JOURNAL OF AGROMEDICINE AND MEDICAL SCIENCES (AMS) ISSN: 2460-9048 (Print), ISSN: 2714-5654 (Electronic)
Available online at https://jams.jurnal.unej.ac.id/index.php/JAMS

Drug Inventory Management With A System Approach to Overcome Drug Inventory Inefficiencies in Hospital Pharmacy Installations

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Article Info

Article History:
Received: December 07, 2024
Accepted: February 13, 2025
Published: May 21, 2025

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How to cite this article:

Triwiranto, Abu Khoiri, Firman. (2024). Drug Inventory Management with A System Approach To Overcome Drug Inventory Inefficiencies In Hospital Pharmacy Installations. *Journal of Agromedicine and Medical Sciences 11 (1): 13-19*

https://doi.org/10.19184/ams.v11i1.53306

Abstract

Hospital is a health service institution that provides complete individual health serv providing inpatient, outpatient and emergency services. One of the non-medical ser that plays an important role in medical support is pharmaceutical serv Pharmaceutical services are very important for hospitals because they are suppo services that become cost centers and revenue centers. Pharmacy installations re good drug management so they can provide effective and efficient serv Management efforts that can be taken are to carry out pharmaceutical log management using a systems approach. The aim of the research is to examine management in hospital pharmacy installations using a systems approach. This rese is qualitative research with a case study approach. The results show that the i components that hinder the drug inventory management process at Hospital X inc human elements (lack of pharmacists and knowledge of health workers), money (d in drug payments waiting for the budget to come down), material (lack of facilities infrastructure, non-ergonomic room layout), method (non-compliance of officers SOP), machine (incomplete SIMRS features and random errors), and market (compl from patients who do not get drugs at Hospital X). Meanwhile, waste in the inventory management process consists of defects (miscalculation of supplies needs, non-ergonomic room layout, and mismatch between real stock, manual s opname, and SIMRS stock opname), overproduction (there are repeated checks a depot due to inconsistencies with SIMRS), waiting (the process of waiting for drugs the distributor and there is a waiting time for the BLUD budget to decre transportation (the capacity of facilities and infrastructure is inadequate so tha distribution process is repeated), inventory (manual stock opname results in was paper and stationery and storage of used and unused drugs in one room), motion hospital must purchase drugs from partner pharmacies if there is an empty stock), e processing (the use of SIMRS for stock opname is less than optimal because it is semi-conventional with manual stock opname).

Keywords: drug management, pharmaceutical installation, hospital, system.

Introduction

A hospital is a healthcare institution that provides comprehensive individual healthcare services, including inpatient, outpatient, and emergency care (Taha et al., 2021). As a healthcare provider, hospitals are required to deliver services that meet established standards and are of high quality. Hospitals offer various types of services, including medical and supporting medical services, nursing and midwifery services, and non-medical services (Permenkes RI, 2016). One important non-medical service that plays a vital role in medical support is pharmacy services (Indrayanti et al., 2020).

Pharmacy services are crucial for hospitals as they serve as both a cost center and a revenue center (Indrayanti et al., 2020). It is shown that 50% of the hospital's total income comes from the management of pharmacy supplies. If pharmacy services are not managed well, they can lead to financial losses for the hospital, evidenced by a decline in revenue (Indrayanti et al., 2020). Losses that may arise from poorly managed pharmacy

installations include inefficiencies in drug inventory. Inventory inefficiency refers to the wastage of drug supplies, characterized by excess stock of certain medications while other types experience shortages (Taufiqurrohman et al., 2021).

Hospital X had a pharmacy installation that served to meet the medication needs of the hospital. Preliminary study results from interviews with medical service and support staff indicated that the hospital frequently encountered issues with drug inventory. These issues included shortages of fast-moving medications while simultaneously having excess stock of slow-moving drugs. Data obtained from Hospital X's pharmacy installation showed that there were stock shortages during the first quarter of 2023. In January 2023, there were shortages of 21 types of medications, including zinc syrup, antacid syrup, clobetasol, gabapentin, laxadine, and phytonadione. In February 2023, there were shortages of 7 types of medications, including furosemide tablets, miniaspi, and cathejel. Stock shortages also occurred in March 2023 for 7 types of medications, including lactulose syrup, furosemide tablets, pulmicort, and laxadine syrup.

Research by Day et al. (2020) indicates that logistics management in the pharmacy installation of Waibakul Regional Hospital in Sumba Tengah faced shortages and stockouts due to medication usage exceeding the amounts planned by the hospital. In addition to medication shortages, there were also excess supplies and a number of expired medications (Day et al., 2020). A similar situation was experienced by Dumai City Regional Hospital in 2021, which encountered significant drug shortages caused by several factors, including insufficient budgets, planning errors, procurement issues, and limitations in the quantity and types of medications available in the market. The amount of expired medications was also substantial, leading to the disposal of drugs amounting to Rp. 139,146,851 in 2021 (Siska & Jepisah, 2022).

Efforts to maintain medication availability were closely linked to pharmaceutical management activities guided by logistics management principles (Satrianegara et al., 2018). This logistics management operated within a system where all elements were interconnected and continuous (Azwar, 2018). Logistics management could be analyzed using a systems approach, which included components such as input, process, output, feedback, impact, and environment (Azwar, 2018). The input elements in pharmaceutical logistics management might include human resources, budgets, and policies (Fitriani et al., 2019). The process in the pharmacy installation consisted of logistics management elements, including planning, organizing, directing, and controlling functions (Siska & Jepisah, 2022). These management elements could be further detailed according to Minister of Health Regulation No. 72 of 2016, which covers selection, planning, procurement, receiving, storage, distribution, recall and disposal, control, and administration.

Methods

This type of research falls under qualitative research with a case study approach. The research location was at Hospital X. The research informants consisted of key informants (the head of the pharmacy installation at Hospital X in Jember), primary informants (junior healthcare administrators in service and medical support at Hospital X in Jember), and additional informants (staff responsible at the logistics warehouse of pharmacy, outpatient pharmacy, central surgical pharmacy, and emergency pharmacy). Data collection instruments included human instruments, interview guides, and observation sheets. Data collection techniques involved in-depth interviews and documentation studies. Data credibility was ensured through triangulation, and dependability was established through expert validation. The ethical test was carried out at the Health Research Ethics Committee of dentistry faculty Jember University No. 2315/UN25.8/KEPK/DL/2023 on November 6, 2023

Results

Identification of Waste in the Drug Inventory Management Process of Hospital X

The results of interviews with 7 informants related to the input, process, and output elements identified the presence of waste that caused inefficiencies in drug inventory at Hospital X, as presented in Table 1.

Table 1 Identification of waste

No.	Kind of *Waste*	*Waste* found
1.	*Defects* (errors)	a. The calculations were still done manually and were not yet automated, making them prone to errors. b. The room layout still included a prayer area within the pharmacy depot. c. The discrepancy between actual stock, manual stock- taking, and SIMRS stock- taking was due to lack of *real-time* input d. The policy regarding the use of selected drugs had been changing frequently. e. Some depots did not yet have administrative staff, resulting in *double duty* in providing services and handling administration tasks.
2.	*Overproduction* (repetition/ excess of needs)	a. Repeated checks by the depot were still happening, although they should already align with the request submitted through SIMRS.
3.	*Waiting* (process of waiting)	a. Waiting for drugs to arrive from distributors due to pending for the distribution license number (NIE) b. Waiting for the BLUD budget allocation to be released.
4.	*Non-utilized talent*	-
5.	*Transportation* (means of transportation/distribution)	a. The repeated movement of trolleys during distribution occurred b. The distance between the warehouse and the depot was quite far.
6.	*Inventory*	a. Manual stocktaking resulted in waste due to paper and stationery use. b. The storage of unused (expired/damaged) drugs awaiting destruction took up space needed for usable drug supplies.
7.	*Motion* (movement of staff resources)	a. The hospital purchased drugs from partner pharmacies and informed patients to return to collect their medications once available.
8.	*Extra- processing* (additional processing that has no value)	a. Submissions through the bottom-up process were still done manually and took time. b. The use of the Integrated Hospital Management System (SIMRS) for stocktaking was not optimal, resulting in it being done twice (manually and in SIMRS).

Identification of Root Causes of Problems in the Drug Inventory Management Process of Hospital X

The waste that was discovered was then subjected to a root cause analysis (RCA). Root Cause Analysis (RCA) was a structured approach to identify the factors that influenced one or more past events in order to improve performance (De Fretes, 2022). One method used to illustrate the root of the problem was the 5 Whys and fishbone diagram. The root causes of problems in the management of drug inventory at Hospital X were analyzed in Table 2 as follows.

Table 2. Root Causes of Problems in the Drug Inventory Management Process of Hospital X

Why 1		**Why 2**		**Why 3**		**Why 4**		**Why 5**	
Why	**Because**	**Why**	**Because**	**Why**	**Because**	**Why**	**Because**	**Why**	**Because**
Why did stockouts and excess stock of medication occur?	Because the calculation of needs and remaining stock of medication was inaccurate	Why did errors in calculating remaining stock and medication needs happen?	Because there was a discrepancy between the actual stock and the stock in the system (SIMRS).	Why did discrepancies between actual stock and the system occur?	Because stock taking was conducted using two methods: manual and in SIMRS.	Why was stock taking done with two methods?	Because the system experienced random errors and could not report in real time.	Why did the system have random errors and fail to report in real time?	Because there had not been an evaluation and correction of the random errors, and additional management features that could assist in calculating stock needs had not been implemented, resulting in frequent inaccuracies in the data used for medication needs calculations.
Why did the workload for pharmacy staff increase?	Because there was a shortage of pharmacy personnel, particularly in administrative tasks.	Why was there a shortage of pharmacy personnel?	Because a job analysis for the needed pharmacy staff had not been conducted.	Why had a job analysis not been done?	Because the managerial capacity of human resources was still lacking.	Why was the managerial capacity of human resources lacking?	Because training related to management for staff had not been provided.	Why had managerial training not been conducted?	Because there had been no priority given to training and capacity development for human resources.
Why did the distribution process to the depot take a long time and require repetition?	Because the capacity of the trolleys used was insufficient, necessitating repeated trips that consumed time	Why was the trolley capacity insufficient?	Because several trolleys were damaged.	Why were there damaged trolleys?	Because there was a lack of maintenance and oversight by the staff.	Why was there a lack of oversight and maintenance?	Because compliance with standard operating procedures (SOP) was low, and the methods for controlling the condition of facilities and infrastructure were inadequate.	Why did this happen?	Because there was a lack of capacity among human resources related to the maintenance and control of facilities and infrastructure.
Why did delays occur in the procurement process for medication?	Because they were waiting for payment processing from the available budget during the medication procurement.	Why was there a delay in payment to the distributor?	Because there was a delay in the disbursement of BLUD funds.	Why did the disbursement of funds get delayed?	Because there was a delay in preparing the SPJ, which affected budget disbursement.	Why was there a delay in preparing the SPJ?	Because the mechanisms for fund disbursement and SPJ involved various parties, such as PPK and PPTK, in completing the SPJ.	Why did this happen?	Because there was a lack of coordination among procurement, finance, and other involved units.
Why did unused medication accumulate in the warehouse?	Because there was no transit space for newly arrived medication and space for unused medication.	Why was there no transit space and no space for unused medication?	Because the storage flow for medication and medication designated for disposal was believed to be able to be streamlined into one room.	Why could room efficiency not be achieved?	Because the layout of the room had not been arranged.	Why had the room layout not been organized?	Because the service process continued and there was a shortage of staff involved.	Why was that?	Because the available staff did not have the knowledge and capacity for organizing the medication storage layout.

Based on the analysis of the root causes of the problem, the sources or causes were identified from the input factors in the management of medication at the pharmacy installation of Hospital X. The root issues from these various input factors were classified and illustrated in a fishbone diagram as Figure 1.

After creating the fishbone diagram, the next step was to determine the priorities of the root problems in the service process using the USG method. The USG method was one way to establish the order of priority for issues through scoring techniques, considering the urgency, seriousness, and growth of each identified root problem (Syahrani et al., 2019). The results of the USG through a Focus Group Discussion (FGD) were presented in the Table 3.

Improvements Proposal to Minimize Waste in the Drug Inventory Management Process at Hospital X

The next stage was to analyze each prioritized root problem to find solutions, determined through brainstorming with relevant parties to identify various alternative solutions. The improvement proposals in medication inventory management at Hospital X were presented using a PICK diagram to reduce waste and inefficiencies in medication supply as Figure 2.

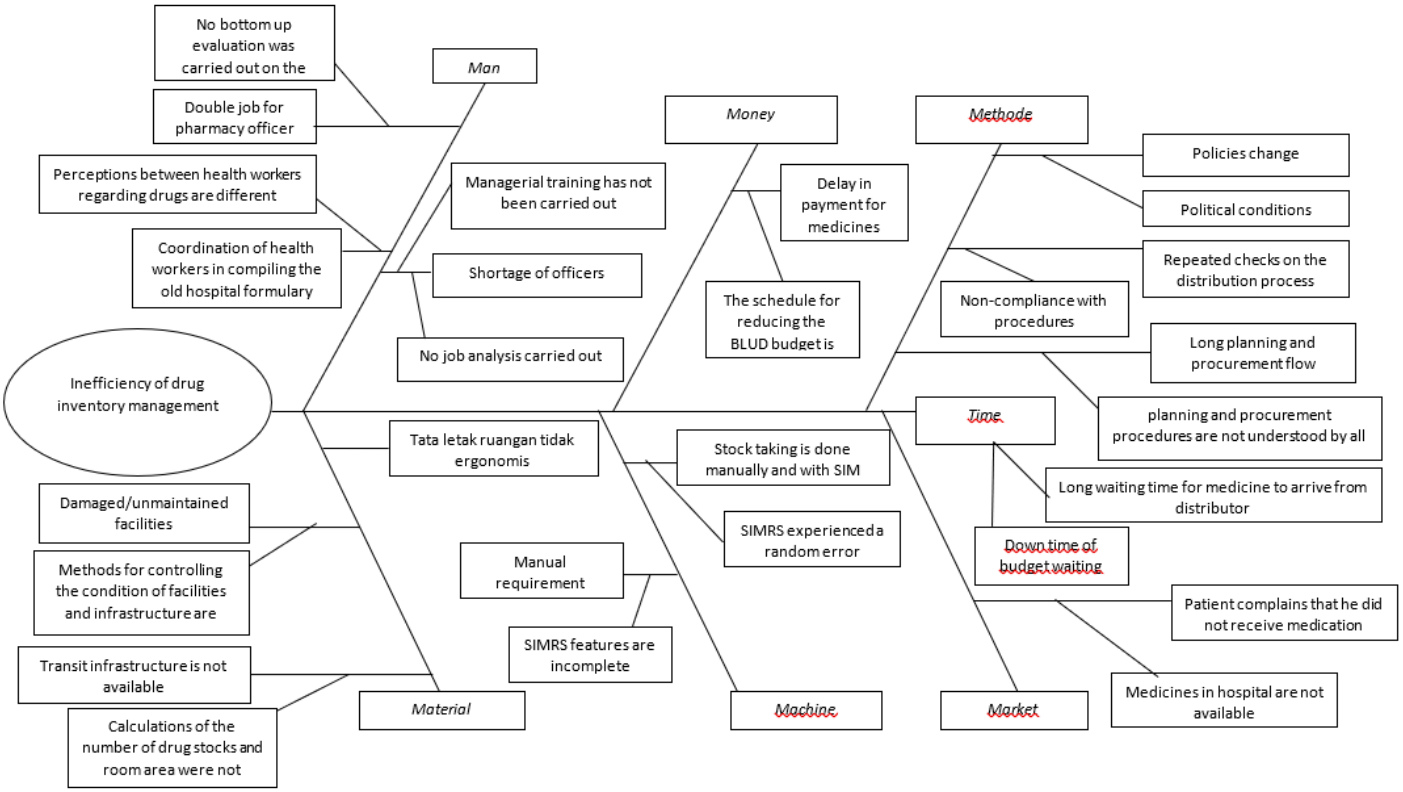

Figure 1 Fishbone Diagram

Table 3. Priority identification of drug management

No.	Problems	U	S	G	Total	Rank
1.	The perception of healthcare workers regarding certain medications differed, causing delays in the selection and planning of needs.	3	4	4	11	9
2.	A shortage of staff led to *double jobs.*	4	3	4	11	10
3.	Delays in payments due to uncertain reductions in the BLUD budget.	5	5	5	15	1
4.	Changing policies on medication usage.	4	4	4	12	7
5.	Non-compliance of personnel in executing service Standard Operating Procedures (SOPs) led to repeated checks.	4	4	4	12	6
6.	The medication management flow was not understood by all parties, necessitating socialization.	3	3	3	9	11
7.	The layout of the pharmacy was not ergonomic.	4	4	4	12	5
8.	The distribution facilities were poorly maintained (damaged) and incomplete (lacking cooler boxes, trolleys, etc.).	3	5	5	13	3
9.	A lack of infrastructure (transit room) and inadequate space in the pharmacy.	4	4	4	12	4
10.	Random errors and incomplete features in the SIMRS (Hospital Management Information System).	5	5	5	15	2
11.	Patient complaints due to unavailable medication stock.	4	4	4	12	8
12.	Waiting times for medications from distributors and delays in delivery.Tata letak ruang farmasi kurang ergonomis	3	3	3	9	12

Implement	***Chalenge***
1. *Socialization of the procedures for creating SPJ (Budget Spending Plan) and further coordination with PPK (Budget Management Officer) and PPTK (Technical Implementation Officer) to minimize delays in the release of the BLUD budget.* 2. *Implementation of online stock-taking integrated with SIMRS.* 3. *Implementation of 5S (Sort, Set In Order, Shine, Standardize, and Sustain).*	1. *Addition of features for planning, calculating needs, procurement, and approvals, as well as correcting errors in SIMRS.* 2. *Addition of human resources.* 3. *Creation of a medication transit room.*
Possible	***Kill***
1. *Analysis of the workload for pharmacy personnel.* 2. *Improvement of distribution facilities.* 3. *Training and development of human resources in both managerial skills and compliance with existing SOPs.*	-

Figure 2 PICK diagram

Discussion

Identification of Waste in the Drug Inventory Management Process of Hospital X

Based on the research results using a systems approach, it was found that the components of drug inventory management at X hospital consisted of inputs, processes, and outputs (Fitriani et al., 2019). The inputs in the systematic approach included human resource inputs, cost or budget inputs, procedure or guideline inputs, and policy inputs. The processes in the systematic approach were carried out through management functions, which included planning, organizing, directing, and controlling functions (Siska & Jepisah, 2022). The basis of management functions was used to outline the logistics management processes in accordance with the Minister of Health Regulation Number 72 of 2016. The input elements processed through the logistics management functions produced outputs in the form of drug availability in the hospital pharmacy installation. The systematic approach clarified the interconnections between each element and stage in the management of drug management. If the outputs generated were inefficient, it could be identified which elements had issues that could be promptly addressed to avoid losses for the hospital and patients (San et al., 2020).

The identified waste could be addressed through strategies or improvement proposals to minimize time, effort, and activity wastage. Defects were errors in activities that caused failures or defects in specific processes. The cause of errors in the drug inventory management process at Hospital X was the suboptimal use of the SIMRS, which hampered the process from planning to inventory control. Another error in the drug inventory management at Hospital X involved the double job assigned to pharmaceutical staff, which caused delays in both service and administrative tasks. The root cause of the double job was the lack of staff or human resources. This could also have been due to incorrect analysis in the distribution of job responsibilities. Therefore, a deeper job analysis was needed to save labor while optimizing task performance. This was consistent with Triyanto et al. (2020), who found that job analysis and workload analysis could optimize employee performance (De Fretes, 2022). Another error that led to wastage was an inappropriate room layout. Layout had many strategic impacts because it determined a company's competitiveness in terms of capacity, process, flexibility, cost, and work environment quality. An effective layout could help an organization achieve a strategy that supported differentiation, low cost, or rapid response (Syahrani et al., 2019). Additionally, borrowing or redeeming drugs outside the hospital due to drug shortages could decrease patient satisfaction.

Overproduction waste referred to activities that were excessive or faster than needed in the management process, leading to bottlenecks or wasted time. In this case, overproduction waste was evident in repeated checks by the depot that should have already aligned with requests submitted via SIMRS. The hospital management information system played a crucial role in drug inventory management. SIMRS provided automation that saved time in management processes. Adding features and fixing random system errors needed to be done regularly to meet the increasing needs of management. This aligned with Pramesti (2019), who stated that SIMRS, as an information communication technology system, processed and integrated all hospital service process flows into a coordination network, reporting, and administrative procedures to obtain accurate and precise information (Yulianingsih et al., 2022).

Waiting was a type of waste caused by waiting times, such as waiting for deliveries from distributors to the hospital due to the pending marketing authorization number (NIE) or because the distributor was out of town. This could have been anticipated by coordinating regularly with the distributor, allowing the hospital to take alternative actions, such as purchasing drugs from partner pharmacies, to avoid drug shortages due to delayed deliveries. Other waiting times occurred during the planning and procurement process, where there was often a delay in payment because the hospital had to wait for the BLUD budget to be released.

Transportation involved activities that increased work time and wasted unnecessary labor (non-value-added movement), resulting in suboptimal output. Transportation waste occurred in the repeated distribution of drugs to pharmacy depots and the considerable distance between the warehouse and the depot. The root cause of this problem was the lack of infrastructure, such as trolleys. Adequate facilities were one of the factors that had to be met by every healthcare facility. With complete facilities, the services provided were also effective and optimal (Triyanto et al., 2020).

Inventory involved drug stocks that did not match needs, resulting in overstocking, which caused drugs to near expiration due to insufficient monitoring in services, or understocking, which hampered service processes. Overstocked drugs reduced space for storing usable drugs. This waste occurred due to the lack of a transit area, causing simultaneous receipt and storage processes, which limited the pharmacy staff's ability to accurately record incoming stock and existing inventory. The

existing facilities needed to be reorganized with a warehouse layout that separated received goods from stocked inventory, allowing proper stock opname recording. Additionally, manual stock opname resulted in unnecessary paper and stationery usage.

Motion referred to activities that were not needed in a process, leading to wasted time and effort. Motion waste at Hospital X was caused by the UP system, which forced existing resources to purchase drugs from partner pharmacies. This consumed time and effort from the staff. Extra processing was any additional process that was unnecessary and added no value. Extra processing occurred during the receipt, storage, and control of pharmaceutical supplies by conducting two stock opnames: manual and SIMRS. Additional processes with the same objective led to wasted effort and time

Identification of Root Causes of Problems in the Drug Inventory Management Process of Hospital X

The root causes of the problems identified in this study stemmed from input factors consisting of man, money, material, method, machine, and market. Based on the prioritization results, the top five issues that needed immediate resolution were:

1. Delays in payments due to uncertain reductions in the BLUD budget.
2. Random errors and incomplete features in SIMRS.
3. Poorly maintained (damaged) and incomplete distribution facilities.
4. A lack of infrastructure (transit room) and inadequate pharmacy space.
5. An ergonomically poor pharmacy layout.

The root cause of the delays in medication payments to distributors was the waiting time and schedule for the reduction of the BLUD budget. Challenges faced by the hospital regarding budget inputs included inadequate funds from the government for purchasing medications, leading to unmet medication needs (Fitriani et al., 2019). Non-government hospitals also faced budgeting challenges, such as suboptimal planning stages, frequent changes in doctors, and ineffective use of medication consumption methods (Day et al., 2020). The budget shortfall resulted in medication shortages due to late payments to third-party suppliers, causing frequent delays in medication delivery (Satrianegara et al., 2018). The budget input issues could be addressed by selectively choosing suppliers, providing feedback based on consumption data during the planning stage, and ensuring effective communication between the hospital and distributors to avoid delays in medication purchases (Pramesti & Djamhuri, 2019).

Random errors and incomplete features in SIMRS were identified as part of the root problems related to the machine input. The machine represents the tools required in management processes. According to Minister of Health Regulation No. 72 of 2016, one optimization strategy must be upheld by maximizing the Hospital Information System in pharmacy management functions. The computerized system must be established and function optimally for secretarial activities, pharmacy supply management, medical devices, and consumables, as well as clinical pharmacy services. This pharmacy information system must be integrated with the hospital information system to enhance managerial efficiency and facilitate easy access to patient clinical data for monitoring therapy and other clinical functions. The computerized system includes: networks, hardware, and software (application programs) (Permenkes RI, 2016).

The root problems concerning material aspects included inadequate facilities and infrastructure (transit room), limited pharmacy space, and a poorly designed pharmacy layout, which hindered service delivery and inventory management at Hospital X. Material refers to the resources needed to achieve organizational objectives. To support pharmacy personnel in carrying out their duties and responsibilities effectively, they must be backed by adequate facilities and infrastructure. This aligns with the Indonesian Minister of Health Regulation No. 72 of 2016 regarding standards for pharmacy services in hospitals, stating that the provision of pharmaceutical services must be supported by adequate facilities in terms of quantity and quality to enhance pharmaceutical service functions and processes.

Improvements Proposal to Minimize Waste in the Drug Inventory Management Process at Hospital X

The Possible, Implement, Challenge, and Kill (PICK) diagram was one of the tools from Lean Six Sigma used to organize process improvement ideas and categorize them by identifying and prioritizing opportunity phases (Yulianingsih et al., 2022). Based on the analysis using the PICK diagram, priority ideas for pharmacy improvement using lean management were identified. Implement referred to ideas or improvement suggestions that were easy to apply and had a high impact. In this case, the socialization of the procedures for creating the SPJ (Budget Spending Plan) and further coordination with PPK (Budget Management Officer) and PPTK (Technical Implementation Officer) to minimize delays in the release of the BLUD budget, the implementation of 5S, and the online stock-taking were easy to implement as they did not require new resources. The 5S method (Sort, Set In Order, Shine, Standardize, and Sustain) aimed to create a clean, tidy, and safe working environment.

Possible referred to ideas that were easy to implement but had low impact, such as improving distribution facilities and analyzing the workload of pharmacy staff to avoid double jobs. Challenge referred to ideas with high impact but difficult to implement. This was due to the fact that adding features to the SIMRS (Hospital Management Information System) required additional budget resources from the SIMRS developers to incorporate planning, needs calculation, and procurement features. Adding human resources also required additional funding for staffing. Additionally, building a transit room was difficult to implement as it needed strategic land and sufficient funding. As for the SPO (Standard Operating Procedures) related to distributors, the duration of goods delivery and obtaining circulation numbers could be addressed to predict medication arrival; however, controlling this was challenging due to the involvement of third parties. Kill referred to ideas that were difficult to implement and had low impact.

Conclusion

The drug inventory management process at Hospital X still had

several wastes, making it less optimal, including defects (errors in inventory calculations and needs, an ergonomic layout, and mismatches between real stock, manual stock-taking, and SIMRS stock), overproduction (repeated checks at the depot due to discrepancies with SIMRS), waiting (waiting for medication from distributors and waiting for the BLUD budget), transportation (insufficient capacity of facilities, leading to repeated distribution processes), inventory (manual stock-taking resulted in waste of paper and stationery, as well as storing used and unused medications in one room), motion (the hospital had to purchase medications from partner pharmacies in case of shortages), and extra processing (suboptimal use of SIMRS for stock-taking due to remaining semi-conventional methods).

It was hoped that the hospital could improve medication inventory management by analyzing workload, improving facilities and infrastructure, conducting training and capacity development for human resources, implementing 5S for room layout, and correcting errors as well as adding features for pharmaceutical management in the hospital information system (SIMRS), thereby creating an effective and efficient medication inventory management system.

Conflict of Interest

No potential competing interest was reported by the authors.

Acknowledgement

Thanks to all the informants involved in this research, as well as Hospital X in Jember Regency for graciously hosting the study

Author contribution

The author is responsible for the publication of the accompanying article.The author approved that the article published in formats for Journal of Agromedicine and Medical Sciences. The article submitted with the knowledge and permission of the department/institution concerned.

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