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Research Article

Reducing Dispensing Time by Applying the Lean Hospital Approach in the Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang Indonesia

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ABSTRACT

The outpatient pharmacy department is the last service unit visited by patients. One common concern is the delay in receiving medicine. Improvements in medicine dispensing time were made with a lean hospital. This study aims to analyze the impact of lean hospital interventions on waiting times and Value Added Ratio (VAR). This quasi-experiment was conducted with a non-equivalent control group before-after design. The study population included non-compounded medicine prescriptions with out-of-pocket healthcare from April to July 2024. The sample was 1,266 prescriptions. Direct observation gathered data for value stream mapping in non-compounded medicine dispensing, recording time for prescription screening, preparation, final checks, and delivery, including patient education. Activity time was considered value-added time. Value-added time divided by Cycle Time (CT) was used to calculate VAR. Critical waste identified by the root-cause analysis was conducted through in-depth interviews using the fishbone diagram guide. Data before and after intervention were analyzed using the Mann-Whitney U-test. Inventory waste significantly affected dispensing times. The lean hospital strategy improved the efficiency of pharmaceutical services by reducing the dispensing time from 19.68 to 16.18 minutes ($p < 0.001$) and increasing the VAR from 51.34% to 57.21% ($p < 0.001$) with an automated medicine planning system.

INTRODUCTION

The outpatient pharmacy department serves as the final service unit visited by patients and has come under investigation due to several service quality issues leading to patient dissatisfaction. Common challenges include complex procedures that hinder patient navigation, ambiguous information provided by staff, and slow pharmacy services, resulting in extended waiting times for patients to receive their medicine. It is imperative to address these issues to enhance the overall patient experience and satisfaction (Ferdi *et al*., 2023; Sari and Pribadi, 2018; Wulandari *et al*., 2023).

Based on the questionnaire report data from customer service in December 2023, the responsiveness dimension, which includes the speed of medicine delivery, received the lowest score of 9.27. The speed of medicine delivery is the dimension most expected by patients in the pharmacy department. The Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang refers to the Minister of Health Regulation Number 129 of 2008 concerning Minimum Service Standards for Hospitals, which states that the service time for non-compounded medicine should be ≤ 30 minutes and the dispensing time for compounded medicine ≤ 60 minutes. In a preliminary study, the average dispensing time for non-compounded medicine

in January was 22 minutes and 34 seconds, while in February it was 34 minutes and 28 seconds. The achievement of dispensing times by Minimum Service Standards for non-compounded medicine in January was 78.48%, and in February, it was 65.38%. The dispensing time for non-compounded medicine during February, compared to January, experienced a decrease of 13.10%. The increasing dispensing time has led to more patient complaints regarding pharmacy services, indicating a need for quality improvements related to the dispensing times. Improvements in service related to dispensing times in the Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang will use the lean hospital method. The lean hospital approach has effectively reduced the dispensing time for prescription services and increased the Value Added Ratio (VAR) (Nurlaila *et al*., 2022; Yani *et al*., 2022).

The lean hospital approach is a management concept aimed at reducing waste in healthcare services. The lean hospital concept represents a continuous effort to minimize waste and enhance the value-added of products, whether in the form of goods or services, to provide added value to patients. Pharmaceutical services in the Outpatient Pharmacy Departments that provide value-added include prescription reception, patient identification, prescription review, transaction input in the hospital information system, medicine preparation, final checks, medicine delivery, communication, information, and education. Meanwhile, non-value-added activities include prescription services that must wait for the processing, final checks, and medicine delivery. The assessment indicators for lean hospitals are expressed through the VAR, which is obtained by comparing total value-adding time with total cycle time. Services are considered lean if the VAR exceeds 30% (Gasperz and Fontana, 2016).

Waste in lean hospitals is called DOWN TIME, which stands for Defect, Overproduction, Waiting, Non-Utilized Talent, Transporting, Inventory, Motion, and Extra Processing. The most prevalent form of waste associated with dispensing time is inventory, specifically concerning the availability of medicines in the outpatient pharmacy. In January, there were 236 instances where medicine stock was insufficient, which increased to 247 instances in February. This shortage has contributed to extended dispensing times for patients to receive their medicines (Atikah *et al*., 2021; Hammoudeh *et al*., 2021; Yanong *et al*., 2023; Yuganingsih *et al*., 2021).

The lean approach has been widely adopted by hospitals worldwide, yielding numerous benefits, including reduced patient length of stay, enhanced efficiency, increased satisfaction among patients and staff, decreased clinical errors, and shorter dispensing times. This background has motivated the researchers to conduct a study focused on the lean hospital approach to improve the VAR and reduce the dispensing time for medicine (Ferdi *et al*., 2023; Graban, 2012; Graban and Swartz, 2014; Nurlaila *et al*., 2022; Rahayu *et al*., 2020; Sari and Pribadi, 2018; Suryana, 2018; Winarno *et al*., 2022; Wulandari *et al*., 2023; Yani *et al*., 2022; Yuganingsih *et al*., 2021). The lean hospital approach has effectively reduced the lead time for prescription services from 54 minutes and 35 seconds to 39 minutes and 23 seconds, while also decreasing service delays from 44 minutes and 25 seconds to 30 minutes and 1 second. Furthermore, the VAR has increased from 15% to 22.8% (Nurlaila *et al*., 2022). In one setting, following the redesign and implementation of lean pharmacy practices in outpatient pharmacy services in 2022, a significant reduction in dispensing time was achieved, with a p-value of 0.000. The dispensing time decreased by 30 minutes, from 86 to 56 minutes (Yani *et al*., 2022). The implementation of lean thinking to reduce dispensing times for medicine services at the Outpatient Pharmacy Department of Panti Rini Hospital has shown that this approach can also improve the VAR by 24% for compounded prescriptions and by 25% for non-compounded prescriptions (Yanong *et al*., 2023).

Consequently, it is necessary to assess the impact of lean hospital intervention on the VAR and the dispensing time for medicine in the Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang.

METHODS

This quasi-experimental study was conducted with a non-equivalent control group before-and-after design using in-depth interviews. The independent variable was the availability of non-compounded medicine in the Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang. The dependent variables were VAR and total lead time of non-compounded medicine. The VAR is calculated using the following formula:

$$VAR = \frac{VA}{\text{Total } CT}$$

Note: VAR = Value Added Ratio, VA= Value Added, CT = Cycle Time (Arthur, 2011)

The inclusion criteria of the samples were non-compounded medicine prescriptions with out-of-pocket healthcare from April to July 2024 in the Outpatient Pharmacy Department of SMC Telogorejo Hospital in Semarang. Exclusion criteria included non-compounded prescriptions that were after 00:00 due to the need for advance orders, prescriptions that were picked up by delivery services, and abandoned prescriptions. This study protocol was approved by the Institutional Ethics Committee with Ethical Approval No. 379/KEP/EC/UNW/2024 on June 11, 2024. A study permit was obtained from the director of SMC Telogorejo Hospital with number 92888A/TU.710/DIR/K/2024 on March 25, 2024.

Study instruments

The dispensing time worksheet for non-compounded medicine services and the comprehensive interview guide served as the study instruments. The dispensing time worksheet for non-compounded services will yield the specifics of each medicine service procedure, such as the total medicine service time (Cycle Time), value-added time (VA), and non-value-added time (NVA). Cycle Time (CT) refers to the duration of a single stage in the service process, which encompasses both value-added and non-value-added activities such as prescription screening, medicine preparation, final checks medicine delivery and communication, information, and education of the patient about their prescribed medications. The time to start and finish each activity was recorded as value-added time, while the dispensing time for subsequent activities was considered non-value-added. In-depth interviews were conducted with pharmacists who are in charge of shifts at the Outpatient Pharmacy Department to identify the primary root causes of non-compounded medicine in investigating prescriptions, especially critical wastes.

Data Collection Techniques, Samples, and Sampling Techniques

Direct observation was used to collect data to investigate value stream mapping. Value Stream Mapping was conducted through direct observation to record the time in the non-compounded medicine dispensed flow. Data were collected for each process, including prescription screening, medicine preparation, final check, and medicine delivery with communication of information and educating the patient regarding the medicines they should take.

In-depth interviews were used to identify critical wastes that are root problems in the non-compounded medicine prescriptions at the Outpatient Pharmacy Department. The validity of in-depth interview guidelines was tested using the professional judgment of two experts who are relevant to the problem being studied. Interviews were conducted with the three pharmacists who are responsible for shifts at the Outpatient Pharmacy Department.

The determination of the minimum sample size was calculated using Slovin's formula. The sample size found was 633 prescriptions before the intervention (April-May 2024) and 633 prescriptions after the intervention (June-July 2024). The samples were selected using purposive sampling methods.

Data Processing and Data Analysis

Results of the in-depth interviews were transcribed and described word by word, or verbatim. The interview guidelines were based on a fishbone diagram, which is also known as an Ishikawa diagram, and is an instrument to identify and analyze the root cause of problems. People, processes, materials, machines, environment, and methods are the main categories, and each can be subdivided into specific causes for further investigation. The visual instrument does not only assist in identifying fundamental causes but also encourages team cooperation, allowing for the development of effective solutions to improve performance and prevent future issues. The results of the in-depth interviews were classified according to waste categories of the lean hospital approach. Wastes that were considered to have a significant impact on dispensing times were selected for improvement. Data before and after intervention then were analyzed using the Mann-Whitney U-test, with significance defined as a p-value < 0.05.

RESULTS AND DISCUSSION

The study criteria were met by the data on 1,266 prescription sheets obtained through direct observation of the non-compounded medicinal services. They were separated into two groups i.e. before and after intervention. The group before the intervention is shown in Figure 1. The total dispensing time is 25.69 minutes, which encompasses value-added activities (9.38 minutes) and non-value-added activities (16.31 minutes). The value-added activity that requires the most time is prescription screening (4.43

minutes), while the non-value-added activity involves the dispensing time for medicine preparation (4.07 minutes). The summary of the result is shown in figure 1.

The duration of value-added activities during the prescription screening is significantly prolonged, particularly in the areas of patient identification and allergy assessment. This is largely due to prescriptions often being redeemed by family members rather than the patients themselves, which necessitates additional confirmation with the patients. Additionally, the non-value-added dispensing time for medicine preparation increases when multiple prescriptions arrive simultaneously. The VAR for non-compounded medicine dispensing before the intervention is 51.33%. The non-compounded medicine dispensing service is classified as lean because it demonstrates a VAR that exceeds 30%. VAR that exceeds 30% indicates that the Outpatient Pharmacy Department has a well-functioning service process. However, several wastes were identified through in-depth interviews, highlighting the need to improve the effectiveness and timing of non-compounded medicine dispensing, as shown in figure 2.

Based on the results of in-depth interviews with the pharmacists, the root causes of issues in non-compounded medicine dispensing can be classified according to waste categories of the lean hospital approach as follows:

1. Inventory: This category encompasses the minimum and maximum stock levels within the hospital's inventory system, which are updated every three months. Such practices result in inventory calculations that do not accurately reflect actual needs, leading to stock shortages that impede the non-compounded medicine dispensing process.

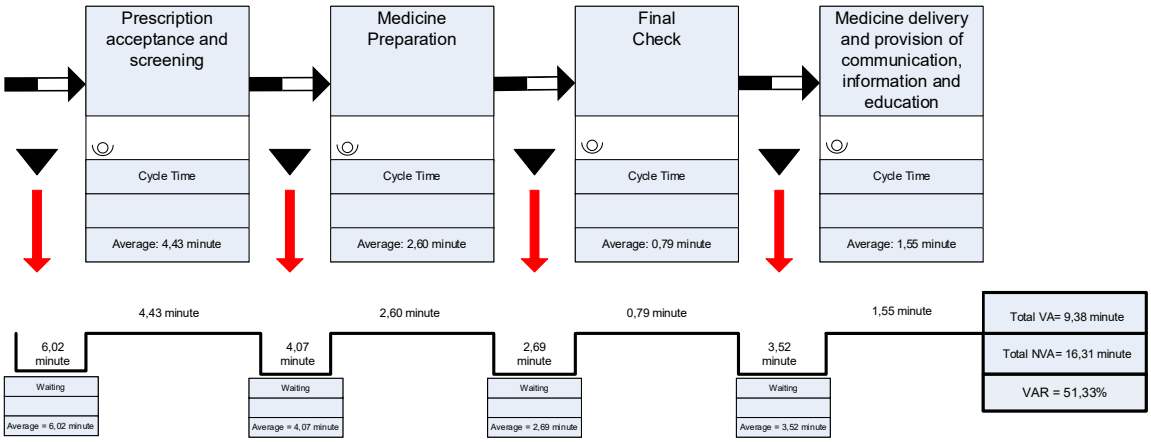


Figure 1. Value Stream Mapping of Non-Compounded Medicine Dispensing Before Intervention.

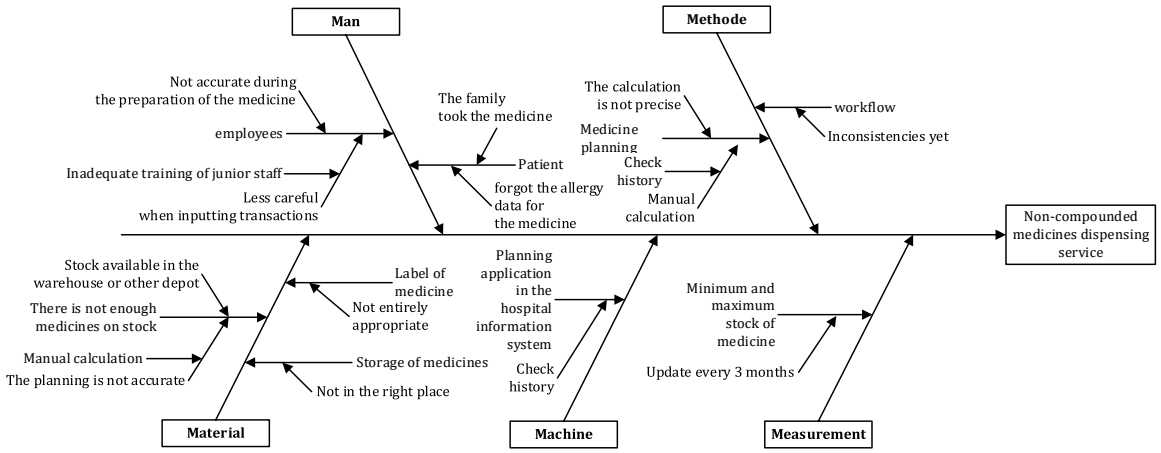


Figure 2. Fishbone Diagram of Non-compounded Medicine Dispensing.

2. Defect: This category includes errors in the input of medicine names, quantities, or usage instructions within the hospital's inventory system, as well as improper labeling processes and the preparation of medicines that do not correspond with prescriptions due to similarities in packaging.
3. Motion: This category pertains to the varied pathways taken by pharmacy staff, which need considerable time to locate medicine, as they are not stored in their designated locations. This situation often requires staff to visit the warehouse to retrieve items that are out of stock.Inventory waste is the waste that most affects dispensing times for non-compounded medicine (Atikah *et al*., 2021; Hammoudeh *et al*., 2021; Yanong *et al*., 2023; Yuganingsih *et al*., 2021)

The availability of medicine plays a crucial role in influencing the waiting time for pharmaceutical services. When medicines are readily accessible, it not only streamlines the dispensing process but also enhances overall patient satisfaction. Conversely, shortages or delays in medicine availability can lead to extended waiting periods, which may negatively affect patient outcomes and the efficiency of healthcare delivery. Therefore, ensuring a consistent supply of medicine is essential for optimizing service delivery in the pharmaceutical sector (Amiruddin *et al*., 2023). The intervention related to inventory waste involves changing the medicine planning system from manual to automated within the hospital information system. The Value Stream Mapping of non-compounded medicine services after the intervention can be seen in Figure 3. The lead time for non-compounded medicine dispensing is 20.75 minutes. After the implementation of lean hospital practices, the lead time decreased by 4.94 minutes (Winarno *et al*., 2022; Yani *et al*., 2022; Yanong *et al*., 2023; Yuganingsih *et al*., 2021). The VAR after the implementation of the lean hospital was 57.20%. The VAR for non-compounded medicine dispensing following the intervention increased by 5.87% (Winarno *et al*., 2022; Yani *et al*., 2022; Yanong *et al*., 2023).

Results from the normality test can be seen in Table 1. The Kolmogorov-Smirnov test indicates that the data were not distributed normally, with a p-value of <0.001 ($p < 0.05$). Consequently, a Mann-Whitney U Test was performed to evaluate the differences in dispensing time and VAR which revealed a p-value of <0.001 ($p < 0.05$).

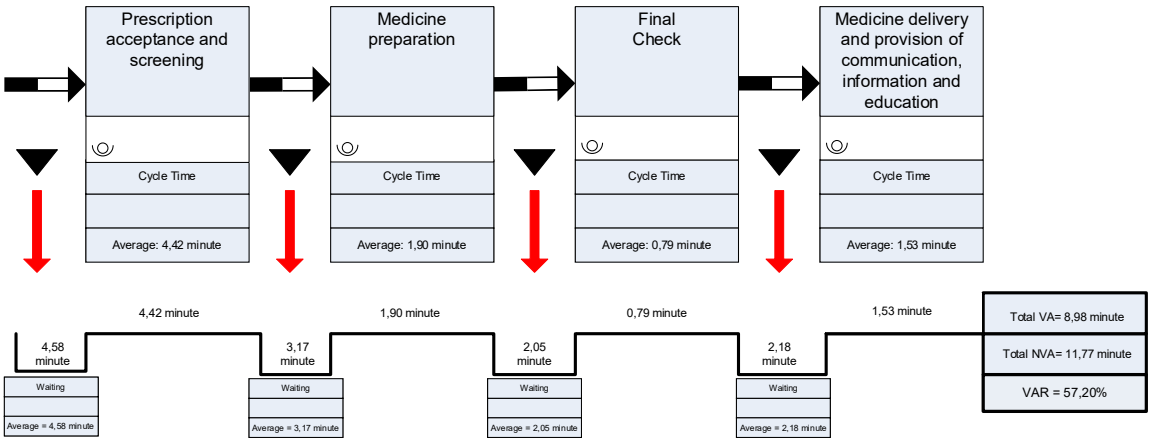


Figure 3. Value Stream Mapping of Non-Compounded Medicine Dispensing After Intervention.

Table 1. Kolmogorov-Smirnov test results

Variable	Group	Mean ± SD	Median (min – max)	*p*
Total CT	Pre	19.68 ± 13.95	17.35 (5.18 – 260.83)	<0.001
	Post	16.18 ± 7.14	14.80 (4.28 – 88.52)	<0.001
VAR	Pre	51.34 ± 19.50	52.40 (6.11 – 94.99)	<0.001
	Post	57.21 ± 17.25	58.24 (9.29 – 99.55)	<0.001

*$p > 0.05$: data normally distributed; CT, cycle time; SD, standard deviation; VAR, value added ratio.

Table 2. Mann-Whitney U test results

Variable	Group		*p*
	Pre	Post	
Total CT	19.68 ± 13.95	16.18 ± 7.14	<0.001*
VAR	51.34 ± 19.50	57.21 ± 17.25	<0.001*

*$p < 0.05$: the differences were statistically significant; CT, cycle time; VAR, value added ratio.

The results of the Mann-Whitney test on VAR and CT are shown in Table 2. The p-value for VAR was <0.001 ($p < 0.05$), and the p-value for CT was <0.001 ($p < 0.05$), both of which indicated a significant difference.

CONCLUSIONS

Defects, motion, and inventory waste are among the wastes that were found during the in-depth interviews. Inventory waste is the waste that most affects dispensing times for non-compounded medicine. The implementation of a medicine planning system, transitioning from a manual process to an automated one within the hospital information system, has successfully reduced dispensing time from 19.68 minutes to 16.18 minutes ($p<0.001$) while simultaneously increasing the VAR from 51.34% to 57.21% ($p<0.001$).

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CONFLICT OF INTEREST

The authors declare there are no conflicts of interest in the study.

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