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Accelerate Out Patient Health Services with Lean Service

(Case Study: RSUP Dr. M. Djamil Padang)

Difana Meilani[1], Feli Elysa[2]
Industrial Engineering Department
Andalas University
Padang, Indonesia
[1]difana@ft.unand.ac.id or
[1]difana.meilani@gmail.com

Merry Siska
Industrial Engineering Department
UIN Sultan Syarif Kasim Riau
Pekanbaru, Indonesia
merrysiska@yahoo.com

Abstract – **Nowdays, industries and companies do not only focus on producing products and services, but also improving the services. This happens because the demand of services by the customers rise sharply.**

Hospitals as a service industry need to improve their services to the patients. They have to reduce the non-value activities and provide more value activities in order not to waste the patients' time. This can be done by applying Lean Approach.

Installation out patient in Dr. M. Djamil hospital is the place where services are found. Cardiac poly has the biggest numbers of patients. Here, lean was used to identify waste by using big picture mapping tool. The method was value stream mapping which includes the detailed mapping of the process activities. Observation and research showed that the average length of service for each patient's heart was 127 minutes and this is judged as spending too much time. 22 minutes 20 second was categorized as the value added activity, 5 minutes 44 seconds as transportation time, while the rest 99-minute 38 seconds as waiting (delay) time. This 99 minutes 38 seconds is the non-value added activity.

It is said as waste if related with waiting, unappropriate processing, unnecessary motion, and unnecessary inventory. Waste appears because of the unimplementation one piece flow system, the unclear of SOP (Standard Operational Procesure), and the lack of discipline time.

To eliminate waste, it is recommended to improve one piece flow in flow documents, to make a clear SOP, to arrange a good layout on patient service facilities, to deploy principle of 5S, to improve time service discipline, and to increase appreciation of employees' working achievement.

By applying the recommendation above and by deleting several waiting activities, the total patient service time can be reduced from 127 minutes to 75 minutes. Customers' value ratio will increase from 21.19% to 26.7%.

Keywords – Lean, waste, big picture mapping, value stream mapping

I. INTRODUCTION

In some of health service organization for many years have adopted techniques of process improvement, such us Total Quality Management (TQM) and Six Sigma (SS). But some experts observe that TQM have its own limited because this methode need a lot of time and cost to apply in health service field. In other case, Benedetto (2003) found the constraint of six sigma application, such us many data

to process, front line worker have difficult to understand about SS tools and the suquence of its process. Ghosh and Sobek (2006) has state that the principle of Toyota (Lean) that developed from Industrial Engineering principles, have offers the right tools to change work process in health service field.

A Research in Montana State University and Community medical Centre in Misssouri Montana, that adopted several tools and lean principle in Health service field, has show the effectively of this Methode in order to improvement the quality of work process in hospital. Lean Methode to eliminate waste was believed to improve Company competitive excellence, especially in productivity and quality (Shingo, 1989). This Productivity improvement can be establish if there is operation downsizing that can indicated waste and quality problems that can be occurs

In this globalization era, industries trend is not only producing, but also improving services. Service can be defined as capability to produce right products and to give services to the customers, start from the customers want a product/service until the customers get it with a good price in a short time or minimum hours [Womack & Jones, 2003]. The adding value is got from reducing waste by applying lean approach. Waste can be defined as all the working activities which do not add value in the transformation process of input into output along the value stream [4]. Lean is defined as efforts to reduce waste and add the value of products and services for customer value.

As a pholosophy, lean can be implemented in manifacture indutries and in health service in Dr. M. Djamil hospital. This hospital is a government hospital which becomes the referral hospital in Central Part of Sumatra. Because of this, Dr. M. Djamil hospital must give the best services to the people.

Polyclinic in Dr. M. Djamil Hospital is the installation with the biggest amount of patients. From 18 polyclinics, the cardiac polyclinic has the biggest amount of patients. The working days are five days a week.

The biggest amount of patients and the limitation of time will influence the time service for each patient. This condition can be seen in table 1 Patients Service Time.

TABLE 1. TOTAL TIME OF SERVING PATIENTS IN CARDIAC POLY DR. M. DJAMIL HOSPITAL

Patient	Arrival Time	Accomplish Time	Time span between arrival and accomplish time
1	7:35:00	10:07:00	2:32:00
2	7:56:00	10:20:00	2:24:00
3	7:58:00	10:25:00	2:27:00
4	8:03:00	10:18:00	2:15:00
5	8:03:00	10:15:00	2:12:00
6	8:07:00	10:55:00	2:48:00
7	8:13:00	10:02:00	1:49:00
8	8:10:00	10:36:00	2:26:00
9	8:10:00	10:25:00	2:15:00
10	8:12:00	9:56:30	1:44:30
11	8:22:00	11:43:00	3:21:00
12	8:22:00	10:22:00	2:00:00
13	8:40:00	11:13:00	2:33:00
14	9:03:00	10:50:00	1:47:00
15	9:03:00	11:47:00	2:44:00
16	9:12:00	11:11:00	1:59:00
17	9:15:00	11:12:00	1:57:00
18	9:15:00	10:46:00	1:31:00
19	9:23:00	12:23:00	3:00:00
20	9:54:00	11:55:00	2:01:00
21	9:56:00	11:29:00	1:33:00
22	10:05:00	11:45:00	1:40:00
23	10:08:00	11:40:00	1:32:00

Referring to the interview in cardiac poly, the total time to serve the patients was too much. The pre survey which was the interview with the head of cardiac poly said that it is caused by the existency of the non value added activities (waste). For example, the patient did a mistake in registration, or the machine is broken. Because of that, evaluation to score the effectiveness of patient service activities is needed.

II. RESEARCH METHODOLOGY

The research methodoly systematically explained the steps which are related in order to help and give the fact of the research.

A. Pre Survey

The first step in the research was pre survey. This pre-survey was to know the system of health services in RSUP Dr. M. DJamil. The purpose of pre survey was to get general picture of patient service in polyclinic. The activity was direct observation on the business and the facilities which support the service of polyclinic. Interview was also carried out.

B. Literature Study

In this step , all the references which related to the research are collected. The references would be the guidance in facing the problems that happens in

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polyclinic services. The references were lean thinking, waste, and value stream mapping.

C. Pre Collecting Data

Pre collecting the data was carried out in order to know which polyclinics have the biggest time problem in servicing the patients. The secunder data was from the monthly report of medical record installation in Dr. M. Djamil hospital. The data were

1. The amount of patients in every instalation of Dr. M. Djamil hospital
2. The data of polyclinic's visitors which categorized into type of visiting and the way of payment
3. The working hours of polyclinic of Dr. M. Djamil hospital.

D. Identification of the Problem

The identification of the problem in this research was the existency of non value added activities (waste) in giving services to polyclinic patients of Dr. M Djamil Hospital, and this influenced the time for serving the patients.

E. The Research Purpose

The purpose of the reseach was to identified and to reduce the non value added activities (waste) at polyclinic services in Dr. M. Djamil Hospital. It was hoped that the time spending for serving the patients can be minimized.

F. The Research Methodology

After identfying the problems and the purpose of the research, the next step was deciding the research methodology. In this research, Lean Service Approach with tool Value Stream Mapping were applied.

G. Collecting Data

The data which were collected were premier data. They were :

1. The activities procedure of polyclinic patients in heart poly
2. The data of time services in cardiac poly
3. Identified the waste through assessment table which was given by using waste workshop method.

H. Data Analysis

The data was analyzed based on the methods in the literatures and references. The data was analyzed by :

1. Counting the Activities Hours
To recognize the activity time that happens during the outpatient service. The activity time is gain by subtracting the accomplish activity time with the starting activity time.

2. Test of Normalcy, Test Sufficiency, Test amount of Measurement needed and Kruskal Wallis Test
Test of normalcy is done using software SPSS 15.0 for windows with histogram method. Test sufficiency is done by using $\bar{X}chart$ with some steps; Group the data into several sub group:

a. Calculate the subgroup average (x) with the equation:

$$\bar{X} = \frac{\sum X_i}{n} \qquad (1)$$

with : n= size of sub group

b. Calculate the average of data from the average of subgroup with the equation

$$\bar{\bar{X}} = \frac{\sum \bar{X}}{k} \qquad (2)$$

with : k = amount of subgroup

c. Calculate the standard deviations with the equation

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{\bar{X}})^2}{N-1}} \qquad (3)$$

with : N = Amount of data

d. Calculate the standard deviations from the average subgroup distribution with the equation

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \qquad (4)$$

with : n = size of subgroup

e. Determine the Upper Specification Limit and Lower Specification Limit with the equation

$$UCL = \bar{\bar{X}} + (3 \times \sigma_{\bar{x}}) \qquad (5)$$

$$LCL = \overline{\overline{X}} - (3 \times \sigma_{\overline{x}}) \qquad (6)$$

f. If the data is outside the specification limit, all of the outcontrol data shall be eliminated, and then the data is determined again.

Futhermore, determined the amount of data with the equation

$$N' = \left[\frac{\frac{a}{b}\sqrt{N\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2}}{\sum_{i=1}^{N} X_i} \right]^2 \qquad (7)$$

N'= Amount of data required

N = Amount of data taken

a = Confidence level coefficient

b = Standard of error

In this research the confidence level is 90% with coefficient 2 and precision level 10%. Futhermore, the next step is Kruskal Wallis test to identify if the average doctor examination time is the same for each doctor that is on duty at the cardiac poly, the equation for Kruskal Wallis test is :

$$. \; h = \frac{12}{n(n+1)}\sum_{i=1}^{k}\frac{r_i^2}{n_i} - 3(n+1) \qquad (8)$$

3. Big Picture Mapping

To know the overall system.

4. Detailed Mapping

To identified the problems more detail based on the waste workshop.

The average score from the two sources is multiple with the value stream mapping tools selected matrix.The mapping type with the highest result will be the tool or detailed mapping which can identified waste

5. Calculate the Customer Value Ration

Customer Value Ratio is the value added rasio from the consumer point of view. Customer Value Ratio can be identified from the time recapitulation on process activity mapping and the equation is:

$$\text{Customer Value Ratio}$$
$$= \frac{\text{Value added activity}}{\text{Type one waste} + \text{Type two waste}} x100\%$$
$$(9)$$

I. Closing

Closing section includes the conclusion about the research, some suggestion for the company's improvement, and suggestion for futher research.

III. RESULTS AND DISCUSSION

After all data been collected, the data analysis was carried out.

A. *Patient's Time Serving*

Previously, identified the types of activities that the patient have to pass through, shown on table 2

TABLE 2. SERVICE ACTIVITY CODE FOR OUTPATIENT CARDIAC POLY

Activity Code	Activity
F1	Registration Process Time
F2	Askes Procedure Waiting Time
F3	Askes Procedure Preparing Time
F4	Patient Registration Waiting Time
F5	Patient Registration Process Time
F6	Medicines Submission Waiting Time
F7	Transportation Time
F8	Measuring Blood Pressure Waiting Time
F9	Measuring Blood Pressure Process Time
F10	Processing Medical Record Waiting Time
F11	Processing Medical Record Process Time
F12	Electronic Cardiograph (ECG) Waiting Time
F13	Electronic Cardiograph (ECG) Process Time
F14	Doctor Examination Waiting Time
F15	Doctor Examination Process Time

Futhermore the calculation of duration for each activity is the time activity completed minus with the time the activity started.

B. *The Statistical Data Test*

The statisical data test consists of test of normalcy, test sufficiency, test amount of measurement needed,

and the Kruskal Wallis test. The calculation is done by using equation (1) until (9) and the result is shown on Table 3.

TABLE 3. RECAPITULATION RESULT ON TEST OF NORMALITY, TEST SUFFICIENCY AND TEST AMOUNT OF MEASUREMENT NEEDED

Activity	Test of Normalcy			Test S
Code	Mean	Standard Deviation	Description	De
F1	0,49	0,02	Normal	Uni
F2	19,3	8,4	Normal	Uni
F3	6,98	3,03	Normal	Uni
F4	7,82	3,38	Normal	Uni
F5	1,37	0,38	Normal	Uni
F6	2,26	0,94	Normal	Uni
F7	5,65	2,21	Normal	Uni
F8	7,21	3,08	Normal	Uni
F9	1,45	0,59	Normal	Uni
F10	20,21	10,19	Normal	Uni
F11	1,69	0,63	Normal	Uni
F12	14,17	5,16	Normal	Uni
F13	5,03	1,41	Normal	Uni
F14	29,58	12,89	Normal	Uni
F15	5,36	1,16	Normal	Uni

Kruskal Wallis test was carried out to identifiy that the three doctors in cardiac poly do not have significant different duration in medical checking. The duration time was in minutes.

1. $H_0 : \mu_1 = \mu_2 = \mu_3$

2. H_1 : The mean of the three doctors examination is not the same

3. $\alpha = 0,05$

4. Critical region : $h > X^2\alpha = 5,991$ for $v = 2$ df

5. Computation : At Table 4 the examination process time is rang and then sum each rang of the doctors.

Futhermore, added the $n_1 = 27$, $n_2 = 26$, and $n_3 = 22$ next r_1 with the value $= 160$, $r_2 = 139$, and $r_3 = 126$ then the result of statistic h is :

$$h = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{r_i^2}{n_i} - 3(n+1)$$

$$h = \frac{12}{75(76)} \left(\frac{160^2}{27} + \frac{139^2}{26} + \frac{126^2}{22} \right) - (3)(76) = -222,92$$

6. Decision: because $h_{computation} < h_{table}$ so do not reject Ho and conclude that there isn't any significant differences in the length of checking time by the three doctors.

TABLE 4. DOCTOR EXAMINATION TIME RANG

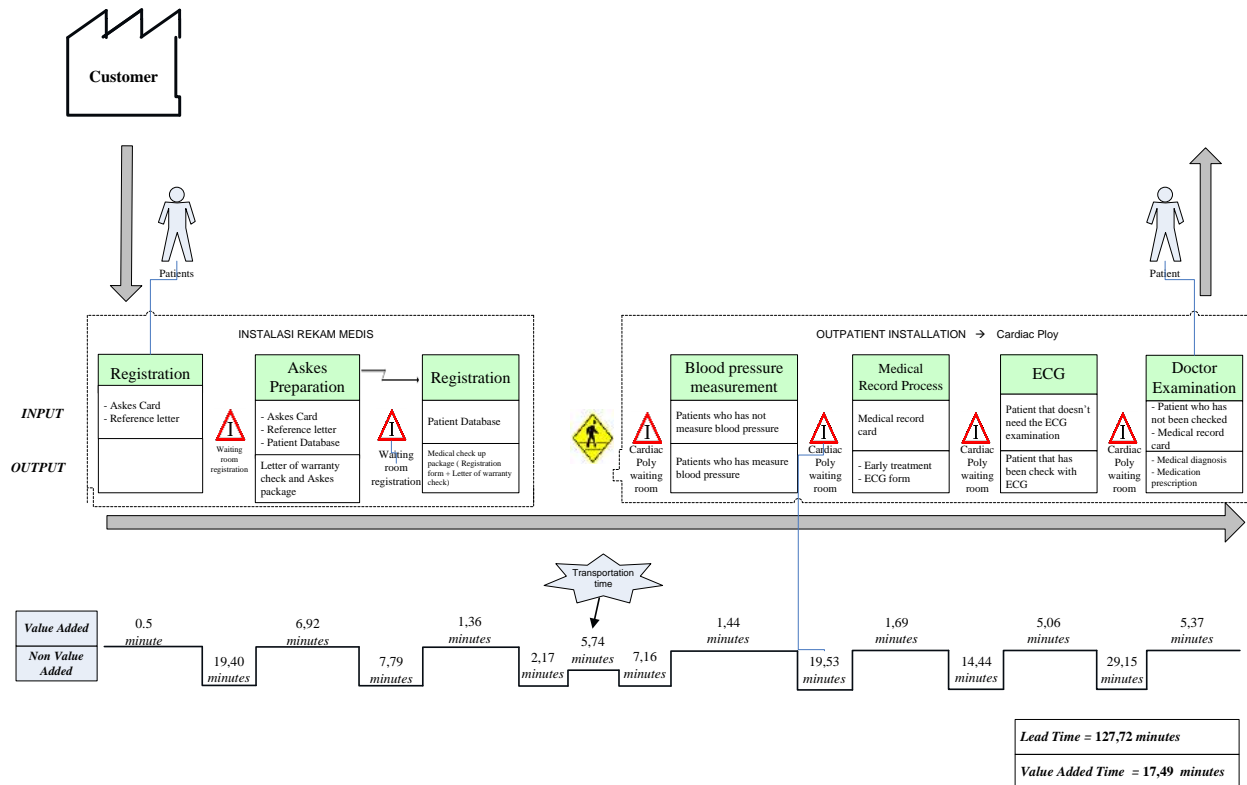| Doctor 1	Doctor 2	Doctor 3
10	5	3
5	6	5
4	4	5
6	3	5
5	6	5
7	7	4
5	5	6
4	3	6
5	5	4
2	4	6
5	4	6
4	9	12
7	6	6
11	3	4
7	7	5
6	8	4
7	8	12
8	3	7
4	5	5
8	9	7
4	3	4
9	7	5
4	5	
3	5	
5	6	
7	3	
8		
r 1 =	r2 =	r 3 =
160	139	126

Fig 1. Big Picture Mapping at Cardiac Poly Patient Services Dr. M. Djamil Hospital

C. Detailed Mapping

Detailed mapping or value stream mapping tools is determine based on waste workshop method. Waste workshop is the predecessor activity that is being done to get information as many as possible related with waste. This is done with asessment table which is filled by the person in charge of the patient care cardic poly. The asessing range is between 0 until 10. The recapitulation of the value is shown at Table 5

TABLE 5. THE AVERAGE SCORE FOR EACH WASTE

No.	Waste	Score		Average	Ranking
		Head of Cardiac poly	Registration Medical record		
1	Overproduction	3	3	3	7
2	Waiting	8	8	8	1
3	Excessive transportation	3	5	4	5
4	Inappropriate processing	4	7	5,5	2
5	Unnecessary inventory	5	5	5	4
6	Unnecessary motion	8	3	5,5	3
7	Defects	4	4	4	6
	Total	35	35		

The average of the waste will next be multiplied with the matrix conversion value seven selection - Value Stream Mapping (VALSAT)- and the result is as shown on Table 6

TABLE 6. THE SUMMARY RESULT OF THE VALSAT SELECTION

No.	Waste	DETAILED VALUE STREAM MAPPING						
		Process activity mapping	Supply chain response matrix	Production variety funnel	Quality filter mapping	Demand amplification mapping	Decision point analysis	Physical structure mapping
1	Overproduction	3	9	0	3	9	9	0
2	Waiting	72	72	8	0	24	24	0
3	Excessive transportation	36	0	0	0	0	0	4
4	Inappropriate processing	49,5	0	16,5	5,5	0	5,5	0
5	Unnecessary inventory	15	45	15	0	45	15	5
6	Unnecessary motion	49,5	5,5	0	0	0	0	0
7	Defects	4	0	0	36	0	0	0
	Total	229	131,5	39,5	44,5	78	53,5	9
	Ranking	1	2	6	3	4	5	7

The chosen Value stream mapping is the tools with the highest weight. Based from the information at Table 6, the tools that is suitable to used for describing the process and waste in detail is the Process Activity Mapping. Process Activity Mapping at Cardiac Poly Patient Care RSUP Dr. M. Djamil is shown on Table 7.

TABLE 7. PROCESS ACTIVITY MAPPING AT CARDIAC POLY PATIENT SERVICES, DR. M. DJAMIL HOSPITAL

Activity Code	Flow Process	Machine/Tools	Distance (meters)	Time	Operation	Transportation	Inspection	Storage	Delay	Description	Category
Registration counters											
F1	Registration			0:00:30	O	T	I	S	D		VA
F2	Waiting for the letter of warranty check preparation			0:19:24	O	T	I	S	D		NVA
F3	Officer prepare the letter of warranty check	Computer, printer		0:06:55	O	T	I	S	D	1 Server, 1 Operator	VA
F4	Waiting for the registration			0:07:47	O	T	I	S	D		NVA
F5	The officer makes the registration form	Computer, printer		0:01:21	O	T	I	S	D	1 Server, 1 Operator	VA
F6	Waiting for the package submission (Letter of warranty check +registration)			0:02:10	O	T	I	S	D		NVA
F7	Leading to the cardiac poly		60	0:05:44	O	T	I	S	D		NNVA
Cardiac Poly											
F8	Waiting for blood pressure measurement			0:07:09	O	T	I	S	D		NVA
F9	Blood pressure measurement			0:01:26	O	T	I	S	D	1 nurse	VA
F10	Waiting for medical record process			0:19:31	O	T	I	S	D		NVA
F11	Processing patient medical record			0:01:41	O	T	I	S	D	2 nurse	VA
F12	Waiting for ECG process			0:14:26	O	T	I	S	D	2 server	NVA
F13	ECG process	Electrocardiogram		0:05:03	O	T	I	S	D		VA
F14	Waiting for doctor medical checking			0:29:09	O	T	I	S	D	2-4 doctors	NVA
F15	Doctor medical checking			0:05:22	O	T	I	S	D		VA
TOTAL	15 Steps		60	2:07:43	7	1	-	-	7		

Operation	0:22:20	
% Value added activity	17,49%	
Delay	1:39:38	
% Non-value added activity	78,01%	
Transportation	0:05:44	
% Necessary but non value added activity	4,49%	

Referring to the Process Activity Mapping, there are three types of Activities. They are Value Added Activity, Non Value Added Activity, and Necessary but Non Value Added Activity. The activity percentage is described on Fig. 2.
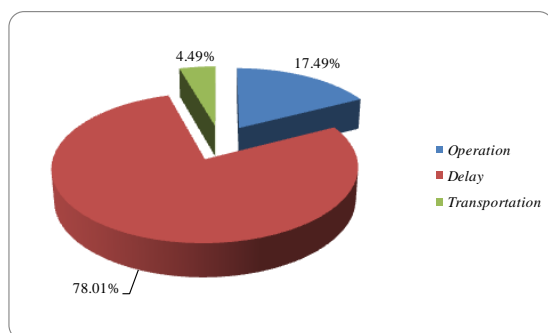

Fig 2. The Percentage of Activity Time at Cardiac Poly Patient Services

It is categorized as waste if it is non value added activity. After observing the serving system in cardiac poly, Dr. M Djamil hospital, waste which occur are:

1. Waiting time happens during the process of ASKES packet, during registration of ASKES, during waiting for the medical record file, and during waiting for doctor's medical checking. The causes are the operators process the documents in batch, the broken machine and tools, and computer system error.
2. Over-processing or Inappropriate Processing which occurs during the patients' re- registration happens because of error procedures or incomplete requirement, medical record revision file for patient who has two medical record cards, and because of wrong process of registration.

3. Unnecessary Motion happens when a nurse tries to find the patient that is not on the spot when the treatment time has come and when the officer tries to find the medical record at the wrong place because of the wrong placement of the medical record before.

4. Unnecessary Inventory. Waste happens because of material stacking such as registration forms and treatment packages which are in storage room and medical record office. This materials are stacked in boxes and take spaces. The office room and medical record storage room are located in one place with the area of approximately 40 m^2 and the stacking material used 3,2 m^2 or nearly 8 % of the area. Locating material in a big amount and unappropriate place affecst the office layout and the storage room become narrow.

D. Customer Value Ratio

Customer Value Ratio is the value added rasio from the consumer point of view. Customer Value Ratio can be identified from the time recapitulation on the process activity mapping and the equation is:

$$Customer\ Value\ Ratio = \frac{Value\ added\ activity}{Type\ one\ waste + Type\ two\ waste} x100\%$$

Total time *Type one waste* (NNVA) = 00:05:44

Total time *Type two waste* (NVA) = 01:39:38

Total time *value added* (VA) = 00:22:20

$$Customer\ Value\ Ratio = \frac{00:22:20}{00:05:44 + 01:39:38} x100\%$$

$$= 21,19\ \%$$

For waste reduction and customer value ratio improvement, the recommendations that can be given are:

a. Applying one piece flow in the document flow or patient registration
b. Making the Standard Operational Procedure (SOP) service for patient with clear and easily understandable language
c. Setting good layout on patient service facilities
d. Applying the principle of 5S (sort, set in order, sweep, standardize, and sustain)
e. Giving each operator the basic skills of tools maintenance, like computer and printer
f. ECG check up in order to avoid stuck machine during the operation.
g. Providing bigger waiting room in Cardiac Poly or move to another big room.
h. Applying advice system from the workers.
i. Being discipline in time serving
j. Understanding the lean by the management and the target to accomplish.
k. Determining the standard time for the process time service.

By implementing the recommendations, it is hoped that the process time and patient waiting time reduce so it will form new activities describe in Table 8.

TABLE 8 PROCESS ACTIVITY MAPPING AT CARDIAC POLY PATIENT SERVICE, DR. M. DJAMIL HOSPITAL (RECOMMENDED)

Activity Code	Flow Process	Machine/Tools	Distance (metre)	Time	Activity					Description	Category
					Operation	Transportation	Inspection	Storage	Delay		
Registration counters											
F1	Registration			0:00:30	O	T	I	S	D		VA
F2	Waiting for the letter of warranty check preparation			0:06:44	O	T	I	S	D		NVA
F3	Officer prepare the letter of warranty check	Computer, printer		0:01:30	O	T	I	S	D	1 Server, 1 Operator	VA
F4	Waiting for the registration			0:01:00	O	T	I	S	D		NVA
F5	The officier makes the registration form	Computer, printer		0:01:15	O	T	I	S	D	1 Server, 1 Operator	VA
F6	Waiting for the package submission (Letter of warranty check +registration)			0:01:19	O	T	I	S	D		NVA
F7	Leading to the cardiac poly		60	0:05:19	O	T	I	S	D		NNVA

Cardiac Poly												
F8	Waiting for blood pressure measurement			0:00:00	O	T	I	S	D		NVA
F9	Blood pressure measurement			0:01:19	O	T	I	S	D	1 nurse	VA
F10	Waiting for medical record process			0:20:06	O	T	I	S	D		NVA
F11	Processing patient medical record			0:01:34	O	T	I	S	D	2 nurse	VA
F12	Waiting for ECG process			0:05:00	O	T	I	S	D	2 server	NVA
F13	ECG process	Electrocardiogram		0:04:40	O	T	I	S	D		VA
F14	Waiting for doctor medical checking			0:20:00	O	T	I	S	D	2-4 doctors	NVA
F15	Doctor medical checking			0:04:58	O	T	I	S	D		VA
TOTAL	15 Steps		60	1:15:14	7	1	-	-	7		
	Operation	0:15:48									
	% Value added activity	21,09%									
	Delay	0:53:50									
	% Non value added activity	71,84%									
	Transportation	0:05:19									
	% Necessary but non value added activity	7,10%									

The activity percentage of recommendation mapping is shown in Fig.3
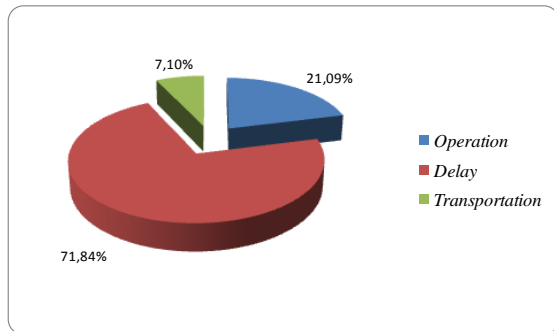

Fig 3. The percentage of serving activities' time of cardiac patients (Recommended)

Then, the increasement of Customer *Value Ratio* happened as followed

$$\text{Customer Value Ratio} = \frac{\text{Value added activity}}{\text{Type one waste} + \text{Type two waste}} x100\%$$

Total time *Type one waste* (NNVA) = 00:05:19

Total time *Type two waste* (NVA) = 00:53:50

Total time *value added* (VA) = 00:15:48

$$\text{Customer Value Ratio} = \frac{00:15:48}{00:05:19 + 00:53:50} x100\%$$

$$= 26,7\%$$

IV. CONCLUSION AND SUGGESTION

A. Conclusion

Based on the research, the waste activities that are found in patients services are waiting, inappropriate processing, unnecessary motion, and unnecessary inventory. By using the tool Process Activity Mapping, the average length of cardiac patient's service was 127 minutes 43 second with the added value activity 17,49% or with the time only 22 minutes 20 second. The transportation time is 5 minutes 44 seconds or 4,49% and 78,01%, and the delay activity time is 99 minutes 38 second.

The non value added activity such as waiting time between the services process can be reduced by using some of the lean concept such as one piece flow and 5S. By reducing non value added activity through recommanded steps, the total time of patient servicing can be minimized from 127 minutes to 75 minutes. Customer value ratio will also increase from 21,19% to 26,7%.

B. Suggestions

For futher research, it is suggested all sections in poly of Dr. M. Djamil hospital being observed in services activities in order to get a vivid picture of the system.

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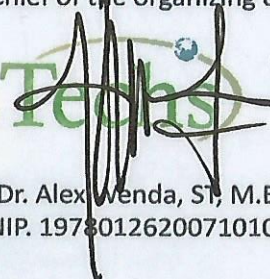This certificate is awarded to :

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