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Digitalization of Outpatient Services Based on Lean Management to Reduce Waiting Time in Government Hospital

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***Abstract*— Hospital outpatient waiting times in Indonesia do not meet the standards. Lean management reduces waste, while digitalization plays a role in managing service complexity. Implementing lean in parallel with digitalization increases the opportunities for improvements, but empirical research on this is still limited. This study aimed to generate an analytical study of the impact of Lean application in reducing the waste of waiting time for outpatient services at a government hospital. The research design was pre- and post-intervention. The study was conducted in a regional government hospital with 80 people as a sample who was recruited by systematic random sampling. Data collection was carried out through observation and mapping the flow of patient service time from booking to completion of a doctor's consultation using the time stamp. Efforts to reduce waiting time are carried out through a simulation of the Lean-based digitalization model. The variables are the number of Service Steps, Lead Time, Waiting Time, Value-Added Activities, Non-Value-Added Activities and Value-Added Ratio (VAR). The results showed that lean-based service digitalization was able to reduce service steps from 10 to 4 steps, waste waiting from 5 to 2 steps, and Lead Time from 336 to 39 minutes (-88.4%), increasing the VAR from 5.1% to 20.5%. This research is limited to the implementation of lean digitally. It is important to statistically compare the impact of digital and non-digital lean implementation in some hospitals.**

***Keywords*— Lean-based digitalization; waiting time; outpatient.**

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I. INTRODUCTION

To achieve the SDG's targets, Universal Health Coverage is a system that brings safe, affordable, and effective health services for the community to be achieved by every country by 2030. The sustainability of health services is the main prerequisite to achieving the SDGs if the quality of health services can be guaranteed [1]. Since 2014, the Indonesian government has issued a National Health Insurance System (NHIS) that makes the Bureau of Social Insurance Provider (BPJS) the world's largest health insurance payer. With the number of participants continuing to increase, in 2017, BPJS paid 223.4 million consultations for health services [2]. Increased utilization of health services causes an imbalance in health service supply and demand, impacting service quality [3]. This is reflected in the increase in hospital outpatient's waiting time. Outpatient waiting time is from registering until getting a doctor's consultation with a standard of equal to or less than 60 minutes, based on the Indonesian Ministry of Health. World health organization (WHO) set the maximum time limit for patients to be served by doctors is 30 minutes from the promised consultation schedule [4]. As a referral hospital for the surrounding area, regional public hospitals have more specialist and equipment than private hospitals. It makes regional general hospitals to have a large number of patients, therefore it has an impact on waiting times that are not up to standard.

Hospital sustainability is reflected by the quality and the level of productivity. Irwandy and Syaf [5] found that the productivity level of hospitals has continued to decline since the implementation of BPJS health insurance in Indonesia. Besides that, several studies showed that since the entry into force of BPJS, health service quality and waiting time (WT) in some hospitals did not meet the standard [6]–[8]. West Sumatera is a province with a low HDI compared to other provinces in Indonesia. Waiting time at a Regional General Hospital in Padang, the capital city of West Sumatera was 239 minutes in 2018. It can be improved by 122 minutes in 2019, but it did not meet the standard [9].

Factors affecting WT are patient volume, the distance between service units, officer communication, and registration number. The discipline and consistency of the practice schedule between the schedules' written and the actual schedule of the doctors affect WT. Lack of skills, experience, and knowledge, scarcity of medical equipment, and lack of speed in treating patients also affect WT [10]. Furthermore, the absence of an appointment system and random patient arrivals affect WT [11].

Long WT harms patients, health workers, management, government, and insurance payers. Long waiting time reduces patient value and service quality, causes treatment delays and poor health outcomes, exacerbates disease conditions, and endangers patient safety [10]. Long WT increases direct medical and non-medical costs [12] and reduces the productivity of the patients and their families [13]. WT increases health workers' stress [14], resulting in poor communication and service performance. For hospital management, it causes waste of capacity and fixed costs for operation such as staff salaries, waiting rooms, facilities, equipment, and materials not used. WT also impacts decreasing customer trust, revisiting the clinics, and reducing hospital income. It was due to reduce patient volume, low bed occupancy, and a number of operations. The government also bears this cost because it must subsidize hospitals whose revenue cannot cover operational costs. WT impacts the insurance payers because of worsening health outcomes, leading to increased cost claims [13].

Lean management is a perspective and methodology to streamline service processes to avoid various forms of waste [14]. The number of activities, processes, and units involved in the service prolongs WT, which is a waste. Lean management offers service efficiency efforts by mapping the service flow and removing unnecessary service activities to create services that minimize waste [15]. Lean management has been applied in the health care sector for the last few decades [16]. The lean hospital is applied to many hospitals in America and positively impacts hospital service performance [15].

Lean management in outpatient services is the implementation of lean methodologies and perspectives that are implemented in outpatient services [17]. Skeldon et al. [17] found that implementing Lean in outpatient services of uro-oncology academic clinics in Canada reduced cycle time from 46 minutes to 35 minutes (day 60) and 41 minutes (day 90) after implementation. Lean increased the consultation time with doctors (value-added activity) from the previous 7.5 minutes to 10.6 minutes on the 90th day. Lean can also increase the value-added ratio by 35.7%. Based on this literature, implementing lean management in outpatient services can reduce waiting times (non-value-added activity) to enhance quality services.

Besides Lean management, digitalization also aims to streamline the health service process. Digitalization is using digital technology and data such as applications and artificial intelligence in the production process to produce more flexible, effective, and efficient services [18]. The company's digitalization includes applying information technology in the service process using cellular technology, tablets, and smartphone application [19]. Digitally connected company supply chain management makes the company more market-sensitive, virtual, network-based, and process aligned, including in the health services sector [20]. Digitalization of services works through fast decision-making, increasing employee productivity, customer satisfaction, and competitive performance [21]. Lean digitization is a management method to integrate lean thinking and digitalization in production process management [22]. To create high-quality health services by avoiding waste, the digitalization of outpatient services is an effort to apply digitalization to outpatient services [23].

Some literature showed that digitalization in health services is necessary to improve service delivery [18], [24]. The high volume of patients and the length of waiting time increase the risk of the spread of Covid-19, which can be anticipated through the implementation of digitally connected services [25], [26]. Digitalization in companies is also helpful in increasing company agility in responding to environmental changes, especially during a global pandemic [21]. Digital technology can reduce lead times, adjust service volumes based on customer expectations, improve service coordination and collaboration, reduce costs, and increase product innovation and customer value. Eventually, digital technology improves access and information sharing to provide certainty of on-time deliveries, customized products, and customer satisfaction with shorter production times [21].

Some opinions questioned the role of digitalization in lean management implementation [27], [28]. Lean simplifies the complexity of services and limits the use of digital technology. Conversely, digitalization is expected to manage the complexity of services. Some literature showed that Lean management, which is applied digitally, increases the efficiency of the service process because the two elements work mutually reinforcing [27]–[29]. Skeldon et-al. (2014) states that implementing Lean digitally increases the opportunity for improvement from 15% to 40% [17]. Serlenga et al. [30] found that the implementation of Digitalized Lean compared to lean non-digital (digital VS non-digital) as seen from the decrease in production costs (-30% VS -15%) and increase in equipment efficiency (35% VS 25%), decrease in goods inventory (-60% VS -40%). Lean digital versus Lean Non Digital is able to increase labor productivity (25% VS 15%), increase repair results (40% VS 25%), decrease logistics costs (-35% VS -20%), and reduce production time (-20 % VS -10%) [30]. Lean digitally improves the quality and on-time provision of logistical information [31].

The implementation of digital lean management has only been discovered in the manufacturing industry. Unfortunately, there is no literature regarding the implementation of Lean management digitally to reduce waiting time for outpatient services in hospitals. This paper aims to produce discussion material regarding the impact of digitally implementing Lean in reducing waiting time in outpatient services at a regional general hospital.

II. Materials and Method

The research was conducted at a regional general hospital, considering that it is the only hospital in West Sumatra Province that is not yet connected digitally in connecting service products with its customers. In general, (96%) of patients in that hospital are BPJS insurance patients [9]. The high volume of patients impacts the waiting times (WT) that

did not meet the standard. In 2018, WT at that hospital was 239 minutes which improved in 2019 to 122 minutes but still did not meet the standard[9]. At the beginning of 2020, the number of outpatients at that hospital increased significantly because two hospitals in adjacent locations no longer served BPJS insurance patients. It increasingly has an impact on the longer WT. The standard of outpatient waiting time refers to the Indonesia Health ministry, is not more than 60 minutes (≤60 minutes). The standard applies to all outpatients based on hospital types, health insurance types, and general patients without health insurance.

This research is quantitative analytic with pre- and post-intervention design (see Fig. 1). The study was conducted at the Outpatient Installation at a Regional General Hospital for two periods. The stage before implementation was conducted in January-March 2020. The next stage is to design Lean management-based applications. After implementing it, the measurement of service waiting times was carried out in August-October 2021.

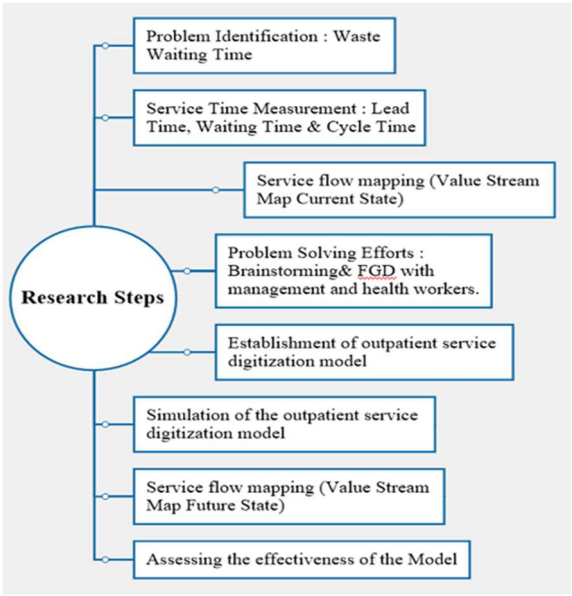

Fig. 1 Research Steps

The research variables are the Number of Service Stages, Lead Time (LT), Waiting Time (WT), Cycle Time (CT), Value-Added-Activities (VA), Necessary Non-Value-Added-Activities (NNVA), Non-Value-Added Activities (NVA) and Value-Added Ratio (VAR). The population was all repeated patients who came to the outpatient clinic during the week. The sample was taken by systematic random sampling every 15 minutes of arrival at the registration section. The registration time ranges from 07.00-12.00 Indonesian time (IDT). Inclusion criteria were patients in internal medicine clinics, and the exclusion criteria were new patients due to did not require a search process medical record document.

Therefore, the samples amounted to 71 people. The data collection method was done by observing and measuring the waiting time for outpatient services. The tool used is the Amano Brand Time Stamp. Patients were observed, and their service time was measured when accessing services, consisting of booking, queuing, medical record services, and doctor consultations at the clinic. All service stages are recorded, timed, calculated, and displayed in tabular form and Value Stream Map (VSM-Current State). After the application simulation, the same assessment is carried out based on the variables studied and displayed in the VSM-future state, then its effectiveness is assessed. The stages of the research are explained with the flow, as shown in Figure I.

III. Result and Discussion

The results of the research and discussion include five subheadings: Lead Time Distribution, Value Analysis Time, Service Flow Mapping Before Implementation (VSM Current-State), Service Flow Mapping after Implementation (VSM-Future State), and Assessment of the Effectiveness of Lean Digitalization in outpatient service.

A. Sample Characteristics

The characteristic of the research sample shown in Table I. The characteristics of the research sample are described according to the time of sampling, the sex of the respondents, and age, as shown in Table I. Sampling was carried out by systematic random sampling every 15 minutes of patient arrival at the registration section, which took place between 07.00 to 12.00 Indonesian Time = IDT,

TABLE I
RESEARCH SAMPLE CHARACTERISTIC

Sample Characteristic	Number (n)	Percentage (%)
Sampling Hours		
- IDT 07.00-07.59	14	19,7
- IDT 08.00-08.59	14	19,7
- IDT 09.00-09.59	14	19,7
- IDT 10.00-10.59	14	19,7
- IDT 11.00-11.59	15	21,1
Sex		
- Man	23	32,4
- Woman	48	67,6
Age		
- ≤45 years old	19	26,8
- 46-55 years old	22	31,0
- 56-65 years old	27	38,0
- >65 years old	3	4,2
Total	**71**	**100**

Therefore, the number of samples was balanced based on the time of collection. Most respondents were women (67.6%), and most were in the late elderly or 56-65 years (38%). The categorization of age is grouped based on the Ministry of Health's criteria, namely young age (≤45 years), early elderly (46-55 years), late elderly (56-65 years), and old age (≥65 years).

B. Lead Time Distribution

The time needed to get outpatient services for respondents is shown in Table II. There are 13 service processes for patients, from pre-booking to consulting a doctor. They are 1) Pre-booking, 2) waiting time before queue picks up, 3) getting queue number, 4) waiting for registration, 5) registration, 6) waiting before medical record (MR) document searching, 7) searching for MR document, 8) idle time before registered on record system, 9) recording in register system, 10) waiting before delivering MR, 11) Delivering MR to clinics, 12) waiting before consultation, and 13) doctor consultation. The process is called Lead Time (a total of ±5 hours 36 minutes). Of the 13 service processes, there were five waiting processes

marked with an * (star sign) as a component forming the waiting time, which is ±5 hours 4 minutes. The average lead time called waiting time for outpatient's services through the standard is not more than 60 minutes, as stated in the method. Most of the lead time was waiting time in the process, which should be zero. The time to process one service cycle (cycle time) is ±32 minutes).

TABLE II
DISTRIBUTION OF LEAD TIME OF RESPONDENTS

No	Service Steps	Lead Time (Hour: Minute: Second)			
		Mean	Min	Max	SD
1	Pre-booking*	01:00:00	00:05:00	05:10:00	00:38:00
	Queuing Process				
2	Idle time before queue pick up	00:10:00	00:00:05	00:40:00	00:12:00
3	Get queue number	00:01:00	00:00:08	00:02:00	00:00:05
4	Waiting for registration *	00:59:00	00:11:03	01:57:00	00:29:04
	Registration				
5	Administration Process (Registration)	00:02:24	00:00:51	00:12:22	00:01:30
6	Waiting before MR document searching*	00:35:09	00:00:00	01:23:13	00:21:52
	Medical Record (MR)				
7	Searching for MR Documents	00:03:27	00:00:23	00:24:59	00:04:13
8	Idle time before recording on the register system	00:05:12	00:00:00	00:31:03	00:05:23
9	Recording on the register system	00:00:41	00:00:09	00:08:40	00:01:08
10	Waiting before delivering MR documents *	00:10:21	00:00:01	01:07:14	00:10:56
	Delivering MR documents				
11	Delivering MR documents to the polyclinic	00:04:38	00:00:09	00:25:32	00:04:25
	Clinics				
12	Waiting before consulting*	02:20:13	00:11:36	04:19:31	01:10:11
13	Doctor consultation	00:04:49	00:01:07	00:16:00	00:02:58
	Lead Time	05:36:54			
	Waiting Time (*)	05:04:43			
	Cycle Time	00:32:11			

Lead time is the time required to meet customer needs. Lead time in health services is the time lag between the patient's request for health services until the service is received by the patient [32]. Lead time consists of Cycle Time and Waiting Time. Cycle time is the time it takes to process one unit of a product or service before repeating the process for the following product or service[33]. Cycle time is the duration of time required to complete one cycle of action, from start to finish [34].

Most of the time spent in clinics is wasting time. The most waste occurs while waiting before consulting a doctor, waiting before registration, and pre-booking or pseudo-booking. Prebooking (pseudo-booking) is an activity for patients who come before the official service hours because they want to get a low queue number by lining up in front of the queue machine. Sometimes patients come early in the morning, and it happens because there is no official booking service, either manually or online. Waiting time is the time between the service process at one stage to the next stage. Waiting time is caused by the queue pile before going to the next production process [35]. Waiting time is an idle time between one workstation and the next, before or after the workstation, or in one workstation on a job with many workers, machines, and production of logs or batches [14], [36]. The Lead time distribution is shown in Table II.

The service processing time for each service unit affects the lead time. Nowadays, lead time is one of the strategies to win the competition in attracting customers [37]. Good coordination and collaboration between health workers in each unit can reduce health service lead times [32].

C. Value Analysis Time

Furthermore, the service activities are grouped based on the value of time, which consists of 3 categories, namely Value-Added (VA), Non-Value-Added (NVA), and Necessary Non-Value-Added (NNVA) activities, as described in Table III.

TABLE III
DISTRIBUTION OF ACTIVITIES BASED ON VALUE-ADDED

No	Service Steps	*VA*	*NNVA*	*NVA*
1	Pre-booking			√
2	Idle time before queue pick up			√
3	Get queue number		√	
4	Waiting for Registration			√
5	Administration Process		√	
6	Waiting before MR document searching			√
7	Searching for MR Documents		√	
8	Idle time before recording on the register system			√
9	Recording on the register system		√	
10	Waiting before delivering MR documents			√
11	Delivering MR documents to the polyclinic		√	
12	Waiting before consulting			√
13	Doctor consultation	√		

Value-added activities are service activities that patients want and are willing to pay. Necessary Non-Value-Added Activities (NNVA) are activities that are required for the health care process and do not add value directly to patients. Non-Value-Added (NVA) activities do not provide added value for patients or benefit service administration. NVA is a form of waste detrimental to patients, service personnel, and insurance payers. NNVA activities in this study are the patient administration process, registration, and processing of medical record documents. The activities are in the form of waiting time and idle time. Based on this, the percentage of VA, NVA, and NNVA activity is calculated from the duration of patient service time in Table IV.

Waiting time is a form of waste that often becomes a public complaint, especially in government hospitals. Patients must wait a long time to process services with a consultation time of ±5 minutes. Waiting time is a form of waste because it comes from activities that do not add value to the patient (NVA). NVA has 6 forms of waste: waiting, defects or work repetition (defect or rework), transportation, motion, additional processes, and overproduction[38]. Outpatient

services need to be considered by controlling the lead time so that the service process does not contain a lot of waste, such as waiting time. It can be achieved by eliminating NVA and reducing NNVA.

There are three categories of activities: VA activities, Non-Value-Added (NVA), and Necessary Non-Value-Added (NNVA). A series of service activities that have added value and the patient is willing to pay for it is called VA, for example, a doctor's consultation. Service activities where patients are not willing to pay for it but are needed for service management are called NNVA, for example, medical record services. Service activities that do not have added value and are detrimental to patients are a form of waste called NVA, such as waiting at each stage of service. The literature showed that only 5% of hospital services are VA, 35% are NNVA, and 60% are NVA[39]. If NVA can be eliminated, then the efficiency of health services can be further improved[39].

In this study, patients coming to get doctor's consultation services were Value-Added (VA) activities. Five service processes are important for service management administration (NNVA), and seven activities are categorized as waste (NVA). Based on Value Analysis Time (VAT), the percentage of service time usage was only 1.43% for VA, and 3.61% was NNVA. Most service time (94.05%) was in form wasting time (NVA). Value-Added Ratio (VAR) is the ratio between value-added activities compared to the activities of the entire service process. This study obtained the ratio from the sum of VA and NNVA activities percentages. The inclusion of NNVA in the VAR calculation because the activity has indirect value for patient care. Thus, the VAR found is only 5.1%. This VAR value is categorized as low because, theoretically, the VAR value should be equal to or more than 30%[34]. The percentage of VAR can be increased by reducing and even eliminating various forms of waste in service. NVA can be eliminated based on its constituent components in Table IV.

TABLE IV
PERCENTAGE OF VA, NVA AND NNVA IN OUTPATIENT SERVICES

No	Activities	Service Time (Hr:Min:Sec)	Percentage (%)
	VA Activities	00:04:49	1,43%
1	Doctor consultation	00:04:49	
	NVA Activities	05:19:55	94,96%
2	Pre-booking	01:00:00	
3	Waiting before queue pick up	00:10:00	
4	Waiting for Registration	00:59:00	
5	Waiting before MR document searching	00:35:09	
6	Waiting for recording on the register system	00:05:12	
7	Waiting before delivering MR documents	00:10:21	
8	Waiting before consulting	02:20:13	
	NNVA Activities	00:12:10	3,61%
9	Get queue number	00:01:00	
10	Administration Process	00:02:24	
11	Searching for MR Documents	00:03:27	
12	Recording on the register system	00:00:41	
13	Delivering MR documents to the polyclinic	00:04:38	
	Lead Time	05:36:54	
	Value-Added Ratio (VAR)		5,10%

This study's waiting time for outpatient services was 5 hours and 4 minutes. The longest waiting time occurred before consulting a doctor (2 hours 20 minutes). The second and third ones were obtained during pre-booking (60 minutes) and before the registration call (59 minutes). The three longest waiting times are related to the absence of a booking system and a doctor's consultation scheduling system. The absence of this system leads to the simultaneous arrival of patients in the morning, so patients experience stagnation and resulting in long waiting times. The main factors causing waiting time are related to the type of appointment system and the link between the informed schedule for starting polyclinic and implemented doctor's consultations [11]. If the appointment system is implemented in health services, patients will come on schedule, so there is no accumulation of patients simultaneously. Patients only need to check-in in and register a few minutes before the schedule. It will impact by eliminating pre-booking activities and reducing waiting times before registration and before consulting a doctor.

Efforts to improve the waiting time for outpatient services need to be prioritized because outpatient services are the main gate of community assessment of hospital services. Outpatient is a service with the highest complaints of dissatisfaction compared to other units in the hospital. This complaint is related to the inaccuracy of service time, inefficiency, and services that have not been oriented to the patient[40]. Services with long waiting times should be reduced to create good performance services. If the waiting time can be reduced, the efficiency of services will benefit the patients, health workers, and management. Service efficiency can be created by implementing lean digitally, which is carried out by standardizing services, automating services, and expediting the flow of service production[38].

D. Service Flow Mapping Before Implementation

Mapping of service activities is carried out based on the Value Stream Map (VSM-current state) to facilitate the evaluation of services and to compare the effectiveness of the intervention program, as shown in Figure 2.

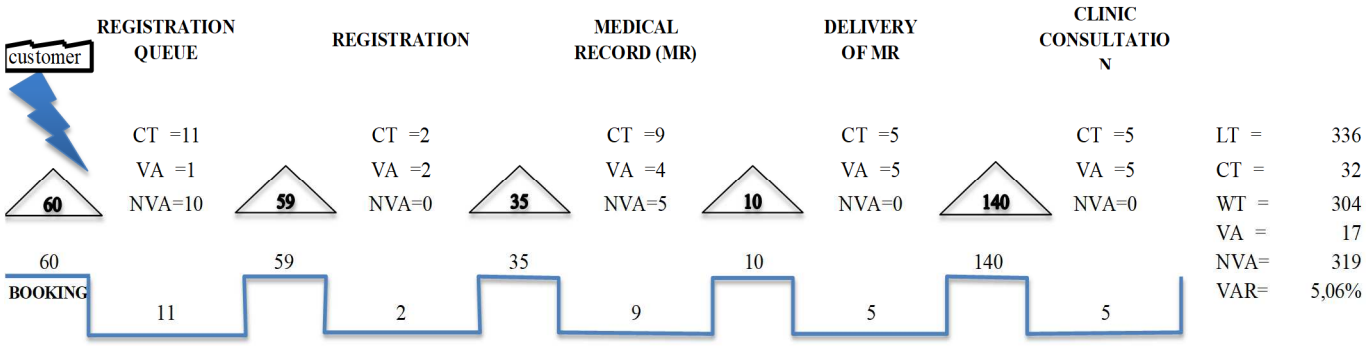

Fig. 2 Outpatient Service Flow Before Implementation (VSM-Current State)

In Fig. 2, service activities and the use of service time are depicted by several symbols. The triangle symbol is the waiting time between the service stages and the next stage, called the NVA. The next NVA occurred in one service stage, where the idle time between one activity and another is in one stage, for example, an idle time before assigning a queue number to the registration queue. Based on Fig. 2, it is known that there are ten stages of outpatient services. They were from pseudo-booking until waiting before consulting and doctor consultation. Lead time is the sum of the time taken from pseudo-booking to leaving the doctor's consultation room. Cycle time is the time to process services in each unit, even though there is an NVA. Waiting time is the sum of the numbers in the triangle sign (NVA between service stages). The total VA in Figure 2 is the sum of the real VA and NNVA, analogous to the description in Table 3 where the VAR value comes from the VA and NNVA percentage. NNVA provides indirect value for service administration. It was an inseparable part of service administration and patient safety because it is related to medical records. Therefore, the calculation of VA is not solely based on direct benefits (consultation) but also on supporting services (administration and medical records). Value Added Ratio (VAR) is 5.1%, resulting from a comparison between VA and LT.

Value Stream Map is a mapping of the flow of services from when the patient makes a booking until the completion of a consultation with a doctor, which is considered an outpatient polyclinic service. VSM describes outpatient services that present service time that can be more easily observed visually. This picture can be used by management in decision-making, and this visual observation is essential for managers with limited time. Efforts to solve the service time problem can be done when the service time is visually described so that easier to understand and explained so that concrete efforts to reduce waiting time with objectively measured indicators can be taken [38].

Based on the depiction of the service production flow with value stream mapping (VSM), an overview of the service process is obtained. Service interventions can be evaluated carefully with process indicators and service times that can be captured quickly visually. Efforts to improve services are carried out by applying the principles of Lean Management by creating an appointment system based on applications created based on applications [9]. Patients are scheduled in a slot time system to avoid long waiting times to consult a physician [11]. The researchers built an integrated outpatient service application to eliminate NVA and reduce NNVA. This application has nine menus: a menu for making appointments, looking for doctors, supporting services, information on hospital services, promotions for hospitals, patient testimonials, medical teleconsultation, menu contact us, and menu statistics for hospitals. Figure 3 displays applications that patients can download on Google Play Store.

Fig.3 Lean-Based Application Menu for Outpatient [9]

E. Service Flow Mapping After Simulation (VSM-Future State)

The application has been designed and disseminated to management, service staff, and patients. The simulation and service mapping are carried out using Value Stream Mapping (VSM Future State), as shown in Figure 4. Figure 4 shows that five service processes are eliminated by using this application: pre-booking services, waiting before registration, searching for medical record documents, waiting before sending medical record documents, and sending medical record documents. The cross in Figure 3 shows the stages of activities that have been successfully removed. The strikethrough (one line) shows the activity stages whose time is reduced to a lower level. Based on Figure 4, it can be seen that the waiting process before registration can be shortened from 59 minutes to 10 minutes because patients come with an appointment system a few minutes before the doctor's

consultation service queue schedule. Through the implementation of Lean Management digitally, the lead time had become shorter than before, which was 39 minutes. The wastage rate was 31 minutes, and the Value-Added-Ratio (VAR) was 20.5%.

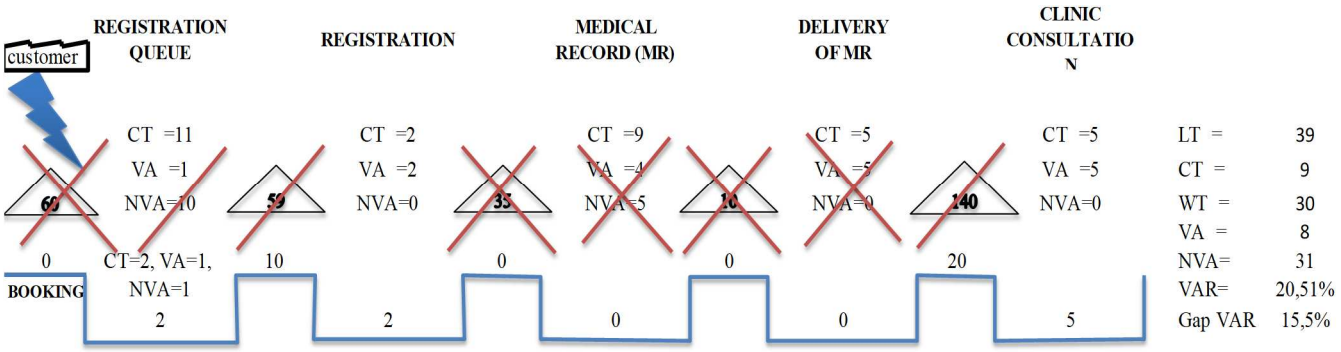

Fig.4 Outpatient Service Flow After Simulation (VSM-Future State)

F. Assessment of the Effectiveness of Digitalization-Lean

Table IV shows the effectiveness of improving service waiting times compared before and after using the application. Based on the VSM Current State comparison in Fig. 1 with the VSM future state in Fig. 4. The service process (lead time) is shortened from 336 minutes to 39 minutes. The wastage rate (NVA), previously 319 minutes, became 31 minutes. There is a decrease in the level of waste by 90.3%, and the previously 5.1% VAR increased to 20.5%.

TABLE V
COMPARISON OF OUTPATIENT SERVICE INDICATORS BEFORE AND AFTER SIMULATION OF DIGITAL-LEAN IMPLEMENTATION

No	Indicator	Before	After	Gap (%)
1	Number of Services Stages	10	5	-50
2	Waiting stages	5	2	-60
3	Lead Time (Minute)	336	39	-88,4
4	Cycle Time (Minute)	32	9	-71,9
5	Waiting Time (Minute)	304	30	-90,1
6	VA Activities (Minute)	17	8	-52,9
7	NVA Activities (Minute)	319	31	-90,3
8	VAR (%)	5,1	20,5	302

The post-implementation evaluation concluded that digital lean in outpatient services could improve service performance by shortening the service process and reducing time wastage. This can be seen from the number of service steps successfully reduced from 10 to 5 steps. It also reduced several stages of waiting, previously five stages, to two stages. Digital Lean also reduced lead time by 88.4%, waiting time (NVA) by 90.1 %, and NNVA activities by 52.9 %. Therefore, Digital Lean can increase Value-Added Ratio (VAR) many as four times, from the previous 5.1% to 20.5%.

In this study, the VAR could not be increased by more than 30% because consultation time could not be extended to more than 5 minutes due to a large number of patients. Efforts can be made to eliminate NVA and reduce NNVA, which has been carried out effectively by digitizing outpatient services based on Lean Management.

The reduction in waiting time will benefit patients related to preventing delays and poor treatment outcomes, and it could prevent jeopardizes for a patient. Moreover, it also reduces service costs burdened hospitals and patients. Lean management in hospitals is a step to improve service efficiency, which has been proven to be better than Total Quality Management (TQM) and the Plan Do, Check, and Action or PDCA approach[34].

The implementation of lean digitally is very important to support the production process. So far, there have been many studies to develop a product, but the development of product delivery processes is still neglected. Lean that is applied digitally can reduce production costs and improve formal and informal communication among people in the production processes [41]. Lean that is applied digitally can improve the performance of outpatient services by accelerating access to service information and communication, supporting services, and assisting management in making decisions regarding service barriers.

The success of implementing Lean digital in hospitals does provide not only benefits for patients but also for hospitals and the community. New digital technologies have brought important changes to individuals, organizations, and society [20]. The vast amount of digital data available is already a new source of value generation. Digital transformation contributes to improving employee performance, product display innovation, and collaboration between organizational units that will enhance service performance in the organization [42].

The challenge of implementing Lean digital arises when hospitals are not accustomed to digital applications in terms of the competence of officers, facilities, infrastructure, and patient readiness, especially in developing countries with low HDI. A lean digital implementation may be successful for developed countries with complete infrastructure, stable internet network, and brainwave familiar with digitization in all aspects. However, there are other considerations in successfully implementing lean digitally in hospitals. First, the high HDI does not determine the success of digitizing services. Mas and Gómez [43] study concluded that higher levels of digital development were not found in countries with the highest HDI. This gives confidence that any country can successfully carry out digital transformation, including countries and communities with low HDI [43].

Second, a government referral hospital can defend itself as a successful hospital incumbent by implementing digitally connected services and choosing the right time to run it. Zhou

et al. [44] assert that incumbents with a solid entrepreneurial orientation in the financial business world can benefit from digitalization. Old organizations in the business world do not improve their performance when they rely on company assets and strong legitimacy without equipping themselves with a digitalization strategy and choosing the right time to implement [44]. The results of this study can be interpreted in terms of health services. The condition of the Covid-19 pandemic that has not ended requires digitally connected services so that waiting times for services can be reduced and the risk of spreading Covid-19 can be minimized. Tortorella et al. (2021) examined the contribution of digital applications to the resilience of healthcare organizations during the COVID-19 outbreak. The digital application is a collection of information and communication technologies used to improve operations in the healthcare value chain. The results show that supply chain-oriented applications and patient diagnosis increase service effectiveness [23]. The analogy of these findings can be applied in assessing the Lean Digital Application applied in this study that Lean Digital can successfully overcome service barriers.

Third, there are strategic implications in the work environment and organizational structure. Baptista et al. [45] stated that the digital transformation process involves humans and their performance and highlights the importance of normative and speculative visions of the future digital/ human configuration so that information systems can contribute to creating desired jobs and organizations[45]. For this reason, it is necessary to change the organizational culture of services in hospitals. Hospitals accustomed to manual services should transform themselves by building an efficient organizational culture using Lean digital. According to Martinez-Caro et al. (2020), successful business digitalization occurs when an organization incorporates a digital organizational culture in its service process [20]. Digital organizational culture is an organizational environment that has implemented and cultivated digital strategies to achieve organizational performance. Digital organizational culture is indispensable for successfully implementing digital services in hospitals. The management needs to respond immediately and form an ecosystem that supports using digital service technology in the form of provisions, standard implementation procedures, supervisory supervision, and performance assessment of digital services for patients. Volberda et al. [46] explain that the role of decision-makers in the digital transformation of an organization is dependent on whether digital migration is evolutionary or transformative and whether the company responds or tries to shape an ecosystem in its implementation [46]. Digital transformation in hospitals requires the commitment of leaders, health workers, and staff in setting service strategies so that the application of lean digital can provide solutions to service problems.

Fourth, hospital management should increase the competencies of health workers and staff in supporting digital services. Ciampi et al. [21] stated that three thematic groups need to be considered, including big data analytic abilities, the relationship between digitalization and agility, and the role of information technology capabilities. These three thematic are very important to improving organizational agility[21]. Hospitals need to manage digital transformation by creating speedy information processing capacity proactively. Li et al. [47] provide empirical evidence to support the idea that firms leverage market agility by managing digital technology relationships with other corporate shareholders by creating superior information processing capacity[47].

The digital competence of hospital management and staff needs to be improved through digital learning. Chanias et al. [48] stated that Digital Transformation Strategy (DTS) is a very dynamic process that involves repetition between learning and doing [48]. Konopik et al. [49] identified seven relevant themes for managing digital transformation, they are, 1) Strategy and ecosystem, 2) Innovation thinking in service, (3) Digital technology transformation, (4) Data, 5) Operations, 6) Organizational design, 7) Digital transformation leadership [49]. The seven themes should be adopted so that digitally applied lean can effectively overcome service barriers in hospitals. Besides that, hospital staff needs to master digital learning in the form of cellular technology, tablets, and smartphone applications that are popular among the public [19]. The hospital management should enhance the time window to operate the system, skill requirements, and working regulations [41], [50]. Furthermore, digital technology needs to change patient behavior as a basis for hospital resilience [51]. Hospital management should focus on socializing and training their patients regarding the digitalization of health services [41]. This study directs hospitals to rethink development strategies for health workers, employees, and patients to anticipate barriers to implementing digital health services in hospitals.

IV. Conclusion

Long waiting times are almost always a problem in every government hospital. Lean management offers an effort to reduce waiting time by eliminating time wastage and reducing time for patient care support activities. Lean digitalization in this study is indicated by the existence of a digital booking system that is integrated with the doctor's practice schedule system in the service application menu. Lean-based service digitalization has effectively eliminated time wastage and reduced time for supporting service activities. This is indicated by the ability to reduce service steps from 10 to 5 steps, waste Waiting from 5 to 2 steps, Lead Time from 336 to 39 minutes (88.4%). Lean-based digitization can increase the Value-Added-Ratio by four times, from the previous 5.1% to 20.5%. This study produces a digital-based service model in the context of implementing the lean management concept in government hospitals which is proven to be effective in reducing waiting time waste. This finding is very meaningful in the current pandemic situation because its ability to reduce waiting times and risk of airborne disease transmission. In the early stages, patients can be served in a hybrid way (digital and traditional way) while setting up competencies, a supportive environment and organizational culture. It is important to advocate the community and the regional government as the owner of the hospital to obtain optimal support in implementing lean digitally health services. It due to the provision of infrastructures, smooth internet access, digital learning for management officers, staffs, and patients. This model is limited to the efficiency of digitizing-Lean management in one hospital. However, this model becomes the basis for research in several government hospitals at a later research stage, so that the efficiency level of using the Lean

Model of Outpatient Digitization can be measured using inferential statistics in several hospitals.

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