, or reduced by 46.5%. To improve service efficiency, this study recommends the addition of polyneural medical personnel including neurologists and registration machines at the poly, rearranging the schedule of doctors and medical personnel through the shift system, adding customer service officers according to the service zone, applying the 5S principle in the polyneural area, the use of real-time information displays and features in the SIPON application of each poly, improving the automatic printing system, validating control documents, developing integrated medical records and digitizing all files, and considering the opinions of medical personnel in an effort to improve the quality of polyneural services.

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