Lean Hospital To Reduce Waste Using Waste Relationship Matrix

by Fitra Lestari

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Fitra Lestari
Industrial Engineering Department
Faculty of Science and Technology
UIN Sultan Syarif Kasim, Indonesia
E-mail: fitra.lestari@uin-suska.ac.id

Rozar Rayendra
Industrial Engineering Department
Faculty of Science and Technology
UIN Sultan Syarif Kasim, Indonesia
E-mail: rozar.rayendra@uin-suska.ac.id

Orie Harasakito
Industrial Engineering Department
Faculty of Science and Technology
UIN Sultan Syarif Kasim, Indonesia
E-mail: Orie_1st@yahoo.com

Rahmad Kurniawan
Informatics Engineering Department
Faculty of Science and Technology
UIN Sultan Syarif Kasim, Indonesia
E-mail: rahmadkurniawan@uin-suska.ac.id

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***Abstract*— This research was conducted at one of Indonesia's hospitals, especially in the outpatient service section. One outpatient services stage is a waste of waiting time on the part of the patient who queues for a long time at the BPJS registration for 1 hour with one person at the service counter. The model developed serves as a proposal for improving the BPJS service system by improving its waiting time waste. The current value stream mapping model is the initial model and the future value stream mapping is a model for the proposed improvement. The tools used are the waste relationship matrix to determine the most influential waste by looking at the value of the process cycle efficiency as a standard reference for lean which is around 30%. This research hopes that it will reference government proposals to other hospitals by improving the hospital service quality.**

Keywords*— *Lean, Hospital, Waste Relationship Matrix, Value Stream Mapping, Indonesia.

I. INTRODUCTION

The current globalization demands an acceleration of development by the era of increasingly sophisticated technology. This has consequences in a significant role for the health of the population to support it. In 2010 the Indonesian public health index was ranked 110th from 172 countries in the world [1]. The low people health condition is an indication that the hospital is still not functioning correctly. The quality of hospital services in Indonesia is still not satisfactory. Some complaints include infrastructure, human resource services, waiting time for services to be served very late [2]. Therefore it is essential to monitor patient preferences to continuously improve the quality of service, one of which is satisfaction [3].

Service waiting time is the time used by health workers at the hospital to provide services to patients and is a problem that is still being encountered, causing dissatisfaction when waiting for a long time [4]. Therefore, this research was conducted in one of Indonesia's government hospitals, which has three service systems, namely inpatient, outpatient, and emergency care. The service that has the most patients is outpatient, especially the surgical polyclinic. This research was conducted in observation and conducting interviews with expert judgment.

The object of this research is BPJS patients. BPJS is one of the Indonesian government's programs as health insurance for the people. The system refers to the insurance system, in which all Indonesians are obliged to separate a small portion of their money for payment of future health insurance contributions. The problem that occurs is that there is a waste of waiting time on the part of the patient queuing at the BPJS registration, which causes an excess of operational hours of care in one day, namely 8 hours. This occurs cause of the random nature of patient arrivals and human factors [5]. Therefore, a tool is needed to overcome the waste of waiting time so that there are no value-added activities [6].

Lean is a collection of methodologies that aim to eliminate waste in any process and be easily applied to hospitals [7]. This research in healthcare cases uses a lean hospital approach with tools, namely value stream mapping (VSM) and Root Cause Analysis. The use of value stream mapping is to identify the most significant waiting waste, and root cause analysis is used to find the causes of problems identified by the value stream mapping. For patients, the quality of service provided by hospital personnel will accelerate their recovery. Based on the results of research by [5], It can be seen that the personal dimension (human factor) is considered necessary for the patient. This is following the research results by [8] which states that the quality of service expected by patients includes the speed of service time, the attitudes and behavior of employees (doctors and other employees), and the clarity of information given. In addition, the transition from the old hospital management to the construction of new hospital management requires careful planning and process and cooperation by all parties involved [9]. To produce quality services that align with patient expectations, the competence of human resources, especially human resources directly related to the care process, is essential.

II. WASTE IN LEAN HOSPITAL

Low productivity will cause losses for the company if the machines/tools are not effective and efficient. It is called six big losses [10]. Nevertheless, productivity can also be interpreted as a service. Work productivity at the service level utilizes the minimum possible resources to achieve a good level of service efficiency. One of the service productivity problems is the amount of work due to employees working lazily or corruption of working hours [11]. Productivity has a close relationship with waste. The greater the waste generated, the smaller the productivity obtained and rather.

Hospitals in Indonesia usually have three services, namely inpatient, outpatient, and emergency care. This research will refer to outpatient treatment following the issues raised. Outpatient care is also divided into emergency, diagnosis

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(laboratory tests), clinical services [12]. Many hospital management is transforming step by step with improving human resources, skills, tools, and sustainable culture, but not on target [13]. Therefore, problems related to the waste in the hospital can be fixed with a lean hospital. The lean hospital's goal is to increase the hospital's continuous efficiency with management indicators based on the actions taken to resolve waste. Actions taken include reducing waiting time for the patient, improving the quality of service to patients, increasing the value of employee involvement, and can to detect waste that occurs in the hospital so that it can minimize operational costs[14]. One of the lean hospital tools is the waste relationship matrix, which connects the seven types of waste and sees their relationship with each other [15]. The seven wastes considered consist of Over Production (O), inventory (I), Defect (D), Motion (M), Transportation (T), Over Processing (P), and Waiting (W). The results obtained from the waste relationship matrix in the form of the highest waste score among other wastes indicate that there must be an improvement. Finding out the improvement is by using a waste assessment questionnaire (WAQ) with different questions representing activities, conditions, or behaviors that can cause waste, aimed at the expert judgment.

III. Methodology

This research is located in one of the government hospitals in Indonesia. The object of research has been identified as the service for BPJS patient registration. This research was conducted with a qualitative approach based on learning from lean hospital literature with data obtained by questionnaires, observation, and interviews [16]. The data sources needed are primary and secondary data. The primary data required data on service process flow time and service process flow. The secondary data required are the document on the number of visitors and the hospital profile. Data collection was carried out by direct observation using a stopwatch.

The data has been obtained, then (1) do identification based on the waste that occurs to determine the activity that causes the waste of waiting time. (2) The current state value stream mapping for measuring the time of each activity. (3) Creating a waste relationship matrix to identify and calculate the linkages or relationships between wastes. (4) Making root cause analysis is used to identify the cause and effect of waste. (5) Repair based on critical waste as a suggested improvement from the root cause of the problem. (6) Making future value stream mapping is used to describe the proposed improvement conditions in the service process. Next, analyze the future value stream mapping results and compare the initial picture with the proposed improvement. To do all experimental designs, tools are needed to process data, namely value stream mapping (VSM), waste relationship matrix (WRM), and root cause analysis. (RCA).

A. Phase 1: Value Stream Mapping (VSM)

Lean techniques and tools were used, such as Value Stream Mapping (VSM), which includes all stages of each medical process which must be described chronologically and described from start to finish [17]. Other opinions, according to [7], Value stream mapping defines the concrete steps in a process and then evaluates each step and the delay between those steps. To know the extent to which the flow process's time efficiency is expressed by PCE (Process Cycle Efficiency). PCE (Process Cycle Efficiency) is the percentage of time used adding value to the product compared to the total time used on the product in processing [18]. The benefits obtained from applying this concept [19] can visualize the process flow like mapping by identifying waste and eliminating waste that occurs and the source of its causes.

B. Phase 2: Waste Relationship Matrix

The waste relationship matrix has seven types involving Over Production (O), inventory (I), Defect (D), Motion (M), Process (P), Transportation (T), Waiting (W). Each type has the function of showing a waste is affected by another waste [20]. The waste relationship matrix consists of six questions, and each answer has a specific weight start from zero to four. One of the list questions used for distributing questionnaires. Does i produce j, answer options (a) always, (b) sometimes, and (C) Seldom. For example, does waiting produce defect, answer options (a) always, (b) sometimes, and (C) Seldom. List of questions as many as six questions to be distributed to the object of research. Then the Score Value is changed to a Waste Relationship Matrix Symbol. The results of the conversion are used again to calculate the magnitude of effect of each type of waste on other types of waste with a conversion value A = 10, E = 8, I = 6, O = 4, U = 2 and X = 0.

TABLE 1. VALUE CONVERSION OF SCORE TO SYMBOL OF WASTE RELATIONSHIP MATIX

Range	Relationship Types	Symbol
17-20	*Absolutely necessary*	A
13-16	*Especially important*	E
9-12	*Important*	I
5-8	*Ordinary Closeness*	O
1-4	*Unimportant*	U
0	*No relation*	X

(Source: [21])

C. Phase 3: Root Cause Analysis

The root cause is part of several factors such as events, conditions, organizational factors that contribute or give rise to possible causes and are followed by unexpected consequences [18]. One of the root cause analysis approach tools used to determine errors or failures in an event or event is to use the five whys. Five Whys (5 W) are a method of determining a cause and effect relationship to the problems.

IV. Case Study

This research raises about health care in Indonesia with a case in one of Indonesia's government hospitals. Before determining the problem, Researchers must make observations to obtain information and conclude problems that occur rightly and correctly and combine with literature studies to support research. This study focuses on outpatient care with a surgical polyclinic because it has the most patients.

Figure1 show there is the high waiting time at the BPJS registration for 1 hour (cycle time 3690 seconds) with a service counter as many as one person. The problem of waiting time at BPJS services occurs because of the large number of patients and only one service counter, causing waste, resulting in non-value added. In addition, there is an additional working hour for the surgical polyclinic, which should have worked 8 hours, but more than 8 hours.

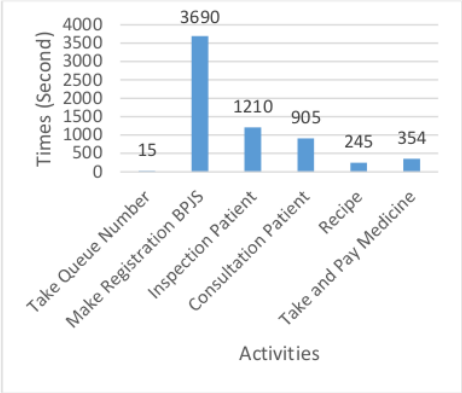

Fig 1. Graph of Activity Time for Each Counter

V. FINDING

Current State Value Stream Mapping can be obtained after identifying waste that occurs in the hospital, especially in the patient registration section. The registration counter consists of 1 counter for BPJS and three counters for non-BPJS with data collection of 30 patients to identify data on service processing time. The average obtained will be used as a reference for making current value stream mapping with the elements used. The distribution of questionnaires is based on the relationship between seven types of waste relationship matrix, such as the relationship between over processing to inventory and vice versa, the relationship between inventory and over-processing. After knowing the weight and the relationship for each waste, the next step is to calculate the score of the level of influence of the waste by using conversion values such as A: 10, E: 8, I: 6, O: 4, U: 2, X: 0. The scoring results among the seven types of relationship matrices can be shown in table 3. The results of distributing the WRM questionnaire are the most influential waste. In addition, waste over processing is 21.93%, and the highest generated waste was waiting, which of 21.93%, which can be seen in table 3.

TABLE 2. WASTE RELATIONSHIP MATRIX WAITING (W)

T / F	Waste					
	O	I	D	M	T	W
O	A	A	E	O	E	A
I	I	A	E	O	E	E
D	I	O	A	U	U	U
M	O	U	O	A	O	A
T	U	U	U	E	A	A
W	I	U	E	A	O	A

TABLE 3. THE WAITING EFFECT LEVEL SCORE

T / F	Waste						Score	(%)
	O	I	D	M	T	W		
O	10	10	8	4	8	10	50	21.93
I	6	10	8	4	8	8	44	19.29
D	6	4	10	2	2	2	26	11.40
M	4	2	4	10	4	10	34	14.91
T	2	2	2	8	10	10	34	14.91
W	6	2	8	10	4	10	40	17.54
Score	34	30	40	38	36	50	228	100

For this stage, the researchers conducted interviews with the five whys method to collect information from the head of the medical service facility planning section as an expert judgment. The question is especially on why waste is waiting in the outpatient service process of BPJS because the waste relationship matrix results have the highest waste. It can be seen at table 4.

TABLE 4. WHY WASTE WAITING

5 Whys Waste Waiting	
Why does waste waiting occur in the BPJS outpatient service process?	Because the employee is slow when inputting data
Why is an employee slow when entering patient data?	Because the employee is not concentration
Why does not employee concentration?	Because employee plays smartphone and chats with other counter employees
Why does an employee play smartphone and chat with other counter employees?	Because bored employee and too much workload
Why is the employee bored and the workload too much?	Because the employee for the BPJS registration counter is only one person and there are too many patients for outpatient BPJS services

Suggestions for improvement made in this study are to provide recommendations to the hospital using the Independent Registration Pavilion (APM) platform. After initial registration, it can be used because the data must be inputted first at the regular counter to verify patient files to obtain the SEP letter. After the proposed improvements are made, the suggested cycle time will reference differences with the Current Value Stream Mapping that can be seen at figure 2. Table 5 show comparison of results current (CSVSM) and future (FSVSM) value stream mapping.

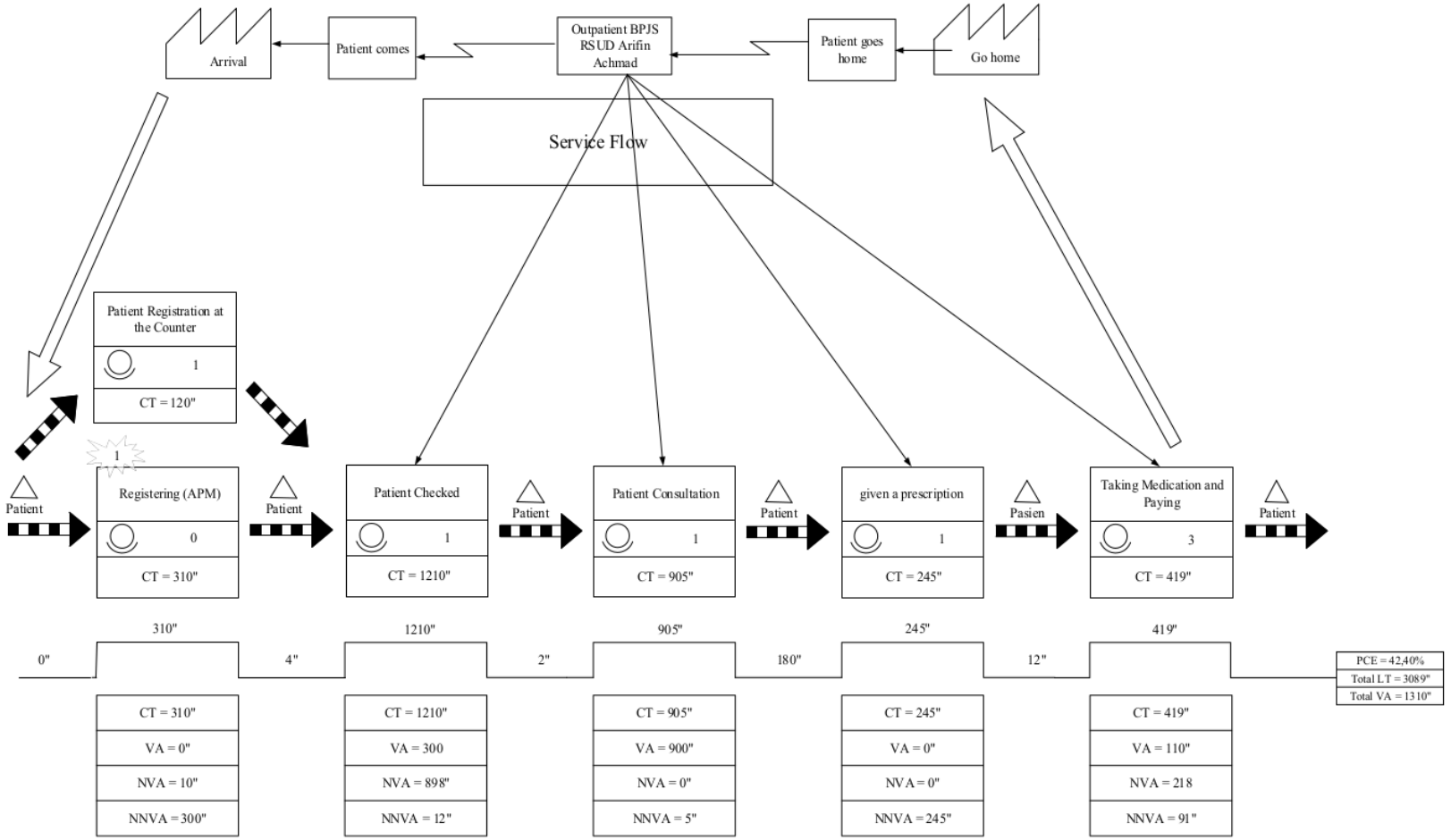

Fig 2. Future state value stream mapping

TABEL 5 COMPARISON OF RESULTS CURRENT (CSVSM) AND FUTURE (FSVSM) VALUE STREAM MAPPING

Variable	CSVSM (second)	FSVSM (second)
Value Added Time	1310	1310
Lead Time	6419	3089
Process Cycle Efficiency (PCE)	*20.40%*	42.40%

VI. DISCUSSION

Current situation value flow mapping is a step taken to group activities and time to see the process cycle's efficiency. Data processing the current value stream mapping with a PCE (Process Cycle Efficiency) value is 20.40%. According to [22], a process says 'lean' the PCE score criteria is 30% or more. The PCE value below the standard was caused by the total lead time very high is 3690 seconds. The BPJS registration counter only has one worker to serve all BPJS outpatient polyclinic patients, so the workload is high and affects workers, which affects the speed and accuracy of workers in work.

After the problem is identified, the waste relationship matrix can determine the relationship between the wastes by distributing questionnaires to expert judgment respondents. Various types of relations show that all relations do not have the same weight [21]. Waiting is the highest waste with the most influential waste is waste over-processing of 21.93%. This is due to (1) the activity of workers asking for patient details repeatedly, (2) the activity of workers when publishing SEP is failed so that it needed repeated treatment, (3) the activity of workers checking patient insurance files repeatedly, (4) submitting information medicine that is unclear so that it needs to do repeatedly, (5) BPJS officers do not concentrate when inputting patient data.

After identifying the highest waste, five whys are tools to increase workplace productivity [23]. The respondent who used to answer the question was the head of the medical service facility's planning section. It is found that the cause of waste waiting is employees slow when inputting data, so that increases service time. Workers cause this is not concentrating because employees play smartphones and chat with other employees and then too many outpatients so that employees feel bored and the workload is too much. Therefore it is necessary to suggest improvements to solve the problem of BPJS registration. The Independent Registration Pavilion is a concrete solution to solve waste waiting in the BPJS registration service. Too many patients are in the BPJS registration section. Human errors often occur, so the Independent Registration Platform is the right solution in reducing waste waiting. This root cause is expected to motivate hospital management to prioritize facility management in the hospital as part of sustainable resource management to improve health care outcomes [24].

After the repair solution is identified, it is necessary to develop a future state value stream mapping by inputting the Independent Registration Pavilion as an indicator. Determination of time using a stopwatch to compare time before repair and after improvement in VSM manufacturing data [25]. The activities that are eliminated are non-value-added activities such as officers talking to colleagues and playing smartphones. The initial waiting time for BPJS registration is 3600 seconds will be around 310 seconds.

VII. CONCLUSIONS

This research's objects are patients, officers, and service processes at the outpatient BPJS installation in one of the government hospitals in Indonesia. After doing the research, the highest waiting time waste is 21.93%, caused by waste over processing caused by officers' carelessness who do not concentrate and are ineffective at work. Hence, they need to do their work repeatedly. The researcher's proposed improvements were successful, and there was an increase in the process cycle efficiency of the entire BPJS registration service process. The cycle efficiency current value stream mapping process is 20.40% to 42.40% for the future value stream mapping with a difference of 22%. This increase occurred cause of the proposed improvement using an effective and efficient Independent Registration Pavilion (APM) platform facility to reduce the waiting time and task of BPJS registration officers. The following research study's proposed improvement is implementing 5S in the hospital in the BPJS registration section.

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