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The Impact of Lean Management Implementation on Inpatient Discharge Prescription Services at Pertamina Central Hospital

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Abstrak

Latar belakang: Waktu tunggu pelayanan resep pasien rawat inap mempengaruhi proses pemulangan pasien. Pada tahun 2022, waktu tunggu di Apotek Rawat Inap Rumah Sakit Pusat Pertamina bervariasi, sehingga membutuhkan upaya untuk memenuhi target waktu dan memperbaiki waktu pemulangan pasien. Penelitian ini bertujuan untuk mengevaluasi dampak dari *lean management* dalam mengurangi waktu tunggu tersebut. **Metode**: Penelitian ini menggunakan desain penelitian gabungan kuantitatif dan kualitatif dengan pendekatan *action research*. Penelitian ini dilakukan dari tanggal 4 Maret hingga 8 Mei 2023, dengan melibatkan apoteker, tenaga teknis kefarmasian, peracik obat, dan kurir farmasi. Analisis data termasuk mengukur perubahan waktu tunggu sebelum dan sesudah penerapan *lean management* dan analisis naratif dari temuan kualitatif. **Hasil**: Setelah menerapkan *lean management*, waktu tunggu untuk resep yang tidak diracik menurun dari 42,6 menjadi 25 menit, dengan *value added ratio* (VAR) meningkat dari 18,9% menjadi 27%. Untuk resep yang diracik, waktu tunggu turun dari 67 menjadi 45,7 menit, dan VAR naik dari 25,2% menjadi 37,9%. Mann-Whitney U *test* mengkonfirmasi perbedaan yang signifikan dalam waktu tunggu rata-rata. **Kesimpulan**: Penerapan *lean management* pada pelayanan resep pasien rawat inap terbukti dapat memperbaiki waktu tunggu dan meningkatkan efisiensi proses (VAR).

Abstract

Background: The lead time of inpatient discharge prescription services affects the overall discharge process. In 2022, lead times at Pertamina Central Hospital's Inpatient Pharmacy varied, requiring continuous efforts to meet target times and avoid disrupting discharge plans. This research aims to evaluate the impact of lean management on reducing these lead times. **Methods**: The study employs a combined quantitative and qualitative research design with an action research approach. It was conducted from March 4 to May 8, 2023, involving pharmacists, pharmaceutical technical personnel, compounders, and pharmacy couriers. Data analysis included measuring lead time changes pre- and post-lean management implementation and narrative analysis of qualitative findings. **Results**: After implementing lean management, the lead time for non-compounded prescriptions decreased from 42.6 to 25 minutes, with the value-added ratio (VAR) increasing from 18.9% to 27%. For compounded prescriptions, lead time dropped from 67 to 45.7 minutes, and VAR rose from 25.2% to 37.9%. The Mann-Whitney U test confirmed the significant difference in average lead time. **Conclusion:** The implementation of lean management in inpatient discharge prescription services has been proven to improve lead time and increase process efficiency (VAR).

INTRODUCTION

The urgency of optimizing inpatient discharge processes is underscored by the Indonesian Minister of Health's Minimum Service Standards (SPM), which mandate that hospitals provide inpatient billing information within 2 hours—a critical benchmark in the discharge process (1). Pertamina Central Hospital (RSPP) adheres to this standard by prioritizing a maximum 2-hour discharge lead time for inpatient services. Despite this, a significant 32.5% of patients report discharge delays, primarily due to waiting for medications (2). These delays predominantly stem from inefficiencies within the Inpatient Unit and Pharmacy Installation, where tasks such as medication preparation and processing of unused supplies average 48 minutes (3,4). Such delays can be exacerbated by mismatches between staff workload and available personnel, particularly during peak times, as well as ineffective service workflows and facility layouts (5). Factors affecting pharmacy service lead times include the number of pharmaceutical technicians, pharmacy counters, prescription volume, and repeat prescriptions (6).

Addressing these extended lead times requires targeted interventions. Tools like 5S (Sort, Set in Order, Shine, Standardize, Sustain), Value Stream Mapping (VSM), Root Cause Analysis, and Spaghetti Diagrams are recommended to streamline processes (7,8). These tools, central to lean management, focus on reducing cycle times by eliminating waste (9). The precise delineation of value constitutes a critical phase in lean thinking, wherein the production of goods or services that do not accurately align with this value is categorized as waste (10). Lean management is particularly advantageous for hospitals, improving patient flow and enhancing service functions, including pharmacy operations (5).

In 2022, RSPP's inpatient discharge prescription services exhibited considerable variability, with monthly average lead times of 30.9 minutes for non-compounded prescriptions and 55.2 minutes for compounded prescriptions. Notably, March 2022 saw peak lead times of 36.2 minutes and 63.7 minutes, respectively. In response, RSPP has revised its target for non-compounded prescriptions from 40 minutes to 30 minutes to align with hospital service standards. To ensure these targets are met and to prevent delays in patient discharge, it is crucial to evaluate input readiness, value processes, waste, root causes, and potential solutions.

This research aims to investigate the impact of lean management on inpatient discharge prescription services at RSPP's Inpatient Pharmacy (FRI). The objective is to assess whether lean management implementation results in reduced lead times for these services. The hypothesis posits that lead times for inpatient discharge prescription services at FRI RSPP will be shorter following the implementation of lean management practices compared to prior periods.

METHODS

The research methodology integrates both quantitative and qualitative approaches within an action research design. Quantitative data were gathered through the observation of the stages in the service process of inpatient discharge prescriptions (both compounded and non-compounded), recording time, and calculating lead time for prescription services. Qualitative data were obtained from observations, Focus Group Discussions (FGDs), and document studies.

The research was conducted at FRI, the Pharmacy Installation, RSPP, from March 4 to May 8, 2023. The research population comprised all samples of compounded and non-compounded discharge prescriptions for inpatients received during the data collection period, both before and after implementation, selected through consecutive sampling. The inclusion criteria were prescriptions received from Monday to Saturday between 08:00 and 15:59. The exclusion criteria were prescriptions that did not meet the required profile (based on prescription type, prescription service day, and number of prescription items). The sample size was calculated using the hypothesis test formula for the difference in means between two populations (11). This study utilized 104 non-compounded and 26 compounded prescription sheets in each group. Participants for the FGDs were selected purposively.

The research variables included input (facilities and equipment, human resources, prescriptions, standard operating procedures, and quality management tools such as lean management), process (implementation of lean management, stages of the inpatient discharge prescription service process, identification of value, identification of waste, and elimination of waste), and output (lead time and Value Added Ratio/VAR). The tools and materials used included digital clocks, stopwatches, observation sheets, waste grouping sheets, FGD guidelines, recorders, cameras, and researchers.

The observation phase was conducted by the researcher with the assistance of two research assistants trained by lean management experts on the technical aspects of filling out observation sheets and measuring lead time variables, which consist of cycle time (including value-added and non-value-added time), waiting time, and waste at each process stage.

Statistical analysis of the difference in mean lead time was preceded by a normality test; subsequently, the non-parametric Mann Whitney U Test was chosen as the data in both groups were not normally distributed. Qualitative data analysis obtained from observations, FGDs, and document studies was described narratively. This research has received approval from the Ethics Committee of UGM number KE/0381/03/2023.

RESULTS

The results of this study observe and evaluate the implementation of lean management in the processing of discharge prescriptions in the inpatient pharmacy installation as follows:

1. Input

   The facilities and equipment at FRI RSPP generally meet the standards of Ministry of Health Regulation No. 72 of 2016 for Pharmaceutical Services in Hospitals. This includes administrative areas, document storage, distribution rooms, non-sterile production for compounded medications,

supporting facilities, office equipment, computerized systems, and storage facilities.

The Human Resources (HR) at FRI consist of Pharmacists, Pharmaceutical Technical Staff (TTK), compounders, and couriers. Most are TTK (76%), aged 21-30 years (37%), holding a D3 in Pharmacy (76%), and have 1-5 years of tenure (24%). Pharmacists and TTKs alternately handle outpatient prescriptions with a team composition of 1 Pharmacist and 5-7 TTKs (1-2 receiving/entry staff, 1 confirmation/re-checking staff for prescription I, 1 filling staff, 1-2 packaging staff, and 1 re-checking staff for prescription II).

During the observation period at FRI, an average of 606 prescriptions were served per day, with 36 prescriptions (5.9%) for outpatient discharges. There are 129 Standard Operating Procedures (SOPs), including the SOP for Outpatient Discharge Prescriptions, which are periodically revised to reflect current needs and conditions.

RSPP is fully accredited and has a quality management system. Commonly used quality management tools include Root Cause Analysis (RCA), Failure Mode Effect Analysis (FMEA), and Plan Do Check Act (PDCA). Although Kaizen, a lean management tool, was previously used in unit competitions at RSPP, its implementation was not sustained.

2. Customer value

The customer value at each stage of the outpatient discharge prescription service is defined and visualized using the Supplier, Input, Process, Output, Customer (SIPOC) diagram. The affinity diagram illustrates the Voice of Customer (VoC), which includes aspects such as prescription lead time that does not disrupt the patient's discharge schedule, avoidance of medication errors, availability of the prescribed medication, and fulfillment of additional required services

3. Stages of the inpatient discharge prescription service process

A Gemba walk or observation prior to the implementation of lean management was conducted on the 8 stages of the outpatient discharge prescription service flow in the FRI room, which are: a. Reception, b. Entry, c. Confirmation, d. Filling, e. Packaging and Compounding of Medications (specifically for compounded prescriptions), f. Re-check I, g. Re-check II, h. The pharmacy courier is ready to deliver the medication or the pharmacy staff has informed the nurse that the medication is ready.

4. Observation results of lead time for inpatient discharge prescription services before lean management implementation were 18.9% for non-compounded prescriptions and 25.2% for compounded prescriptions.

5. Current value stream mapping (c-vsm) of inpatient discharge prescription services

The Current Value Stream Mapping (C-VSM) for non-compounded prescriptions indicates that the lead time for inpatient discharge prescription services is 42.6 minutes with a Value Added Ratio (VAR) of 18.9% (Figure 1). The C-VSM for compounded prescriptions shows a lead time of 67 minutes with a VAR of 25.2% (Figure 2). For both non-compounded and compounded prescriptions, the longest waiting time occurs after the second prescription re-check stage until the courier is ready to deliver the medication or the pharmacy staff informs the nurse that the medication is ready, reaching 9.5 minutes and 7.4 minutes, respectively

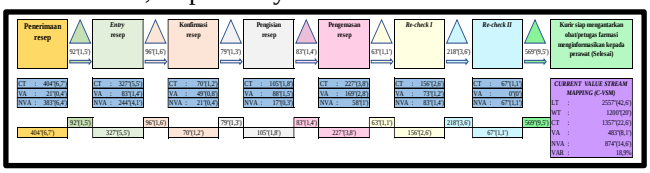

Figure 1. Current Value Stream Mapping (C-VSM) of Non-Compounded Prescription Services for Inpatient Discharge

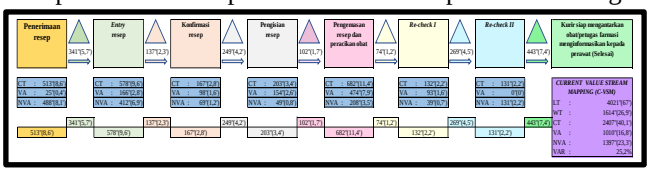

Figure 2. Current Value Stream Mapping (C-VSM) of Compounded Prescription Services for Inpatient Discharge

6. Identification results of waste and root cause analysis

The results of the waste identification were categorized and analyzed using the DOWNTIME framework (Defect, Over Production, Waiting, Non-Utilized Talent, Transportation, Inventory, Motion, Extra Processing). The types of waste identified in the prescription services, both for non-compounded and compounded prescriptions, include defects, waiting, motion, and extra processing. Among these, motion was identified as the most frequent type of waste, occurring 1,031 times in total, with 779 instances in non-compounded prescriptions and 252 in compounded prescriptions.

The root cause analysis of waste was conducted using the Five Whys method on the top ten most frequently occurring wastes across the total sample of non-compounded and compounded prescriptions. These include: 1) Waiting for staff to finish communication via direct communication, telephone, WhatsApp, or waiting for the call to be answered. 2) Re-checking medications belonging to patients at the entry, confirmation, and packaging stages. 3) Waiting for

medications to be collected by couriers or staff making calls to the inpatient ward because the staff is occupied with prescriptions or other tasks. 4) Walking from the entry section to the prescription confirmation section (14 steps). 5) Walking from the confirmation section to the prescription filling section (7 steps). 6) Walking from the filling section to the prescription packaging section (14 steps). 7) Walking from the packaging section to the re-check prescription I section (8 steps). 8) Walking from the re-check prescription I section to the re-check prescription II section (10 steps). 9) Re-checking packaged medications at re-check II (which had already been done at re-check I). 10) Waiting for prescriptions to be processed because staff are not on standby, are working on prescriptions or other tasks, or because prescriptions are not immediately forwarded to the next stage.

7. Solution ideas for addressing waste and prioritizing their implementation

   Solution ideas were formulated to address the 66 types of waste identified and were prioritized for action using the PICK chart tool, which assesses both impact and ease of implementation. The PICK chart is divided into four categories:

   a. Possible: Solutions that have low impact and are easy to implement. b. Implement: Solutions that have high impact and are easy to implement. c. Challenge: Solutions that have high impact but are difficult to implement. d. Kill: Solutions that have low impact and are difficult to implement.

8. Implementation of the selected solution idea

   In this study, 23 solution ideas categorized as "Implement" and "Possible" were executed, including:

   a. Relocating the prescription confirmation to the final stage of the prescription service, serving also as a re-check before medication delivery, and providing information to nurses to reduce motion and extra processing waste.

   b. Eliminating the second re-check stage to reduce extra processing and waiting waste.

   c. Implementing the 5S methodology (Sort, Set in Order, Shine, Standardize, and Sustain) to minimize motion waste.

   d. Introducing visual management, such as providing dedicated storage boxes for packaging materials and pink baskets, to reduce motion waste.

   e. On holidays, having prescription confirmation staff directly call the inpatient ward to inform that the prescription is ready to reduce waiting waste.

   f. Educating staff on the importance of value from the outset to ensure that every stage aims to avoid errors, thereby reducing defect waste.

9. Stages of the prescription service process for discharged inpatients

   A Gemba walk, or observation following the implementation of lean management, was conducted on the 6 stages of the patient discharge prescription service flow. This flow was streamlined compared to the pre-lean management process: specifically, the prescription confirmation stage was moved to the end of the service as a re-check, and the second re-check stage was eliminated.

10. Results of observing lead time in prescription services for discharged inpatients following lean management implementation

    The lead time for data, cycle time (including both value-added and non-value-added time), and waiting time for both non-compounded and compounded prescription services, as observed following the implementation of lean management, were 27% for non-compounded prescriptions and 37.9% for compounded prescriptions.

11. Future value stream mapping (F-VSM) of prescription services for discharged inpatients

    The Future Value Stream Mapping (F-VSM) for non-compounded prescriptions indicates that the lead time for patient discharge prescription services is 25 minutes with a Value-Added Ratio (VAR) of 27% (see Figure 3). The F-VSM for compounded prescriptions shows a lead time of 45.7 minutes with a VAR of 37.9% (see Figure 4). In both non-compounded and compounded prescriptions, the longest waiting times occur after the confirmation and re-check stages, until the courier is ready to deliver the medication or the pharmacy staff informs the nurse that the medication has been prepared. These waiting times are 3.3 minutes and 4.1 minutes, respectively.

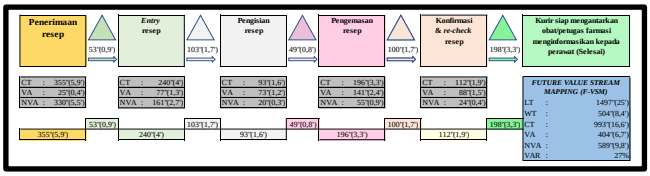

Figure 3. Future Value Stream Mapping (F-VSM) for Non-Compounded Prescription Services for Patient Discharge

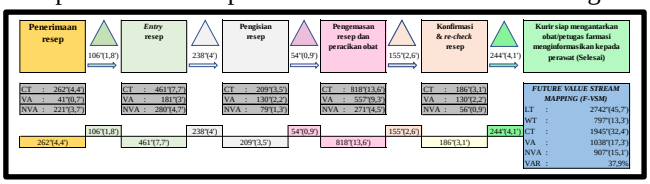

Figure 4. Future Value Stream Mapping (F-VSM) for Compounded Prescription Services for Patient Discharge

12. Results of data analysis before and after lean management implementation

    The normality test for non-compounded prescription data was conducted using the Kolmogorov-Smirnov test, given that the sample size for each population was 104 (>50). For compounded prescriptions, the Shapiro-Wilk test

was used due to the sample size being 26 ($n \leq 50$). The results indicated that both data groups were not normally distributed, with a P = < 0.05. The Mann-Whitney U test was employed to assess the significance of the average lead time between the two non-normally distributed data groups. The SPSS output revealed that the average lead times for both non-compounded and compounded prescriptions had a P = < 0.05, indicating a significant reduction in lead time between the periods before and after the implementation of lean management (see Table 1)

Table 1. Results of the Mann-Whitney U Test for Non-Compounded and Compounded Prescriptions Before and After Lean Management Implementation

Description	n (Sample size)	*Mean Rank*	*P-value*
Lead time for non-compounded prescriptions			
Before implementation	104	131,4	< 0,05
After implementation	104	77,6	
Lead time for compounded prescriptions			
Before implementation	26	32,5	< 0,05
After implementation	26	20,5	

The lead time for prescriptions obtained from the information system (SIM) is faster compared to the observational results, both for non-compounded and compounded prescriptions before and after the implementation of lean management. Electronic prescription lead times are generally longer than those for manual prescriptions, except for non-compounded prescriptions before the implementation of lean management.

DISCUSSION

The various facilities and equipment in the Inpatient Pharmacy at RSPP need to be utilized optimally to prevent waste, which can reduce the efficiency of pharmaceutical services. By employing one of the lean tools, specifically 5S, it is highly possible that these facilities and equipment will support efforts to reduce waste, such as minimizing the activities of searching, sorting, walking, and other additional movements (5).

The success or depth of the implementation of lean management in the discharge prescription services for inpatients can be more easily achieved when various input standards are met. One of the keys to the successful implementation of lean management is the availability of sufficient time and committed resources for improvement, including financial resources and, most importantly, well-trained and dedicated individuals (12).

The implementation of lean management in the inpatient discharge prescription services at FRI RSPP began with the deployment of lean management in line with the operational conditions of the Pharmacy Installation. This aims to raise staff awareness about waste and value in a process (13).

Based on the SIPOC produced, pharmacy staff at each stage of prescription service desire value in the form of the accuracy of prescriptions processed from the previous stage. Near misses (Near Miss Incidents/NMI) in the dispensing stage or dispensing errors can occur at every stage of prescription processing. Proper dispensing procedures are essential to ensure that errors can be detected and corrected at all stages of the dispensing process (14).

The Current Value Stream Mapping (C-VSM) shows that the longest waiting time occurs after the second re-check stage. This is because the two available pharmacy couriers are mostly mobile across all inpatient floors to deliver medication needs, both for discharges and non-discharges, causing discharge medication deliveries to wait for the couriers to return to the FRI room. Outside the couriers' working hours (outside working days and hours), the waiting time after the second re-check is also long due to the limited number of pharmacy staff.

The DOWNTIME analysis results for both compounded and non-compounded prescriptions indicate that extra processing in the prescription entry stage is the most frequent waste item. This is related to the limitations of the SIM menu, which requires staff to re-check the remaining medication entries made by the floor pharmacy staff, substitute the prescription item codes selected by doctors, re-enter compounded components prescribed by doctors, or perform more clicks due to the impractical SIM display when multiple menus are needed simultaneously on one screen. A well-managed Information Management System in the pharmacy ensures smooth patient and medication data retrieval, thereby speeding up lead time and shortening patient service processes (15).

The PICK chart indicates that various solution ideas related to Information Technology (IT) and additional human resources fall into the challenge category (high impact and difficult to implement). Many improvements to the SIM menu are needed to reduce waste and significantly impact the lead time of discharge prescription services. However, currently, requests for menu additions or improvements have a long queue time in the IT department, making these solutions unimplementable in the near future. The solution for additional human resources still requires a comprehensive workload assessment, as the hospital is actively pursuing efficiency measures.

Various solutions to reduce the lead time of prescription services and minimize the difference between the lead time data obtained from SIM and observation results were carried out in this study. The SIM waiting time calculation ends when the staff clicks re-check (re-check I staff), while before lean management implementation, after the lead time was stopped in SIM, the prescription still had to wait for the second re-check, completion of the second re-check, and until the courier was ready to deliver the medication to the floor or the pharmacy staff informed the

nurse, either directly or by phone. Reducing non-value-added lead time, no matter how small, is significant in the lean concept, including reducing waiting time and performing the second re-check.

The prescription confirmation stage immediately after prescription entry was based on administrative directives from several years ago due to the need for immediate patient billing reporting to the guarantor (unable to wait for the medication to be prepared). However, the current work system of administrative staff has changed, where billing to the guarantor is done only after the medication arrives on the ward. Therefore, the solution to move the prescription confirmation to the final stage of the prescription service, simultaneously as a prescription re-check before medication delivery/informing the nurse, was implemented.

The second re-check stage was added after the first re-check due to a dispensing error that occurred at FRI. From a lean perspective, inspection steps can be categorized as necessary waste due to imperfect and error-prone processes, but for patients, it adds no value. Lean thinkers will always strive to find ways to prevent errors rather than using inspection or re-checking to find them after they occur (5).

Eliminating the second re-check stage was chosen as a solution to address waste, considering that the need for re-checking the packaged medication according to the prescription has been fulfilled in the first re-check stage. Combining the confirmation stage with the first re-check and eliminating the second re-check reduces the workload of staff, thereby minimizing the potential for dispensing errors. Of the several solution ideas implemented, three solutions were deemed by researchers to have a significant impact on reducing the lead time of prescription services:

1. Moving the prescription confirmation to the final stage of the prescription service, simultaneously as a prescription re-check before medication delivery/informing the nurse.
2. Eliminating the second re-check stage.
3. On holidays, prescription confirmation staff directly call the ward to inform them that the discharge prescription has been completed.

The implementation of lean management improves lead time and increases the efficiency of the discharge prescription service process (VAR) at FRI RSPP. These results align with various previous publications that have proven that the implementation of lean management can eliminate waste and improve lead time in pharmaceutical services (16).

The lead time for prescriptions obtained from SIM is faster than observation results, both for non-compounded and compounded prescriptions before and after lean management implementation, due to a more streamlined process stage for remaining medication entries by floor pharmacy staff for manual prescriptions.

The lead time for electronic prescriptions is longer compared to manual prescriptions, except for non-compounded prescriptions before lean management implementation, due to several unrecorded stages in the discharge prescription service process in SIM.

CONCLUSION

In terms of input, FRI RSPP has successfully implemented lean management. The primary customer value (patients) in the inpatient discharge prescription service process includes a lead time that does not interfere with the patient's discharge schedule, avoidance of medication errors, availability of prescribed medications, and fulfillment of any additional required services. The value for pharmacy staff is the accuracy of prescriptions processed from the previous stage. The implementation of lean management has streamlined the inpatient discharge prescription service flow from 8 stages to 6 stages. The types of waste identified include defects, waiting, motion, and extra processing. The lean management tools most frequently used for solution implementation were 5S and visual management. The implementation of lean management has improved the lead time and increased the efficiency of the inpatient discharge prescription service process (VAR) at FRI.

Further observation is required for the stages of the inpatient discharge prescription service process that occur outside of working hours, outside the FRI room, and those that occur in parallel, to identify waste and provide solutions to address it. Improvements to the SIM are needed to better accommodate the recording of lead time. Enhancements to the SIM are necessary to expedite the lead time of the inpatient discharge prescription service. Continuous implementation of lean management is required to address the waste that still occurs.

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