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IJIE

Journal homepage: http://penerbit.uthm.edu.my/ojs/index.php/ijie
ISSN : 2229-838X e-ISSN : 2600-7916

The International Journal of Integrated Engineering

Implementation of Lean Technique towards Reducing Waiting Time in a Public Healthcare using Arena Simulation

Ahmad Nur Aizat Ahmad[1*], Md Fauzi Ahmad[1], Norhadilah Abdul Hamid[1], Nor Aziati Abdul Hamid[1], Lee Tee Chuan[1], Gusman Nawanir[2], Adnan Bakri[3], Mustaqqim Abdul Rahim[4]

[1]Department of Production and Operation, Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja,Batu Pahat, Johor, MALAYSIA

[2]Faculty of Industrial Management,
Universiti Malaysia Pahang (UMP), MALAYSIA

[3]Facilities Maintenance Engineering Department,
Universiti Kuala Lumpur –Malaysian Institute of Industrial Technology, MALAYSIA

[4]Department of Civil Engineering, School of Environmental Engineering,
Universiti Malaysia Perlis (UniMAP), MALAYSIA

*Corresponding Author

DOI: https://doi.org/10.30880/ijie.2021.13.07.024
Received 1 September 2021; Accepted 15 September 2021; Available online 30 September 2021

Abstract: Lean is a set of operating philosophies and methods that can help patients create maximum value by reducing waste and waiting time. Longer waiting times are associated with increased levels of discomfort experienced by patients that may affect the patient's mental health, leads to depression, anxiety disorder and psychological distress. The waiting time of clinic is considered one of the crucial aspects of patient satisfaction which is a key indicator of service delivery. Therefore, the purpose of this study is to implement lean techniques towards reducing waiting time at outpatient department in one of the public healthcare centres in Kedah. This study had collected the data for three days at the outpatient department by using qualitative method through interview and observation. Data was collected through a record phenomenon with instrument and observing the service time of patients in the process flow throughout the treatment period from the moment they arrived at the healthcare until treatment is provided and the patient leaves the outpatient department. Arena simulation software designed for data analysis was used to simulate the modeled process in the simulation software. The simulation system can help to produce more accurate decision for an efficient flow of the patient's in and out of the treatment process and reduce the waiting time. The results showed the total average processing time for each patient through all the process had reduced by 7.21 minutes (15.20%) after the waste was eliminated and improvement process had been made. This can lead to an increase in the number of patients in and out in daily operation at the outpatient department.

Keywords: Lean, healthcare, arena simulation

1. Introduction

Lean is a set of operating philosophies and methods that can help patients create maximum value by reducing waste and waiting time. It aims to fundamentally change the thinking and value of the organization, and ultimately lead

*Corresponding author: aizat@uthm.edu.my

to changes in organizational behavior and culture over time. Although there are indications that lean is common in healthcare, many authors consider that the implementation of lean is pragmatic, patchy, and fragmented as mentioned by [1]. In today's world, the 'necessity' of using lean techniques in healthcare is very clear in terms of quality, patient safety, cost, waiting time, and staff satisfaction [2].

According to [3], roughly 25% of survey-takers relayed that they have stopped seeking medical treatment due to excessive waits. The pressure on the healthcare sector is growing worldwide. Medical advancements make it possible to save patients or make them alive longer. This means that more patients need treatment and in most cases, they need to wait for a longer period. Issues such as medication safety, overcrowding, long patient waiting times, and inadequate resource allocation can lead to patient dissatisfaction and reduced health care quality. As a result, hospitals are now under increasing pressure to reduce costs, become more efficient, and improve the quality of care provided to patients as mentioned by [4]. This has prompted leaders of healthcare to change the design aspect of hospital operations and processes to minimize waste and improve healthcare delivery.

Healthcare in Malaysia is well known in all countries of the world where the healthcare sector plays an important role in giving health services to everyone. According to the World Health Organization (WHO), governments and the private sector play a crucial role in providing quality lives for their citizens through a good health system [5]. Waiting time is the amount of time that a patient has to wait in a clinic or hospital before being seen by a clinical staff. Waiting time in clinics and hospitals is an important factor that leads to patient dissatisfaction and creates discomfort for patients. This situation seems to exist all over the world [6].

Strategies of renovating scheduling systems and better labor-management can reduce waiting time and improve satisfaction with care. However, due to the shortage of staff and the increase in the number of patients, it is often unavoidable to wait for a long time [7]. Waiting for treatment for a long time can be considered frustrating to patients because the time is not spent fruitfully and impatient patients do not want to wait to be seen. According to previous studies, it has been mentioned that longer waiting times are associated with increased levels of discomfort experienced by patients that may affect the patient's mental health, leads to depression, anxiety disorder, and psychological distress. Therefore, the waiting time of the clinic is considered one of the crucial aspects of patient satisfaction which is a key indicator of service delivery [6]. Lean techniques have been applied quite effectively as a way to deal with time issues without additional resources or funding [8].

2. Literature Review

This topic presents a review of the relevant literature for researchers to convey knowledge and provide detailed information on this research topic.

2.1 Lean Manufacturing

Lean is a process improvement approach originally from the Japanese automotive industry derived from Toyota Production System (TPS) that designed to reduce costs by eliminating several of waste and maximizing utilization of staffs' ability [9]. Besides, lean is considered a set of operating philosophies and methods aimed at maximizing operating efficiency, speed, cost, and quality in the services [3]. The lean intervention aims to improve healthcare quality by reducing waste and facilitating the flow in care processes of the patient [10]. According to [11], the main factors that motivated hospitals to implement lean healthcare are reducing patient waiting time, lowering costs, and improving the financial situation of the healthcare sector.

2.2 Lean Technique

In today's world, the 'need' of using lean techniques in the healthcare sector is very clear in terms of quality and patient safety, waiting time, cost as well as staff satisfaction [2]. The application of lean manufacturing techniques in the outpatient department can improve the flow of patients, thereby reducing the potential for overcrowding and access block [12]. Lean techniques can improve service delivery by understanding and researching the details about how to provide safe health services. To improve or solve the problem of waste and waiting times, public healthcare is using lean techniques that are known and widespread in the manufacturing area such as value-stream mapping (VSM), 5s, Kaizen, and use of the staff as a source of quality improvement as well as continue refinement of the process steps form the basis of the project. The goal and benefit of implementing lean techniques in healthcare are the best ways to reduce waste, waiting times, unnecessary travel while building speed, quality, and flexibility into the organization.

2.3 Type of Waste

In healthcare, waste can be defined as any activities in healthcare service that do not help patients or move them further from cure. Waste is service aspects that do not add value to customers and is commonly grouped into seven types that lean healthcare aims to reduce as transportation, inventory, motion, waiting, overproduction, over-processing, and defects [13]. When the waste is removed in public healthcare, the process flow will flow smoothly and reduce the

waiting time of the patient. This can further increase the quality, efficiency, and safety of patient care as well as fulfill their satisfaction [12].

2.4 Outpatient Department

Most patients with health problems who come to the outpatient department at public healthcare are seeking diagnosis or treatment. Outpatient department services are medical procedures or tests that can be done without requiring a bed or to be admitted for overnight care at this time. Therefore, several stages need to be held by each patient during the treatment period.

(a) Outpatient Process Flow

In the healthcare service, managing the patient flow is one of the important elements in improving efficiency. Patient process flow in the outpatient department is shown in figure 1.

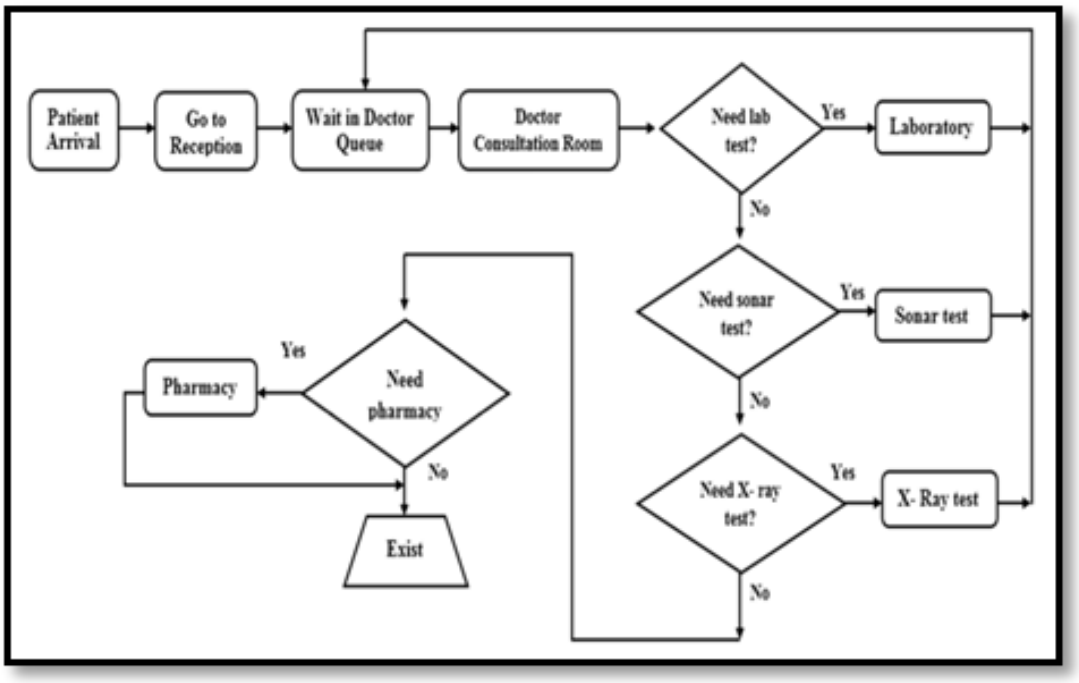


Fig. 1 - The outpatient department daily routine (Ali & Kassam, 2017)

(b) Waiting Time

Generally, waiting time can be referred to as the time spent before a patient is attended by a healthcare provider. One of the criteria patients use to assess their satisfaction with healthcare services is the time they spend before seeing a doctor or visiting a department of the hospital. The time spent waiting is the resource that the patient invests in achieving the purpose of being seen by the physician. Hence, it may be alleviated by the quality of care or recovery. Crucially, long waiting times are still a major concern in the healthcare system, and the difficulty of managing waiting times was a common problem in all hospitals [14]. In the management and organization of healthcare system, patient waiting time is one of the important factors that should be considered. Outpatient department scheduling is considered one of the important factors that may influence hospital efficiency. It plays a crucial role in bringing efficiency to the hospital through effectively using the available resources in the department, and provide a good service to meet patient satisfaction by reducing waiting times [3].

2.5 Arena Simulation

Systems Modeling Corporation is a flexible and powerful tool that enables analysts to create the models of animated simulation models that accurately represent almost any system with the help of simulation and animation [15]. This software is an extended software simulation and animation packages that can provide a complete simulation environment that supports all the steps in the simulation research [16]. The study by [17] reported that Arena is a simulation environment that consists of module templates built using the SIMAN language construct and the package of the CINEMA animation. Therefore, when creating the Arena model, it is implemented in the SIMAN code which is then compiled and run without the need to write programming code. Arena is a graphical or animation system that is based on the concept of hierarchical modeling. It allows users to create a new modeling object called modules, which

are the building blocks of model creation. It also provides Application Solution templates, which can be used to customize the software to specific animations as mentioned by [16]. Moreover, Arena also includes an input analyser that is used to obtain appropriate probability distribution to be used in the models and an output analyser also allows users to carry out statistical analysis on the results obtained [18].

3.0 Research Methodology

The methodology of the case was chosen because while under investigation of this research it allows the researcher to gain a detailed understanding of the concept and provides the possibility to study phenomena in a real-life context [5].

3.1 Research Design

According to [19], the design research method was deployed according to the systematic process, in which field-driven knowledge was developed and applied through the development of ad hoc solutions such as tools, artifacts, and frameworks. Then the practical problems are tested to verify their validity. To identify the factor related to long waiting time in the healthcare organization, a qualitative method was used in data collection on the flow of information from the entry point to exit time in the outpatient department. Therefore, this study applied a qualitative method that was designed to measure the actual waiting time of patients and to seek some factors that can cause patients to spend time in the assessment center to provide information on the quality of services delivery.

3.2 Data Collection

Data collection is the process of gathering information from all relevant sources to find answers to research problems, test hypotheses, and evaluate the results [16]. In this study, the methods of data collection used are primary data and secondary data.

(a) Primary Data
Primary data is the data that has been collected from first-hand-experience. It is a type of data that never existed before, therefore has not been published yet, and was more reliable and authentic as mentioned by [17]. The primary data were obtained from the interview and observation in the outpatient department at a public healthcare.

(i) Interview
An interview is a conversation in which someone is asked their opinion about a product or service so that it can be improved [17]. Simple questions for the interview need to be prepared which focuses on the patient flow to reduce waiting time that is related to the topic. The interviewer interviewed a suitable interviewee such as a healthcare staff and questioned them on their experience and views in managing tasks or job in the outpatient department for patient care.

(ii) Observation
In this study, data was collected through a recorded phenomenon with an instrument and by observing the service time of patients in the process flow throughout the treatment period in the outpatient department. The data required to develop the patient flow are patient arrival time, patient waits at the registration counter, waiting for a consultation service time at the consultation room and the pharmacy counter, patient leaves time as well as the number of staff and doctors at each stage.

(b) Secondary Data
Secondary data is a type of data that has already been published in any form. The sources of collecting the secondary data are journal articles, online portals, magazines, newspapers, books, and other publishing sources. Therefore, the literature review in any research is based on secondary data [17].

3.2 Data Analysis

Data analysis is all the data that were collected from the qualitative method such as interviews and observation. The data that have been collected to reduce waiting time was simulated by using the Arena simulation software to evaluate the result. The focus of qualitative research is to capture the viewpoints of the researched person in order to understand the environment in which they are inserted and to analyze their ideas and opinions [3]. The qualitative method of data analysis was used because the observation use as an instrument of data collection that could provide the necessary information in numbers. Then, the data for the study had also been collected through an interview with the interviewee of the public healthcare organization in the outpatient department. After collecting data, Arena simulation software designed for data analysis was used. Arena simulation modeling software had analysed the data and results to do some improvement by eliminating waste in the process flow of the patient.

4.0 Data Analysis, Simulation, and Results

This research was carried out in the outpatient department in one of the public healthcare centres in Kedah and the data research was collected on 24, 27 & 28 September 2020 between 0900 hrs to 1300 hrs which is the largest average number of patients' arrival for treatment collectively about 230 patients. The data collection was based on the patient who has registered at the counter to have a medical check-up and observing them until they finished their visit to the department. Based on the observation, it can be seen that some of the process flow had wasted in terms of transportation, waiting as well as motion.

4.1 Process Flow of the Patient in the Outpatient Department

In the outpatient department, there are six processes of patient flow that need to be held by each patient during the treatment period. The patient flow is observed as the time and process the patient undergoes from the moment they come to the healthcare until treatment is provided and the patient leaves. The process flow of the patients in the outpatient department is shown in figure 2.

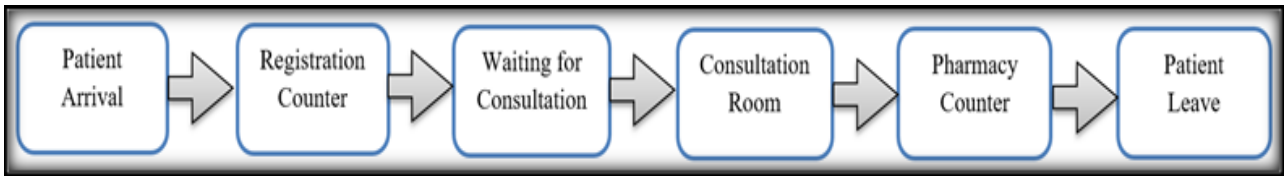


Fig. 2 - Process flow of the patient in the outpatient department

4.2 Data Collection and Data Analysis

Several data have been collected through interviewing in public healthcare in the outpatient department at registration and pharmacy department as well as observing the process of patient flow. The data research was collected on 24, 27, and 28 September 2020.

(a) Interview

In this study, the respondents of the interviewee for the researcher to obtain the relevant information are from the head of the registration department with 5 years experience and the head of the pharmacy department with 10 years of experience working in one of the public healthcare centres in Kedah. They were the person who held vital positions to control the situation and giving the proper instruction to the staff in their department to ensure the process can run fluently without error. The data collected from the interview was then further analyzed in this research.

(b) Observation

The data was collected through the observation from each of the processes of a patient flow in the outpatient department by using a stopwatch and a sheet of paper to independently observed and record the start and end times for each process of service delivery to the patient experienced. The time taken to record as shown in the table below was taken from the 10 outpatient visit that was chosen randomly for the researcher to collect data when the patient starts entering the entrance gate of healthcare for each of the process flow in the outpatient department. Table 1 shows the time taken for each process flow from the 10 patients respectively.

Table 1 - Time taken for each process flow of a patient in the outpatient department in public healthcare through observation

Time Observation Sheet												
Process: Flow of patient								Observer: Yeap				
Area: Outpatient Department in Healthcare								Date: 24,27 &28/09/2020				
Process	Name of process	Number of patient observe (min)										Average
		1	2	3	4	5	6	7	8	9	10	
1	Patient Arrival	3.22	3.51	2.50	3.42	2.11	2.35	2.24	2.47	3.18	3.37	2.84
2	Registration Counter	11.31	7.26	9.20	11.51	13.53	7.22	12.56	11.51	15.46	8.11	11.17
3	Waiting for Consultation	11.09	8.35	9.49	10.33	12.02	10.58	11.27	10.33	9.40	7.49	10.04
4	Consultation Room	12.43	14.18	13.12	9.41	10.49	8.10	10.51	11.08	11.10	10.37	11.08
5	Pharmacy Counter	10.22	9.16	8.22	10.28	12.16	9.14	12.39	9.24	12.44	7.40	10.07
6	Patient Leave	1.44	1.56	2.33	1.43	2.04	2.13	1.21	2.23	1.49	2.35	2.22
Total process flow for 1 patient		49.71	44.02	44.86	46.38	52.35	39.52	50.18	46.86	53.07	39.09	
Total average												47.42

4.3 Process Improvement

The process of improvement was made to improve the service performance and efficiency of the process flow by reducing and eliminating waste problems in the outpatient department.

(a) Reduce Waiting Time through the Improvement Patient Process Flow

In order to reduce this waiting time, the researcher has adopted the kaizen approach to plan, determine and analyze the problem at the outpatient department as well as to take action to make the improvement on the flow of patient and relocate the layout. The improvement can be made by adding one counter and staff for the registration counter and the pharmacy counter respectively. In addition, open one doctor's room for treatment 3 who provided the services for the patient in the outpatient department to deal with the problem of wait. This improvement had reduced the average waiting time at the registration counter, waiting for a consultation, and the pharmacy counter respectively as well as increased the number of patients in and out for daily operation service in the outpatient department at public healthcare.

(b) Eliminate Waste in Term of Transportation through the Relocate Layout at the Outpatient Department

Furthermore, the researcher can eliminate waste in terms of transportation by adopting the kaizen approach. In transportation, it is regarding transport for distances greater than necessary. This problem happened because the patient need to walk a long distance from the registration counter to the waiting area. Some of the wasteful movement in transportation often resulting from an improperly designed layout of the doctor's room. To resolve this issue, the researcher has suggested relocating the layout of the outpatient department especially for the arrangement of the doctor's room. This method can speed up the patient flow, improve work organization and manage healthcare services in becoming more effective by adopting the kaizen approaches. Hence, the reduction of waste is often targeted to improve flow.

(c) Eliminate Waste in Term of Motion

The researcher can also eliminate waste in terms of motion by adopting 5s through sort and set in order which maximizes value-added levels by removing all necessary factors that do not generate value. Motion refers to the ergonomics of staff at the registration counter who provided the services for the patient is poor and requires excessive physical effort. It is also referred to as the movement that involves the placement of various obstacles for providing the services. In sort, the receptionists should separate the necessary item from the unnecessary item from the workplace by sorting through items and placing the item at one side that is not often used by using red-tagging. This method makes it easier for receptionists to distinguish between necessary and unnecessary items at their place to improve the efficiency of their service performance. Besides, the receptionists also can use the set for placing their documents and get the documents arranged accordingly by labeling the document at the location appropriately. Once the document is labeled, it can be easily found by the staff, save time as well as energy. Hence, sort and set in order can be used in healthcare to increase space and reduce search time for their workflow more efficiently without any obstacle.

4.4 Comparison between Current Layout and Relocation of the Layout in the Outpatient Department

For the comparison layout in the outpatient department at public healthcare, Figure 3 shows the difference between the current layout and the improvement layout (relocation) which includes the registration counter, pharmacy counter, and doctor room. In the improvement layout, the registration and pharmacy counter has added another counter and staff for each department to reduce the waiting time. In addition, the doctor’s room had also been relocated. This is to ensure that the waiting time of the patient and the movement of the patients from one process to another process in healthcare layout can be reduced.

4.5 Comparison for the Current and Improvement Process Flow of the Patient in the Arena Simulation Model

All the current and improvement process flow of patients are divided into 6 processes such as patient arrival, registration counter, waiting for a consultation, consultation room (treatment), pharmacy counter, and patient departing. However, there is one registration counter and pharmacy counter was added and one doctor room was opened in the improvement process flow to become 2 registration counters, 2 pharmacy counters, and 3 doctor rooms compared to the current process flow which only has one counter at the registration and pharmacy respectively as well as two doctors room. All these processes are further divided according to the process and treatments of health services. An overview of the Arena simulation model for the comparison between the current and improvement process flow of the patients in the outpatient department is shown in Figure 4.

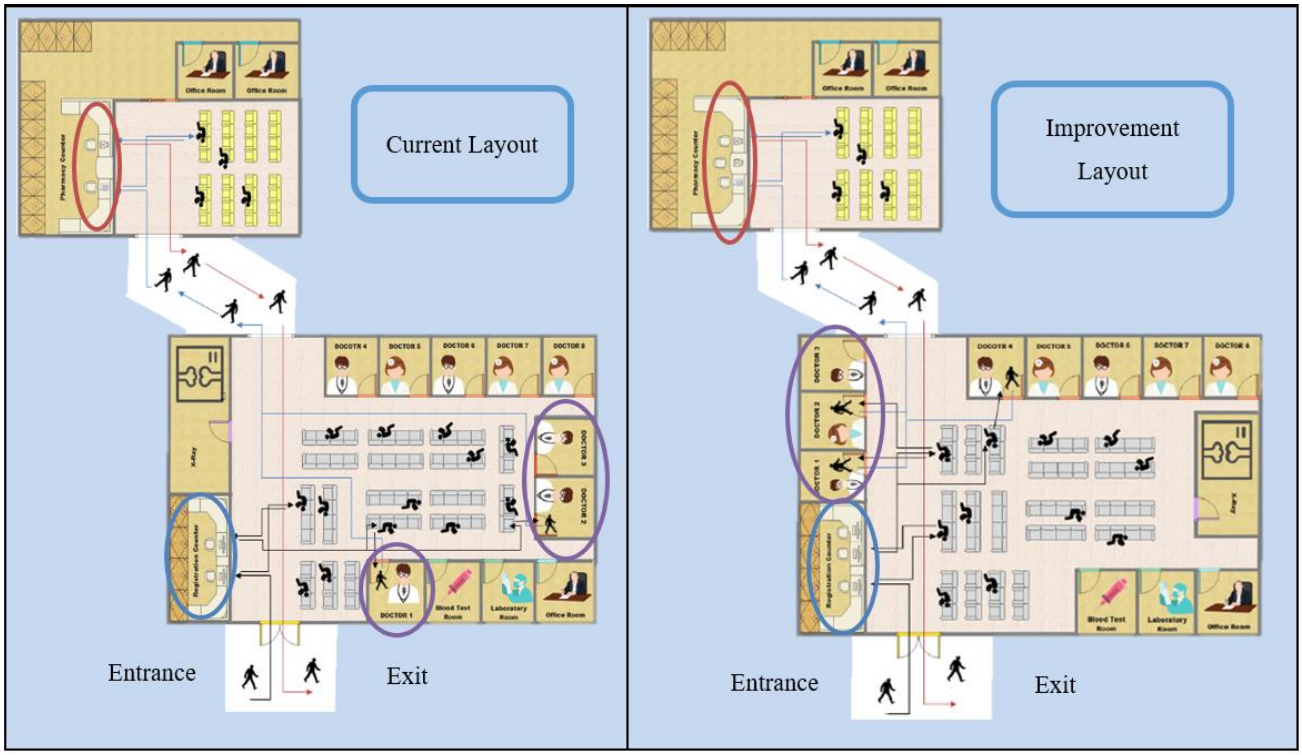


Fig. 3 - Comparison of current and improvement (relocation) layout at the outpatient department

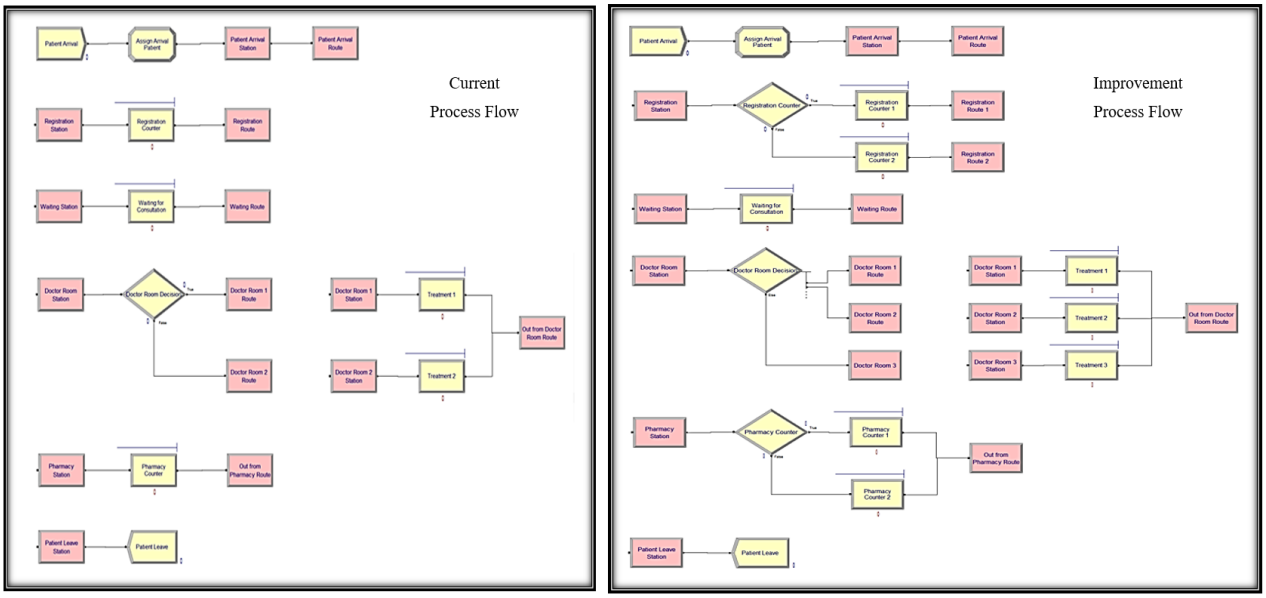


Fig. 4 - Comparison for the current and improvement process flow of the patient in the arena simulation model

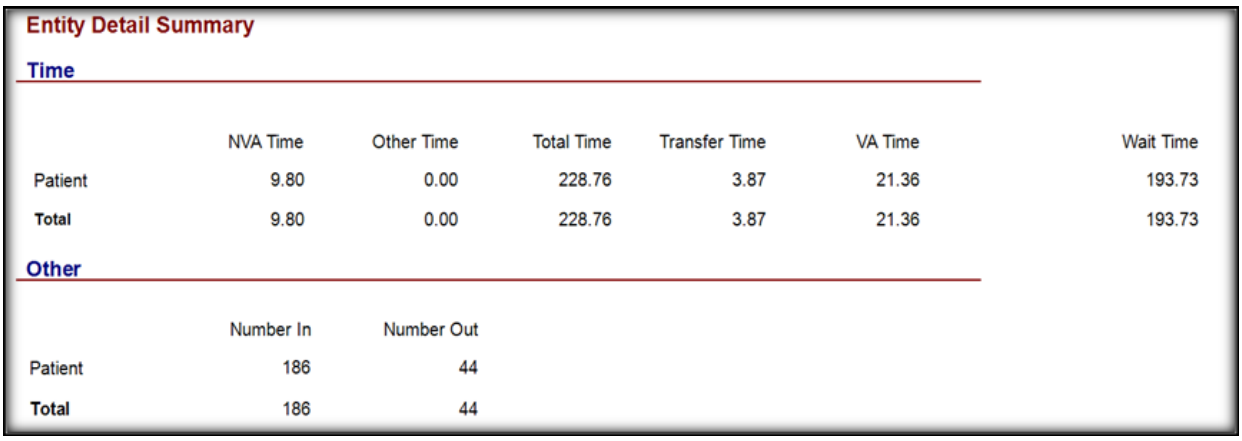
4.6 Simulation Result for the Current Process Flow of the Patient

i) Entities result

Figure 5 below shows the number of the output of entities in the current simulation of process flow in the outpatient department. The number of outputs for this current process flow is 44 patients in average.

Fig. 5 - Number out in system

Figure 6 shows the current average result of the non-value-added time (NVA) is 9.80 minutes, total time is 228.76 minutes, transfer time is 3.87 minutes, value-added time (VA) is 21.36 minutes, and wait time is 193.73 minutes. While the current number of patients in is 186 and the current number of patients out is 44.



Entity Detail Summary

Time

	NVA Time	Other Time	Total Time	Transfer Time	VA Time	Wait Time
Patient	9.80	0.00	228.76	3.87	21.36	193.73
Total	9.80	0.00	228.76	3.87	21.36	193.73

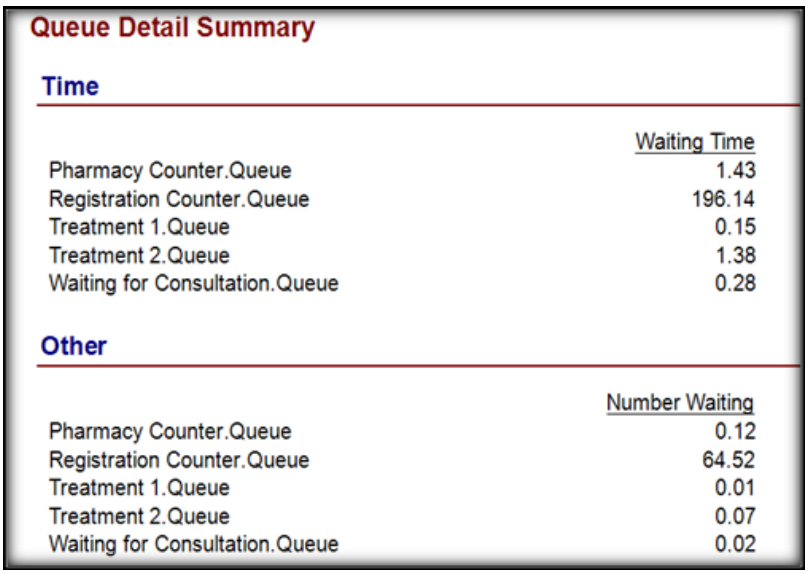
Other

	Number In	Number Out
Patient	186	44
Total	186	44

Fig. 6 - Average of time, number in and number out

ii) Queues result

Figure 7 below shows the results of the current Queue detail summary for the waiting time and the number waiting in average for all the process flow of the patient at the outpatient department.



Queue Detail Summary

Time

	Waiting Time
Pharmacy Counter.Queue	1.43
Registration Counter.Queue	196.14
Treatment 1.Queue	0.15
Treatment 2.Queue	1.38
Waiting for Consultation.Queue	0.28

Other

	Number Waiting
Pharmacy Counter.Queue	0.12
Registration Counter.Queue	64.52
Treatment 1.Queue	0.01
Treatment 2.Queue	0.07
Waiting for Consultation.Queue	0.02

Fig. 7 - Average of the waiting time and number waiting.-

4.7 Simulation Result For the Improvement Process Flow of the Patient

i) Entities result

Figure 8 below shows the number of output of the improvement process flow which is 58 patients in average. When the improvement had been made, the number of output increased from 44 patients to 58 patients that show an increased number of 14 patients. Figure 9 shows the improvement average result of the non-value added time (NVA) is 8.78 minutes reduce from 9.8 minutes, total time is 208.75 minutes reduce from 228.76 minutes, transfer time is 3.37 minutes reduce from 3.87 minutes, value-added time (VA) is 19.30 minutes reduce from 21.36 minutes and waiting time is 177.30 minutes reduce from 193.73 minutes. While the improvement number of patients in is 190 increase from 186 patients (4 patient) and the improvement number of patient out is 58 increase from 44 patients (14 patient).

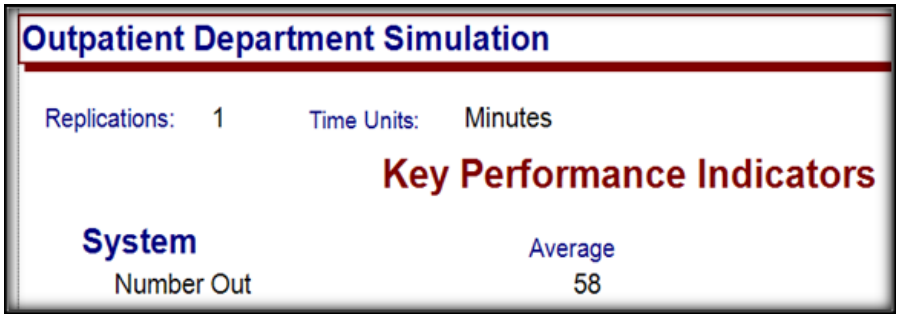


Fig. 8 - Number out in system (improved process)

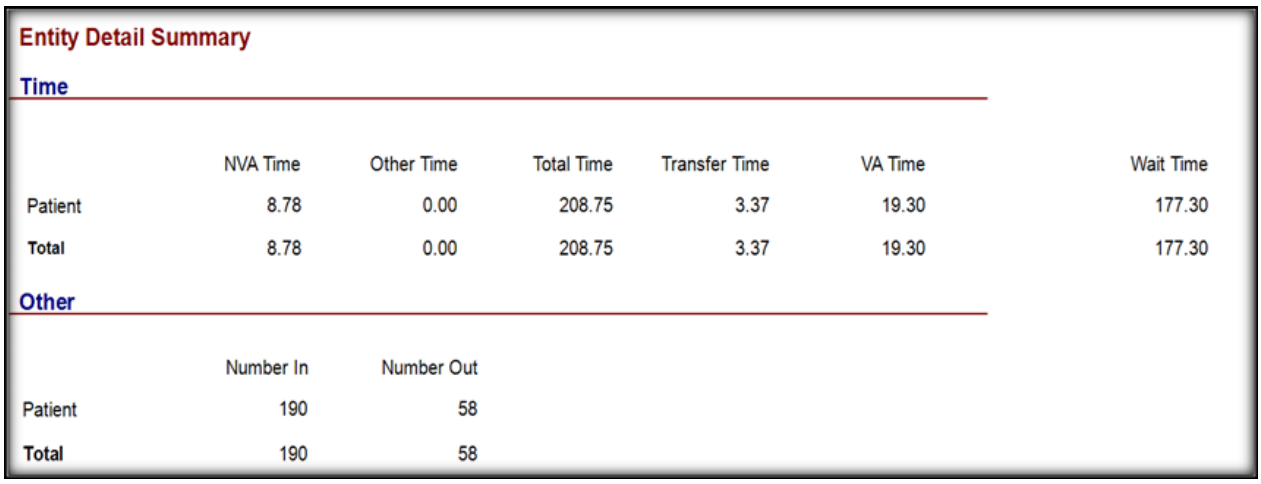


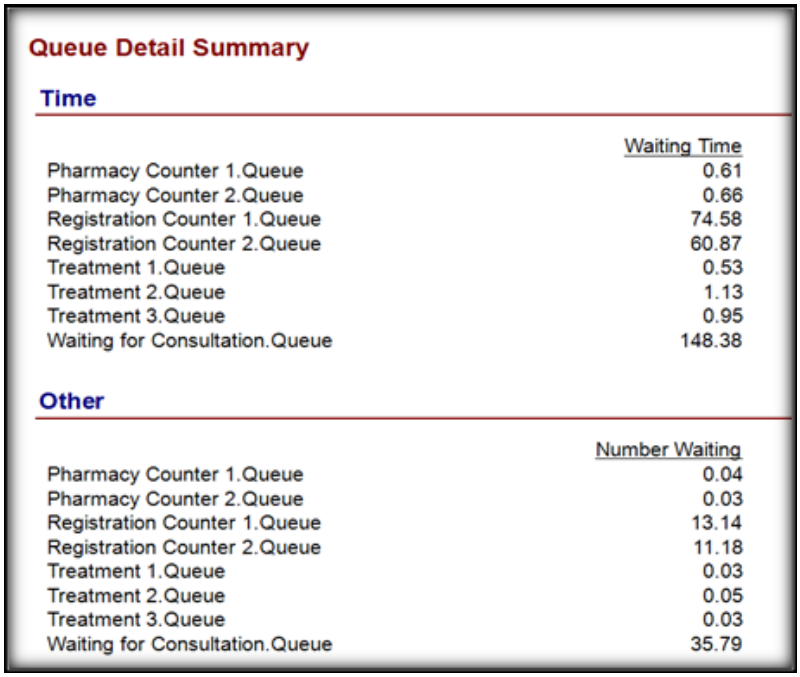
Fig. 9 - Average of time, number in and number out (improved process)

ii) Queues result

Figure 10 below shows the results of the improvement Queue detail summary for the waiting time and the number of waiting in average for all the process flow of the patient at the outpatient department.

4.8 Comparison of the Current and Improvement Process Time of the Patient Flow in the Outpatient Department

Based on Table 2 and Figure 11, the processing time for the patient's arrival, consultation, and the patient departing was similar at the current and improvement. This depends on the patient's movement and the treatment provided by the doctor and is based on the patient's disease. The processing time from the registration counter, waiting for a consultation and the pharmacy counter had reduced between the current and improvement that had been made. This reduction occurs due to the improvement that had been made such as by adding one counter and staff at the registration and pharmacy department as well as by opening one more doctor room as well as relocating the layout of the doctor room.



Queue Detail Summary

Time

	Waiting Time
Pharmacy Counter 1.Queue	0.61
Pharmacy Counter 2.Queue	0.66
Registration Counter 1.Queue	74.58
Registration Counter 2.Queue	60.87
Treatment 1.Queue	0.53
Treatment 2.Queue	1.13
Treatment 3.Queue	0.95
Waiting for Consultation.Queue	148.38

Other

	Number Waiting
Pharmacy Counter 1.Queue	0.04
Pharmacy Counter 2.Queue	0.03
Registration Counter 1.Queue	13.14
Registration Counter 2.Queue	11.18
Treatment 1.Queue	0.03
Treatment 2.Queue	0.05
Treatment 3.Queue	0.03
Waiting for Consultation.Queue	35.79

Fig. 10 - Average of the waiting time and number waiting (improved process)

Table 2 - Comparison the process time of the patient flow between the current and improvement

Comparison of Process Time of the Patient Flow				
Categories	**Current (Average in Min)**	**Improvement (Average in Min)**	**Different**	**Percentage (%)**
Patient Arrival	2.84	2.84	0	0
Registration Counter	11.17	8.45	- 2.72	- 24.35
Waiting for Consultation	10.04	8.27	- 1.77	- 17.63
Consultation Room	11.08	11.08	0	0
Pharmacy Counter	10.07	7.35	- 2.72	- 27.01
Patient Leave	2.22	2.22	0	0
Total	47.42	40.21	- 7.21	- 15.20

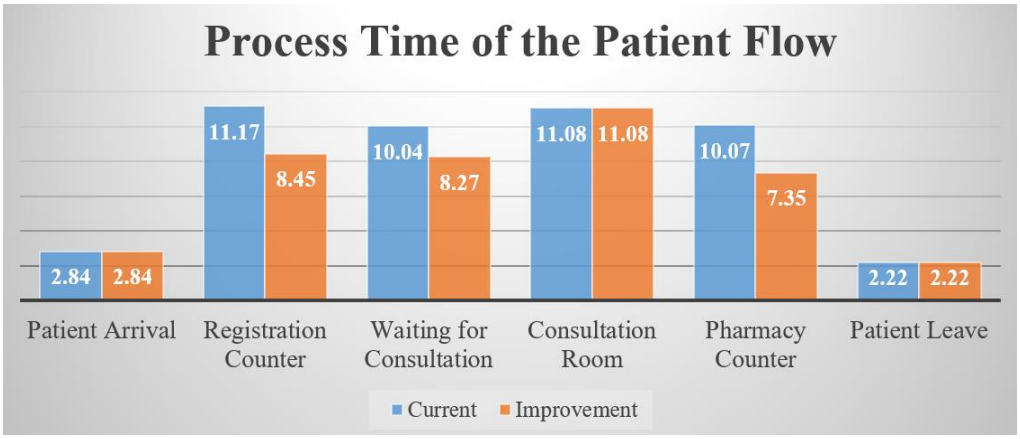


Fig. 11 - Current and improvement process time for each of the patient flow

4.9 Comparison of the Current and Improvement Total Average Process Time

From the table above, the total average time for all the process flow for 1 patient is decreased from 47.42 minutes in the current process to 40.21 minutes in the improvement process when the improvement had been made as shown in Figure 12.

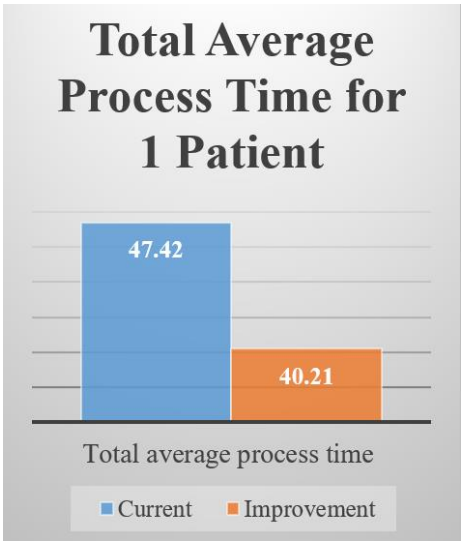


Fig. 12 - Total average process time for 1 patient for the current and improvement process

4.10 Comparison of the Time of Non-Value Added (NVA), Transfer and Wait and the Number of Patient In and Out between Current and Improvement Simulation

Based on Figure 13, the non-value added time, transfer time, and waiting time had reduced 1.02 minutes (10.41%), 0.50 minutes (12.92%), and 16.43 minutes (8.48%) respectively compared to the current process. This result indicates that the improvement and relocation of the doctor room that had been made can reduce or eliminate the waste in terms of waiting, motion, and transportation of the flow of patient in the outpatient department.

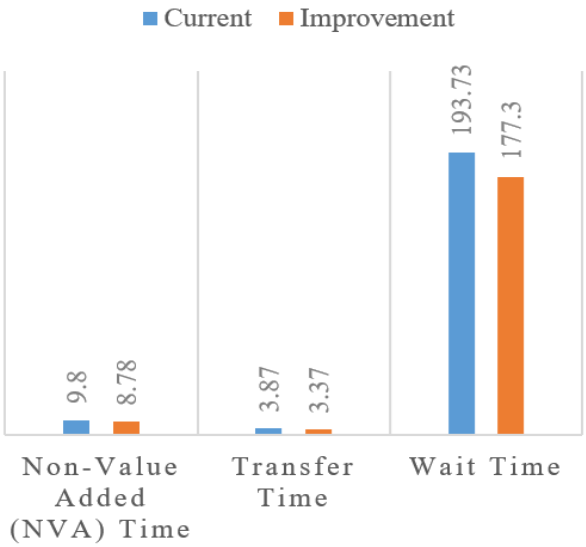


Fig. 13 - Non-value added time, transfer time and wait time for the current and improvement simulation

Figure 14 shows the total number of patients in and out of the outpatient department was increased by 4 patients and 14 patients respectively when the improvement had been made. When this total number is increasing in daily operation, it can be said that the time of the process flow of patient and service performance in the outpatient department at public healthcare become more efficient. Table 3 shows the comparison of the number of patients in and out and the time of NVA, transfer and wait between current and improvement simulation.

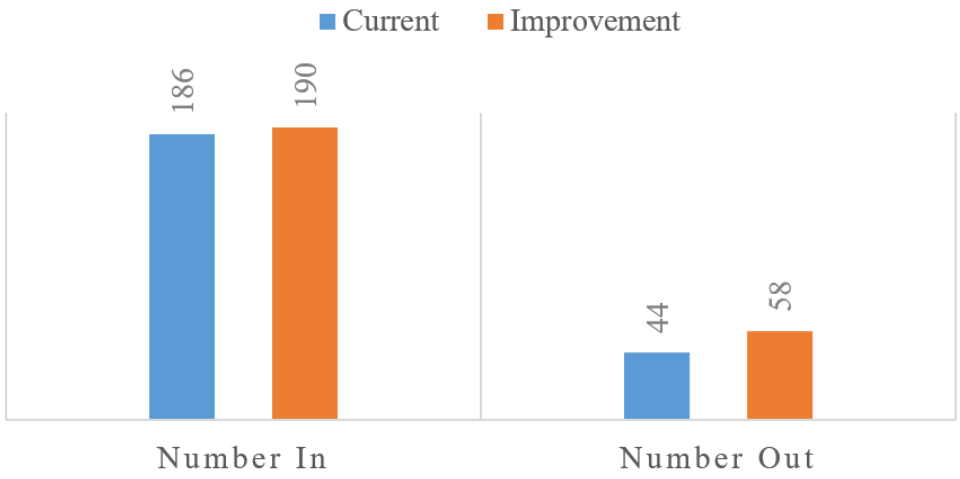


Fig. 14 - Number of patient in and out for the current and improvement simulation

Table 3 - Comparison of the time of NVA, transfer and wait and the number of patient in and out between current and improvement simulation

Comparison of the Time of NVA, Transfer and Wait and the Number of Patient In and Out				
Categories	**Current (Average in minutes)**	**Improvement (Average in minutes)**	**Different**	**Percentage (%)**
Non-Value Added Time (NVA)	9.80	8.78	- 1.02	- 10.41
Transfer Time	3.87	3.37	- 0.50	- 12.92
Wait Time	193.73	177.30	- 16.43	- 8.48
Categories	**Current (Average)**	**Improvement (Average)**	**Different**	**Percentage (%)**
Total Number of Patient In	186	190	+ 4	+ 2.11
Total Number of Patient Out	44	58	+ 14	+ 24.14

4.3 Overall Result

The total number of patient in and out in day operations was increased by 2.11 % and 24.14 % respectively. Then the processing time for the registration counter pharmacy counter and waiting for consultation was also reduced 24.35%, 27.01%, and 17.63% respectively. This is because the improvement made in the process at the outpatient department was reduced or eliminated in order to improve the service performance and efficiency of the process flow of public healthcare as well as reduced the level of discomfort experienced by patient. Table 4 shows the summary result between the current and improvement process.

5.0 Conclusion

In conclusion, the objectives of this research were achieved by the overall findings and results. According to the result, it can be seen that the performance has been enhanced by improving the flow, reducing the distance, reducing the time and increase in the number of patients. Thus, it was indicated that the implementation of lean technique on process flow had shown significant improvement on the service quality of public healthcare. The aim of the lean is to minimize the waste and creating value of service delivered to the end customers by means of eliminating non-value added activities. There were two limitations encountered in this study. Firstly, an important limitation of this study is that the research focused only in Johor area. Thus, the improvement layout for public healthcare at Johor area as a case study cannot be applied with healthcare in other areas whether they are public or private healthcare. It can been seen that obvious reasons contributed to the limitations. The second limitation of this study is regarding the method of collecting data. Observations and interviews at public healthcare were the main data collection instruments to answer and analyze the research questions for this study. The benefit of face to face interview is that participants were able to

give total involvement and direct contact between researcher and interviewees. However, the healthcare staffs were busy providing service to the patient therefore they were willing to be interviewed.

Several recommendations can be proposed in this research. Firstly, based on the overall findings of this research, it is proved that the implementation of lean techniques has a positive effect on service quality in public healthcare. The relationship between the lean techniques and the service quality is tied together with each other. Therefore, it is essential for every healthcare institution to implement lean techniques. Besides, the healthcare institutions aim to satisfy society's needs, help patients to solve health problems and to provide quality care to patients. Thus, the service quality of healthcare is unable to compare with other service quality of other fields. Secondly, the comparison of service quality can be conducted on public healthcare and private healthcare because the layout for these two types of the healthcare institutions might be different. Thus, it would be interesting to compare their lean management as well. Lastly, the lean techniques studied in this research was based on general healthcare institutions and further study can be conducted on particular healthcare institutions such as emergency department or hospital in order to improve the process flow.

Table 4 - The summary result between the current and improvement process

Comparison Table				
Categories	**Current (Average in Min)**	**Improvement (Average in Min)**	**Different**	**Percentage (%)**
Patient Arrival	2.84	2.84	0	0
Registration Counter	11.17	8.45	- 2.72	- 24.35
Waiting for Consultation	10.04	8.27	- 1.77	- 17.63
Consultation Room	11.08	11.08	0	0
Pharmacy Counter	10.07	7.35	- 2.72	- 27.01
Patient Leave	2.22	2.22	0	0
Non-Value Added	9.80	8.78	- 1.02	- 10.41
Transfer Time	3.87	3.37	- 0.50	- 12.92
Wait Time	193.73	177.30	- 16.43	- 8.48
Categories	**Current (Average in minutes)**	**Improvement (Average in minutes)**	**Different**	**Percentage (%)**
Total Number of Patient In	186	190	+ 4	+ 2.11
Total Number of Patient Out	44	58	+ 14	+ 24.14

Acknowledgement

The authors gratefully acknowledge Universiti Tun Hussein Onn, Malaysia and Ministry of Higher Education for the financial support provided for this research through Research Grant Scheme, TIER 1 Vot H844.

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