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Efficiency and Risk Analysis of Hospital Supply Chain and Strategy Development Using FMEA and Swot: A Case Study of Husada Hospital

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Abstract

Efficient supply chain management (SCM) is essential for ensuring service continuity, cost efficiency, and patient safety in hospitals. This study aims to analyze the efficiency of the hospital supply chain, identify critical operational risks, and formulate strategic recommendations for improving logistics performance at Husada Hospital, Jakarta. A mixed-methods approach was employed by integrating quantitative inventory analysis with qualitative risk and strategic analyses. Quantitative assessment included demand patterns, lead time, inventory coverage, and inventory control indicators, while qualitative analysis involved process mapping, in-depth interviews, Failure Mode and Effects Analysis (FMEA), Internal Factor Evaluation (IFE), External Factor Evaluation (EFE), Internal–External (IE) Matrix, and SWOT analysis. The findings reveal that the existing supply chain is supported by a structured procurement and distribution workflow but remains highly dependent on manual planning, periodic reviews, and experiential decision-making. FMEA identified inventory planning, critical-item management, and supplier coordination as the highest-priority risk areas. The IFE score of 2.481 and EFE score of 2.427 positioned the organization within Cell V of the IE Matrix, indicating a hold-and-maintain strategic posture. Consequently, the recommended strategy emphasizes strengthening data-driven inventory planning, optimizing information systems, standardizing inventory parameters, improving vendor mapping and performance monitoring, establishing risk registries, and implementing risk-based approval mechanisms. These findings contribute to hospital supply chain management by demonstrating that sustainable logistics performance is achieved not through extensive structural changes but through systematic enhancement of planning accuracy, inventory control, risk mitigation, and strategic decision-making, thereby supporting operational resilience and improving healthcare service quality.

INTRODUCTION

Supply Chain Management (SCM) is a modern approach that aims to improve efficiency and effectiveness both in manufacturing companies and in the healthcare sector, including hospitals. In a hospital setting, SCM includes the process of managing the flow of goods, medicines, services, information, and finance between suppliers and customers, as well as the infrastructure that supports the smooth flow. SCM serves as an integrated system that addresses a wide range of problems from suppliers to end consumers with a systematic approach in planning, logistics, and information aspects. On the other hand, the logistics system in hospitals focuses more on regulating the flow of goods within the institution itself (Siagian, 2012).

The hospital supply chain consists of medical and non-medical products (Habib et al., 2022; Iannone et al., 2013; Kazemzadeh et al., 2012). Medical products include clinical and pharmaceutical items such as stretchers, anesthesia machines, patient monitors, sterilizers, ECG machines, operating tables, surgical lights, and surgical equipment . On the other hand,

non-medical products include items necessary to provide services to patients such as aprons, human skeletons, bones, medical books, as well as administrative staff (Pervez et al., 2016).

Modern healthcare requires hospitals to not only provide quality clinical services, but also to manage resources effectively and efficiently (Nugraha et al., 2023; Tamir et al., 2017). One of the supporting functions that has a major contribution to the cost and quality of services is Supply Chain Management (SCM), which includes the procurement, storage, distribution, and information flow of medical and non-medical goods. In the context of hospitals, SCM is crucial because it is directly related to the availability of drugs, medical devices, and consumables needed in the patient service process (Farida et al., 2021).

Studies have shown that logistics costs account for a significant portion of the total operational costs of health facilities, and logistics activities also take up the time of health workers that should be able to be focused on clinical services. Supply chain optimization through more accurate needs planning, proper inventory policies, and good coordination with suppliers, has the potential to increase cost efficiency while maintaining smooth service. In this perspective, SCM efficiency is not only a financial issue, but also related to the quality of service and patient safety.

On the other hand, hospital supply chains also contain various risks (Chopra & Meindl, 2021). Dependence on certain suppliers, variations in patient demand, procurement lead time, and complexity of information flow, can cause uncertainty that affects the availability of goods. Various SCM literature in the health sector emphasizes the importance of supply chain risk management through systematic approaches such as *risk matrix* and *Failure Mode and Effect Analysis)* to identify pain points, assess risk levels, and prioritize improvements.

Husada Hospital is a private public hospital in Jakarta that has a long history in health services. Based on official hospital information, Husada Hospital originated from "Jang Seng Ie" which was established on December 28, 1924 and has since developed as a hospital that serves patients continuously. Based on the profile of the Ministry of Health's health facilities, Husada Hospital is a class B public hospital, which shows that this hospital has a relatively wide and complex service coverage compared to hospitals with lower grades.

This complexity is also reflected in the facilities and services owned. Hospital profile data shows that Husada Hospital has an inpatient capacity that includes various classes of care as well as intensive care units such as ICU, NICU, PICU, isolation, and perinatology. In addition, based on official information from the hospital, Husada Hospital also has a 24-hour emergency facility, operating room, pharmaceutical installation and other supporting services, including a hemodialysis unit with 15 HD machines. The diversity of these facilities shows that hospital operations do not only depend on medical services, but also on the readiness of support systems that are able to ensure the availability of medicines, medical devices, consumables, and the proper distribution of goods to various service units.

In a hospital with service characteristics such as Husada Hospital, supply chain and logistics management is important because it must meet the needs of various units with different levels of criticality, usage patterns, and urgency. Emergency departments, intensive care units, operating rooms, pharmacies, and inpatients require the availability of precise, fast, and continuous goods, so that a hospital's supply chain system cannot be viewed only as a procurement activity, but as a system that includes needs planning, inventory control, storage, internal distribution, and information flow between units. In these conditions, hospitals have the potential to face challenges in terms of inventory efficiency, supply chain operational risks, and the need to develop a more structured logistics strategy, especially related to potential overstock, stockout, lead time variations, dependence on suppliers, and information missynchronization between units.

However, until now, there has been no study that comprehensively maps the efficiency and risks of the Husada Hospital supply chain and connects it with the hospital's supply chain

development strategy. This condition has the potential to make supply chain improvements carried out in a partial and reactive manner, without a basis for risk prioritization and structured analysis. Therefore, a study is needed that is able to provide a comprehensive picture of the efficiency and risks of the Husada Hospital supply chain as the basis for the formulation of a more targeted and data-based hospital logistics system development strategy.

Based on the above background, the formulation of the problem in this study is: 1) How is the implementation of supply chain and logistics management at Husada Hospital, reviewed from the procurement components, inventory management, internal distribution, and information flow? 2) What is the level of efficiency of supply chain and logistics performance at Husada Hospital, if analyzed using quantitative indicators such as demand, *lead time*, EOQ, ROP, *safety stock*, and other efficiency indicators? 3) What are the main risks contained in the supply chain and logistics management of Husada Hospital, and what is the level of risk priority if assessed using the FMEA approach? 4) How is the formulation of supply chain and logistics management development strategies at HUSADA Hospital based on the results of supply chain efficiency and risk analysis using the IFE–EFE, IE Matrix, and SWOT approaches?

According to the formulation of the problem above, the objectives of this research are: 1) Describe the application of supply chain and logistics management at HUSADA Hospital in the aspects of procurement, inventory management, internal distribution, and information flow. 2) Analyzing the efficiency of supply chain and logistics performance at HUSADA Hospital using a quantitative approach, including through demand analysis, *lead time*, EOQ, ROP, *safety stock*, and other efficiency indicators. 3) Identify and assess key risks in supply chain and logistics management of HUSADA Hospital using the FMEA method to determine the level of risk priority. 4) Prepare recommendations for supply chain and logistics management development strategies at HUSADA Hospital based on the results of efficiency and risk analysis, by utilizing strategic analysis tools such as IFE-EFE, IE Matrix, and SWOT.

METHOD

Research Design

This study used a mixed methods approach that integrates quantitative and qualitative approaches to gain a comprehensive understanding of the efficiency, risks, and development strategies of supply chain and logistics management at HUSADA Hospital. The quantitative approach is used to measure the performance of the logistics system based on operational indicators, while the qualitative approach is used to identify risks, evaluate actual conditions, and formulate development strategies. The results of the two approaches complement each other so that they are able to produce more applicable recommendations.

Research Location and Time

The research was carried out at HUSADA Hospital, Jakarta, which includes procurement units, logistics warehouses, pharmaceutical installations, service units as users of medical materials and drugs, and other units related to logistics management. Data collection was carried out in the period February-April 2026, while the quantitative data analyzed was historical data on logistics operations for a maximum of the last three years.

Research Object

The object of the research is the supply chain and logistics management strategy at HUSADA Hospital which is studied based on the level of operational efficiency, supply chain risk, as well as the procurement process, inventory management, and distribution of hospital logistics.

Population and Sample

Quantitative Population

The quantitative population includes all inventory data and logistics transactions of HUSADA Hospital, including data on demand, orders, lead time, inventory, stockout events, and vendor performance during the research period.

Quantitative Sample

Quantitative samples were determined using the purposive sampling technique, which is to select inventory items that have a high use value, are critical to patient service, and represent the main characteristics of the hospital's logistics procurement and distribution process so that they are suitable for analysis using inventory efficiency indicators.

Qualitative Population

The qualitative population consists of all stakeholders involved in the supply chain and logistics process, including procurement units, logistics warehouses, pharmaceutical installations, service units, and hospital management.

Sample/Qualitative Informant

The research informants were selected using the purposive sampling technique, namely individuals who are directly involved in the supply chain process and have experience and knowledge about logistics policies and operations at HUSADA Hospital.

Operational and Research Variables

This study uses variables consisting of demand, lead time, Economic Order Quantity (EOQ), Reorder Point (ROP), safety stock, stockout rate, forecast error, vendor performance, supply chain risk, and supply chain strategy. Each variable was measured using operational indicators sourced from hospital logistics data and interview results, then analyzed using descriptive statistical methods, inventory calculations, Failure Mode and Effect Analysis (FMEA), as well as IFE-EFE, IE Matrix, and SWOT analysis.

Data Types and Sources

The research used primary data and secondary data. Primary data were obtained through interviews, observations, discussions with informants, and filling in FMEA assessment instruments and IFE–EFE factors. Secondary data comes from the hospital's logistics information system, including demand, inventory, order, lead time, stockout, vendor performance reports, as well as policy documents and SOPs related to supply chain management.

Data Collection Techniques

Document Study

Document studies are carried out on historical data on demand, inventory, orders, lead time, vendor reports, and logistics SOPs to obtain information that supports supply chain efficiency analysis.

Observations

Observations are carried out on the entire flow of the supply chain process, starting from needs planning, procurement, receipt, storage, to distribution of goods, to understand operational conditions and identify potential obstacles in the field.

In-Depth Interviews

Semi-structured interviews were conducted with key informants to obtain information about supply chain processes, operational constraints, risks, logistics system efficiency levels, and development recommendations. The results of the interviews were also used as the basis for the assessment of the FMEA analysis.

Questionnaire/Assessment Form

The questionnaire was used to obtain the Severity, Occurrence, Detection assessment score on FMEA as well as the assessment of internal and external factors in the preparation of the IFE–EFE and SWOT matrix using a predetermined assessment scale.

Data Analysis Methods

Quantitative Analysis of Supply Chain Efficiency

Quantitative analysis was carried out by processing data on demand, lead time, inventory, and logistics costs to calculate EOQ, ROP, safety stock, stockout rate, and forecast needs using MAPE, MAD, and RMSE indicators. The results of the analysis are used to evaluate the level of inventory efficiency and identify potential logistics cost savings.

Risk Analysis Using FMEA

Risk analysis is carried out by identifying potential failures at each stage of the supply chain, then assessing the Severity (S), Occurrence (O), and Detection (D) levels to calculate the Risk Priority Number (RPN). The RPN value is used as the basis for determining risk priorities and preparing appropriate mitigation recommendations for the hospital's logistics system.

Strategy Analysis Using IFE–EFE, IE Matrix, and SWOT

The results of efficiency and risk analysis are then used to identify internal and external factors of the organization, compile IFE, EFE, and IE Matrix matrices, and formulate alternative strategies through SWOT analysis. The resulting strategy is prioritized based on the level of relevance, impact, and feasibility of its implementation as a recommendation for the development of supply chain and logistics systems at HUSADA Hospital.

RESULTS AND DISCUSSION

Drug and BHP Supply Chain Process Mapping

The drug and medical BHP supply chain process at Husada Hospital involves a workflow between Pharmaceutical Installations, Pharmaceutical Procurement, and vendors. In general, the process starts from identifying needs by Pharmaceuticals/Pharmaceutical Warehouses, submitting and approving requests, issuing POs by Purchasing, procurement to vendors, receiving goods, storing them in pharmaceutical warehouses, to distribution to pharmaceutical units or satellites.

Needs Planning Flow by Pharmacy

Planning for drug needs and medical BHP is initiated by the Pharmaceutical Warehouse through the withdrawal of usage data from the system. The data comes from drugs, medical devices, and BHP that come out through prescriptions and service transactions. Based on this data, the Pharmaceutical Warehouse compiled a list of items and the number of initial needs.

Regular bookings are made twice a week, namely every Monday and Thursday. The list of needs compiled by the Pharmaceutical Warehouse is then reviewed by the Head of Pharmacy. At this stage, the Head of Pharmacy can adjust the order amount by considering the overall stock, warehouse stock, service/satellite stock, running usage, average daily usage, on-order goods, and a buffer target of about two weeks.

After being reviewed and approved by the Head of Pharmacy, the needs plan is continued for approval by the Head of the Medical Support Division. Requests that have been fully approved should ideally go to Purchasing at around 11.00 so that the PO can be processed and sent to the vendor before the cut-off at around 13.00. If approval passes this time, the PO process has the potential to shift to the next working day.

Procurement Flow by Purchasing

After the needs plan is fully approved, the request is forwarded to Purchasing Pharmaceuticals. The Purchasing Staff then processes the request into a PO and sends it to the vendor.

On routine requests, Purchasing staff can directly forward the PO to the vendor. The condition is that the request has been approved, the price has not changed significantly, and the goods are available. Purchasing does not change the number of goods submitted by the Pharmacy/Pharmacy Warehouse. The quantity remains according to the approved demand.

After the PO is sent, Purchasing monitors the status of the fulfillment of the goods. If the goods have not arrived as estimated, Purchasing follows up with the vendor. Monitoring is carried out through PO status, delivery date, receipt date, PO aging, and fulfillment status.

In practice, not all POs are fully fulfilled. Vendors can send goods partially as per available stock. The remaining goods that have not been fulfilled need to be monitored again so as not to cause a shortage of stock.

If there is a change in price, Purchasing confirms first. Reasonable price changes can be informed. Significant price increases require the approval of the Head of Purchasing. If there are empty goods, changes in specifications, new goods needs, or vendor payments that are withheld, Purchasing coordinates again with Pharmaceuticals, vendors, or Finance according to the source of the constraint.

Receipt, Storage, and Distribution Flow of Goods

Goods sent by vendors are accepted by Pharmacy Warehouse. At the receiving stage, the officer checks the suitability of the goods with the delivery documents. If the goods are sent via a third-party courier, they must be accompanied by a roadmark. If the goods are shipped directly by the distributor, confirmation can be made via invoice or shipping document from the distributor.

Goods received must conform to the shipping documents. The check includes item name, quantity, batch, and expiry date. If the item does not match, the item is confirmed and returned to the vendor. If the quantity of goods is more than the documents, the excess goods are also returned. If the quantity of goods is less than the PO, the condition is recorded as partial fulfillment.

The goods that are suitable are then stored in the pharmaceutical warehouse. Once the goods are available, distribution is carried out on demand from pharmaceutical units or satellites. Goods are mutated from pharmaceutical warehouses to related units. Stock movements are recorded in the system. After the goods are used for recipes or services, the use returns to demand data for the next planning.

Request Flow from Unit/Satellite to Pharmacy Warehouse

Once the goods are available in the warehouse, the internal needs come from pharmaceutical satellites, nursing rooms, and other units. The Pharmaceutical Warehouse acts as a stock center. Satellites or pharmaceutical depots are located in several service areas, such as outpatient hospitals, OK/OKA, EMERGENCY ROOMS, BPJS, and other service units.

Pharmaceutical satellites request goods to the Pharmaceutical Warehouse to fill the operational buffer. For pharmaceutical units or satellites, requests to the warehouse are made daily. Buffers are daily and subject to actual usage. Changes in doctor's prescribing patterns can also affect the need for buffers on satellites.

The determination of satellite buffers has not yet used a formal formula. The basis still comes from experience, trial-error, and assessment of unit officers. Each unit or satellite has its own buffer. The buffer amount is determined by the head of the associated unit.

For BHP from the nursing room or non-pharmaceutical unit, the request is scheduled twice a week, namely Wednesday and Saturday. Before the schedule, the unit sends orders to the Pharmacy Warehouse. The warehouse then prepares the needs for pick-up or fulfillment according to the schedule.

The demand pattern also differs in certain units. For example, HD units have more structured needs because the types of items are clearer. However, the amount of needs can still change. The need for the Operating Room or Operasi Kamer (OK) is more difficult to predict. Disposable and small medical devices may differ depending on the doctor's actions. If the required goods are not available at the Pharmacy, the need can become CITO. In these conditions, Purchasing helps find goods to vendors.

CITO/Urgent Needs Flow and New Items

CITO or urgent needs do not wait for routine booking schedules on Monday and Thursday. If there is an urgent need, the Pharmacy can make a request on the same day as the CITO statement. The basic flow remains through Pharma, systems, Purchasing, and vendors, but the process is accelerated.

Pharmacies have officers who are on guard 24 hours. Purchasing does not operate a full 24 hours. For urgent needs outside of working hours, coordination is carried out through WhatsApp groups and PIC Purchasing according to the category of goods. Purchasing still helps contact vendors if needed. If you need escalation, the process can be assisted by the Head of Purchasing or related management.

The main PICs in the CITO pipeline come from Pharmaceuticals, Purchasing, requesting units, and vendors. Pharmaceuticals identify needs and make demands. Purchasing helps find goods and contact vendors. Vendors can generally respond fairly quickly, especially if goods are available.

For medicines, finding items is relatively easier. For small or disposable OK/OK medical equipment, the search is more difficult. The type of item may differ according to the doctor's actions. Some items already have a master but are not kept as regular stock. Some of the other items didn't have masters at all.

The master item is the basic data of the item in the system. This data is necessary for goods to be processed in request, PO, receipt, and billing. If the goods do not have a master yet, the administration process can be longer because it needs to be established a master first.

Under certain conditions, goods can be used first through a consignment scheme. Goods are ordered and used according to the needs of the action. The vendor then charges the item on weekdays. If the billed item is not yet available in the master, Purchasing processes the master formation so that transactions and billing can be recorded in the system.

Evaluation of Actual Supply Chain Planning and Efficiency Practices

Based on the previous process mapping, the drug and BHP supply chain at Husada Hospital went through several main stages. These stages include needs planning by Pharmaceuticals, procurement by Purchasing, receiving goods, storage, distribution to units or satellites, and fulfilling CITO needs.

The evaluation in this section is directed at looking at actual practices that are running. The focus includes requirements planning methods, inventory efficiency, Pharmaceutical process efficiency, and procurement process efficiency by Purchasing. The evaluation was conducted using available data from interviews, internal documents, and relevant operational indicators.

Characteristics of Actual Planning Methods

The practice of planning drug needs and BHP at Husada Hospital has not fully used formal calculations such as ROP, EOQ, or safety stock based on standard formulas. However, the process that runs still has a clear supply chain logic. This practice can be understood through the concept of periodic review system, consumption-based replenishment, and manual buffer adjustment.

The planning process began with the withdrawal of usage data by the Pharmaceutical Warehouse. The data comes from drugs, medical devices, or BHP that comes out through prescriptions and service transactions. From this data, the Pharmaceutical Warehouse compiled a list of items and the number of initial needs. This list is then reviewed by the Head of Pharmacy.

Regular bookings are made twice a week, namely every Monday and Thursday. This pattern shows the character of the periodic review system. Ordering decisions are made on a specific review schedule, not automatically every time the stock touches a specific message point.

In the review process, the Head of Pharmacy looked at some data in the system. The data includes overall stock, warehouse stock, service or satellite stock, usage or sales for the current month, average daily usage, goods being ordered, and QTO. This data is used to assess whether an item needs to be ordered, added, subtracted, or postponed.

In practice, the number of orders refers a lot to the actual usage of the current month. At the beginning of the month, the usage that has already occurred becomes the initial basis for the order. In the next review, Pharmaceuticals looks back at the accumulated usage of the current month. The difference in usage from the previous review is one of the additional basis for the order.

This pattern shows the character of consumption-based replenishment. Pharmacies are trying to replace used stocks. The focus is not on calculating projected demand with statistical models, but on keeping the outgoing goods can be replaced through a regular order cycle.

In addition to actual use, Pharmaceuticals also considers a target buffer of about two weeks. This buffer serves as a practical backup so that the stock remains sufficient for service needs. If the available stock is still sufficient for the next two weeks, the item will not necessarily be reordered. If the stock starts to approach the buffer limit, the order amount can be increased.

Thus, the two-week buffer reflects the concept of safety stock in a practical way. However, the buffer has not been formally calculated based on usage variations, lead time, and service level targets. Buffer adjustments are still carried out manually through the judgment of the Head of Pharmacy.

Based on these characters, the actual method of RS Husada can be referred to as a combination of periodic review, consumption-based replenishment, and manual buffer adjustment. This practice is simple and based on real usage data. However, these methods have not been fully standardized in formal inventory control parameters such as ROP, EOQ, and safety stock.

Evaluation of Pharmaceutical Operational Process Efficiency

Operationally, the Pharmaceutical process already has several aspects that support work efficiency. These aspects include:

Regular booking schedule is clear

Orders are placed twice a week, so that Pharmacy and Purchasing have an orderly work rhythm.

The system already helps with data retrieval.

Usage and stock data can be pulled from the system. This data is the basis for compiling initial needs and reviewing the number of orders.

The acceptance of goods has basic controls.

Incoming goods are inspected based on items, quantity, batch, and expiry date. These controls help reduce the risk of goods not compliant.

Internal requests already have a pattern.

Pharmaceutical satellites make daily requests. BHP from the nursing room is scheduled for Wednesday and Saturday. HD units have a demand pattern of about weekly. However, the operational process of Pharmaceuticals still has several areas that depend on manual judgment. The area includes:

Review the order quantity.

The Head of Pharmacy is still adjusting the amount based on stock, current usage, goods on order, and buffer targets.

Quantity correction.

The system provides data, but the final decision is still made through manual review.

Determination of unit and satellite buffers.

The buffer is determined by the respective head of the unit. The basis is still experience, trial-error, and daily usage patterns.

Stockout and service level data.

Stockout and service level data are not necessarily available automatically. This limits the evaluation of efficiency quantitatively.

Thus, the Pharmaceutical process already has a fairly good work rhythm and operational control. However, the standardization of stock parameters still needs to be strengthened so that decisions do not depend too much on individual experience.

Evaluation of the Efficiency of the Procurement Process

Pharmaceutical Purchasing plays a role in processing Pharmaceutical requests to POs and connecting hospitals with vendors. In terms of process, there are several aspects that support procurement efficiency. These aspects include:

The division of roles of Pharmacy and Purchasing is quite clear.

Pharmaceuticals determine the need and quantity of goods. Purchasing processes requests into POs and coordinates with vendors.

Purchasing does not change the quantity of demand.

The quantity remains in line with the demand that has been compiled and approved from the Pharmaceutical side. Thus, the efficiency of the number of orders is more determined in the Pharmaceutical planning process.

The PO process is already running through the system.

Requests that have been approved can be processed into POs. The Purchasing Staff then sends the PO to the vendor as needed.

Procurement monitoring can be done.

Data such as PO status, PO date, receipt date, fulfillment, and aging can be used to monitor the fulfillment of goods.

Identify Supply Chain Risks Based on FMEA

Risk identification is carried out in two main areas, namely the Pharmaceutical process and the Pharmaceutical Purchasing process. Risks are compiled based on the results of interviews, process mapping, and validation of failure modes that appear in the drug and BHP supply chain flows.

Each failure mode is assessed using Severity, Occurrence, and Detection scores. The RPN value is used to determine risk priority. In this study, the RPN was used as a prioritization tool, not as an absolute statistical measure.

The risk assessment was carried out based on the researcher's interpretation of the risk impact, the frequency of events described by the informant, and the controls that were already running. The results of the FMEA Pharmacy and Purchasing are presented in the following subchapter.

Results of FMEA on Pharmaceutical Processes

Based on the results of FMEA, the RPN value in the Pharmaceutical process is in the range of 60 to 576. The risk with the highest RPN is related to the stock planning system that is not yet flexible to set the ROP/min-max parameters based on the item's risk category. Other prominent risks related to monitoring risk of availability, critical items, patient wait times, and the burden of manual PO reviews.

Pharmaceutical risk patterns can be grouped into three main areas. First, the risk on the planning of needs and stock parameters. Second, the risk in monitoring the availability and critical items. Third, risks to operational workloads and manual judgment. This pattern shows that the main critical point in the pharmaceutical process is at the stage of planning, inventory control, and monitoring of drug availability risk/BHP.

FMEA Results in the Purchasing Process

FMEA in the Purchasing process results in 15 failure modes. In Chapter IV, the FMEA results are presented in the form of a summary of the 10 risks with the highest RPN values. The full FMEA Purchasing table is presented in the appendix.

Based on the results of FMEA, the RPN value in the Purchasing process is in the range of 32 to 144. The risk with the highest RPN pertains to vendor mapping that has not been validated based on items, active substances, and criticality levels. Other prominent risks relate to request-to-PO delays, partial fulfillment, vendor evaluations, CITO needs outside of business hours, and vendor payment coordination.

In general, the RPN Purchasing value tends to be lower than Pharmaceuticals. However, Purchasing risk remains important. Purchasing plays a role in procurement execution, vendor coordination, fulfillment, lead time, price, and CITO needs. If the Purchasing process is late, the risk from the Pharmaceutical side can continue to be a delay in the fulfillment of goods.

Analysis of Internal and External Factors

Internal and external factors are compiled based on the results of interviews, process mapping, efficiency evaluation, and FMEA Pharmacy and Purchasing. This section summarizes the strengths, weaknesses, opportunities, and threats in the drug and BHP supply chain at Husada Hospital. These factors are the basis for the preparation of the IFE and EFE matrix in the next subchapter.

Internal Factor Evaluation (IFE) Analysis

The IFE matrix was used to assess internal factors that affect the drug supply chain and BHP at Husada Hospital. Internal factors consist of strengths and weaknesses derived from the Pharmaceutical process, Purchasing, information systems, approval flows, stock control, and vendor coordination.

Weight is determined based on the level of importance of each factor to the performance of the drug supply chain and BHP. The total weight of the whole factor is 1.00. The ratings use a scale of 1 to 4, with the provision that 1 indicates major weaknesses, 2 minor weaknesses, 3 minor strengths, and 4 major strengths. The weighted score is obtained from the result of weight multiplication and rating.

The total IFE score of 2,481 shows that the internal condition of the drug supply chain and BHP Husada Hospital is in a position close to average. The hospital has a pretty good internal foundation. This can be seen from the use of information systems, SOPs, goods receipt control, division of Pharmaceutical-Purchasing functions, and the team's experience in handling urgent needs and procurement constraints.

However, these strengths are still offset by some important weaknesses. The main weaknesses are in the use of an inventory system that is not optimal, UOM standardization, buffer calculation, classification of critical items, supply chain dashboards/KPIs, and proactive vendor mapping. Thus, internal improvements need to be directed at strengthening the planning system, standardizing data, and monitoring supply chain risks.

External Factor Evaluation (EFE) Analysis

The EFE matrix was used to assess external factors that affect the drug supply chain and BHP at Husada Hospital. External factors consist of opportunities and threats originating from system vendors, vendors/distributors, clinical needs, market conditions, and supply risks.

Weight is determined based on the level of importance of each factor to the performance of the drug supply chain and BHP. The total weight of the whole factor is 1.00. EFE ratings show how well RS Husada responds to these opportunities or threats. Rating 1 indicates poor response, 2 less than optimal, 3 quite good, and 4 very good. The weighted score is obtained from the result of weight multiplication and rating.

The total EFE score of 2,427 shows that Husada Hospital's response to opportunities and external threats from the drug supply chain and BHP is still close to average. The main

opportunities come from system vendor support, alternative IT vendors, access to vendor information, relatively fast vendor lead time, vendor flexibility, product return process, as well as the momentum of accreditation and quality improvement.

The main threats come from the variability of clinical needs, vendor/principal supply uncertainty, partial fulfillment, dependence on specific vendors, price changes, and the risk of expiry or dead stock. Thus, external responses need to be strengthened through the development of supply chain dashboards, vendor mapping, vendor performance profiles, and more regular supply risk monitoring.

Internal External (IE) Matrix

IE Matrix is used to determine the strategic position of the drug supply chain and BHP Husada Hospital based on IFE and EFE results. The IFE score becomes the internal axis, while the EFE score becomes the external axis.

Based on the calculation results, the total IFE score is 2,481 and the total EFE score is 2,427. Both scores are in the medium category. Thus, the position of the drug supply chain and BHP Husada Hospital is in cell V in IE Matrix.

The position of cell V indicates a hold and maintain strategy. This means that the supply chain system that is running is not in a weak condition, but also does not have a dominant strategic force. The foundation of the process is in place, but it still needs to be strengthened in critical areas.

In the context of RS Husada, the hold and maintain strategy does not mean maintaining the process without changes. This strategy is more accurately interpreted as a gradual strengthening of the system that is already running. Areas that need to be strengthened include inventory planning, data standardization, critical item management, vendor mapping, dashboard monitoring, risk registry, and risk-based approval.

SWOT/TOWS Matrix

The SWOT/TOWS matrix is used to formulate a strategy based on a combination of internal and external factors. The strategy is structured by linking the strengths, weaknesses, opportunities, and threats that are most relevant to the FMEA, IFE, EFE, and IE Matrix outcomes.

Based on the position of IE Matrix, the drug supply chain and BHP Husada Hospital are in a hold and maintain position. Therefore, the strategy is not directed at a total change in the system, but at a gradual strengthening of the processes that are already running.

The SWOT/TOWS strategy shows that the direction of drug supply chain development and BHP Husada Hospital needs to focus on strengthening the planning and monitoring system. The main strategy is information system optimization, data standardization, item classification, vendor database strengthening, risk registry, and risk-based approval.

The strategy is in line with the results of FMEA. The highest risks are in stock planning systems, critical items, risk monitoring, and vendor readiness. Therefore, improvement strategies need to be geared towards processes that make supply chain decisions more data-driven and less reliant on manual corrections or case-by-case responses.

Strategy Priorities

Strategy priorities are compiled based on the results of FMEA, IFE, EFE, IE Matrix, and SWOT/TOWS. The prioritized strategy is the one that most directly answers the main risks in the drug supply chain and BHP Husada Hospital.

The main priority is to strengthen the data-based drug and BHP needs planning system. This is in accordance with the FMEA results which show that the highest risk is in the stock planning system, ROP/min-max parameters, buffers, and critical items. This strategy also answers internal weaknesses related to UOM standardization, item classification, and recommended order quantity.

The second priority is the compilation of a list of critical slow-moving items. This strategy is important because not all items can be controlled based solely on historical demand. Some items are rarely used, but they should still be available because they have a high clinical impact. Items like this require a special minimum stock.

The third priority is the early detection of dead stock or decreased demand. This strategy is necessary because changes in doctor's prescribing patterns or shifts in brand usage can make certain items no longer moving. Without early indicators, the risk of overstock, expiry, and dead stock can be seen too late.

The fourth priority is the development of database vendors and vendor performance profiles. This strategy answers the risks of Purchasing, especially vendor mapping, partial fulfillment, lead time, backorder, discontinuity, and price changes. With more structured vendor data, vendor selection can be done more proactively.

The fifth priority is the determination of supply chain indicators and risk registry. This strategy is necessary so that events such as stockout, CITO, pending request, vendor delay, partial fulfillment, expiry, and dead stock are not only resolved when they occur. These events need to be recorded and evaluated as a risk pattern.

The sixth priority is risk-based approval. This strategy aims to speed up the request-to-PO process without losing control. Routine items with small values or quantities according to historical patterns can be processed faster with retrospective reviews. Real-time approvals can be focused on new items, large values, significant price changes, CITOs, or unusual amounts.

In general, the drug supply chain development strategy and BHP Husada Hospital needs to be directed at strengthening data-based planning, monitoring, and risk mitigation. The main focus is not on replacing the entire process that is already running, but optimizing the system so that decisions are less dependent on individual experience and case-by-case responses.

Integrated Discussion

The results of the study show that the supply chain of drugs and BHP at Husada Hospital already has the foundation of the ongoing process. The workflow has been formed through routine ordering schedules, the use of information systems, the approval process, the control of receiving goods, and the division of roles between Pharmacy and Purchasing.

However, the foundation is not yet fully supported by a standardized planning and monitoring system. Some processes still rely on manual review, officer experience, quantity corrections, and case-by-case responses to sudden needs. This condition shows that strengthening the supply chain is not enough to be done at the procurement stage alone, but needs to start from planning needs, stock parameters, risk monitoring, and vendor evaluation.

The findings of this research need to be read from the perspective of inventory management, supply chain risk management, and process development strategies. Thus, the results of FMEA, IFE-EFE, IE Matrix, and SWOT/TOWS do not stand as separate analyses, but explain each other's directions for improving the drug supply chain and BHP Husada Hospital.

Actual Supply Chain Practices in Inventory Management Perspective

The practice of drug planning and BHP at Husada Hospital already has a structured work pattern. Regular bookings are made every Monday and Thursday. This pattern shows that the planning process does not run randomly, but has a fixed work rhythm. This rhythm is important because the supply chain process does not only involve Pharmaceuticals, but also internal approvals, Purchasing, and vendors.

From the perspective of inventory management, the practice can be read as a combination of periodic review, consumption-based replenishment, and manual buffer adjustment. Periodic review can be seen from the booking schedule made on a certain day. Consumption-based replenishment can be seen from the use of actual usage data as the basis for orders. The manual

buffer adjustment can be seen from the review process of the Head of Pharmacy in adjusting the number of orders based on stock, usage, goods on order, and buffer needs.

Periodic review is a rational pattern for the hospital context. The approval, procurement, and payment process cannot always be done at all times. Having a regular schedule helps to divide work time and keep the control process running. This pattern also makes it easier to coordinate with Purchasing and vendors as requests can be collected and processed over a specific period.

However, periodic reviews still have risks. Tagaras and Vlachos explained that periodic reviews require stockout protection for a longer period than continuous reviews. With the same safety stock, the probability of stockouts can be higher in the periodic review system. These risks mainly arise towards the end of the cycle, before the next routine order arrives.

This condition explains why the manual review of the Head of Pharmacy still plays an important role in the practice of Husada Hospital. The Head of Pharmacy does not only follow the purchase triggers from the system. Under certain conditions, orders can still be placed if the stock is considered to be lower than the level it should be. In this context, manual reviews serve as an additional control mechanism to reduce the risk of vacancies before the next booking cycle.

What needs to be clarified is the difference between an actual buffer and a formal safety stock. The two-week buffer used in the practice of Husada Hospital is more accurately understood as a target coverage or coverage buffer. The buffer is not necessarily the same as safety stock in inventory theory. In the ROP formula, safety stock is an additional component beyond the need during lead time. In other words, ROP consists of the needs during the lead time plus safety stock.

This difference is important because safety stock, minimum stock, and maximum stock have different functions. In the Minimum-Maximum Stock Level method, the minimum stock is calculated from consumption during the lead time plus safety stock. The maximum stock is then calculated from the minimum stock plus the needs during the procurement period. Thus, the safety stock is only one component in the stock parameters, not the entire buffer.

Needs during the procurement period also need to be differentiated from safety stock. Functionally, this need is related to the quantity that must be replenished in one order cycle. In inventory theory, the number of orders can be determined through the EOQ approach, or in a periodic system it can be adjusted to the needs during the procurement period. At Husada Hospital, this component is still largely determined through manual review and experience.

Manual buffer adjustment has the advantage of being adaptive to changing clinical needs. Pharmacies can adjust the number of orders when there is a change in physician prescribing patterns, an increase in certain measures, or a change in unit needs. This flexibility is important because hospital demand is not always stable and not all needs can be predicted from historical usage.

However, manual buffer adjustment also has its drawbacks. If the increase in demand is only temporary, the system can read the increase as a new fixed need. As a result, bookings can increase too much. If demand returns to normal in the next period, the stock risks turning into overstock, slow-moving, or dead stock.

The opposite scenario can also occur. If the usage in the current month is low, the buffer formed can also shrink. In the following month, demand may rise again due to a change in recipe patterns, increased visits, or certain actions. If the vendor has a long lead time, Purchasing will not necessarily be able to catch up with the fulfillment of goods quickly. This condition can increase the risk of stockout or CITO needs.

These findings suggest that the planning system requires more stable parameters. Sulistioningsih et al. show that the EOQ, ROP, and Minimum-Maximum Stock Level methods are widely used in hospital pharmaceutical inventory research. The indicators used include

inventory value, stockout, dead stock, inventory turnover ratio, and customer service level. In general, these methods have the potential to increase inventory efficiency, but the results still depend on demand conditions, procurement systems, and the hospital's operational context (Sulistioningsih et al., 2026).

Forecasting can also be a further development. However, the selection of forecasting methods must follow the character of the data. Fazli's study shows that more complex methods are not always more precise. In the case of Bloodline, Single Exponential Smoothing produces fewer errors than some other methods, including Holt and Winter. This shows that Winter is more suitable if the data has a clear trend pattern and seasonality. If the pattern has not been proven, overly complex methods can make planning too reactive to temporary fluctuations.

Thus, strengthening the drug supply chain and BHP Husada Hospital needs to start from the standardization of planning parameters. The system needs to help distinguish between normal needs, target coverage, safety stock, minimum stock, maximum stock, and recommended order quantity. Manual review remains necessary to capture clinical context, critical items, CITO, and changes in prescribing patterns. However, basic booking decisions need to be made more stable, documented, and parameter-based.

Inventory Efficiency and Service Availability Risk

The efficiency of drug and BHP inventory cannot be judged only from the low inventory value. In the context of hospitals, inventory that is too high can cause storage costs, retained capital, expiry, slow-moving, and dead stock. On the other hand, too low inventory can increase the risk of stockout, CITO, service delays, and disruption of the availability of essential items.

Based on the initial estimate from the interview results, the inventory coverage of drugs and BHP Husada Hospital is in the range of 1.5–1.6 months, or around 45–48 days. If converted indicatively, this figure is equivalent to inventory turnover of about 7.5–8 times per year. This calculation is still preliminary because it has not used actual average inventory and usage/COGS data.

Indicatively, the coverage does not seem excessive. Yudianti et al. said that a good BHP inventory is at the optimal amount, no less than safety stock, and no more than three monthly usages. On this basis, coverage of 1.5-1.6 months is still below the limit of three monthly usages. However, this interpretation still needs to be validated with stockout, CITO, expiry, dead stock, and service level data (Yudianti et al., 2021).

This is in line with Sulistioningsih et al. who show that hospital pharmaceutical inventory efficiency indicators not only include inventory value, but also stockout, dead stock, inventory turnover ratio, and customer service level. Thus, inventory coverage or inventory turnover is not enough to stand alone as a measure of efficiency (Sulistioningsih et al., 2026).

The main risk arises when efficiency is only interpreted as a decrease in stock. Critical low-usage items can seem unimportant if judged only from historical usage. In fact, these items can still be made mandatory because they have a high clinical impact. If the planning only follows consumption-based replenishment, items like this can have low or even zero order recommendations.

The findings of Yudianti et al. at Bali Mandara Eye Hospital also show that historical consumption-based BHP planning becomes less accurate when there is an increase in cases. These conditions can encourage the purchase of CITO outside of planning. These findings are relevant to Husada Hospital because the needs of drugs and BHP can change due to doctor's prescription patterns, certain actions, or urgent needs.

Thus, the inventory efficiency of Husada Hospital needs to be directed to selective stock control. Fast-moving, slow-moving, high-value, expiry-sensitive, CITO-prone, and critical low-usage items need to have different parameters. Inventory coverage can be used as an initial indicator, but efficiency evaluation still needs to be complemented by stockout count, CITO request, expiry/near-expiry value, dead stock, fulfillment rate, and service level.

Analysis of Key Risk Patterns in Pharmaceuticals and Purchasing

The FMEA results show that the main risks in the Pharmaceutical process are concentrated in needs planning, stock parameters, critical items, and availability monitoring. The risk with the highest RPN is related to the stock planning system that is not yet flexible to set the ROP/min-max based on the item's risk category. These findings suggest that the main problem is not only in the ordering process, but also in the standardization of stock parameters and the quality of the data used in planning (Suriani & Sari, 2020).

These findings are in line with Suriani and Sari's finding that the procurement of consumable medical drugs and medical devices based on average usage can cause logistical shortages if inventory data is not up-to-date, does not have safety stock, and does not use a standard calculation method (Mukhamedjanova, 2018; Sequeiros, 2023). Thus, the planning risks at Husada Hospital are not enough to be solved by accelerating purchases. This risk needs to be controlled through improving stock parameters, utilizing system data, and strengthening needs calculation methods (Suriani & Sari, 2020).

Dzulquarnain and Kirono also found that pharmaceutical supply chain problems are related to stock availability, supply capability, planning accuracy, and inventory deficits. They emphasized the importance of collaboration and data exchange to minimize supply chain issues. These findings reinforce the results of RS Husada's FMEA, especially on IT system risks, critical items, and availability monitoring. The drug/BHP supply chain requires not only physical stock, but also accurate data flow between Pharmaceuticals, Purchasing, and service units.

The risk of critical items with low usage is also an important finding. Items like this can be neglected if stock control only follows actual usage. In this context, a consumption-based replenishment approach needs to be complemented by a classification of critical items. Permatasari et al. used the Kraljic Portfolio Matrix to differentiate items based on supply risk and profit impact. The approach suggests that items with high supply risk require different procurement strategies. At Husada Hospital, this principle can be applied through a list of critical or never-stockout items, mandatory minimum buffers, and alternative vendors for items that are difficult to replace.

Another risk in Pharmaceuticals is related to the lack of formal availability risk documentation. Drug availability issues and BHP can be discussed as they arise, but have not been documented in the risk register that is evaluated periodically. Farida et al. (2021) explain that pharmaceutical supply chain risks can be related to product discontinuities, product shortages, poor performance, patient safety, expense errors, and technological errors. This suggests that availability risk needs to be seen as a pattern to be monitored, not just as a daily operational occurrence (Farida et al., 2021).

One of the risks with high RPN is outpatient waiting time. This risk is not entirely a supply chain risk in the narrow sense. This risk is closer to the quality of Pharmaceutical service and dispensing process (Habib & Hasan, 2019). However, these risks remain relevant because the process of preparing and delivering drugs is the end point of the drug availability flow. Chaisani et al. also place drug inventory management as an important part of maintaining service stability and reducing inefficiencies, including lead times and inventory. Thus, the risk of waiting time can still be read as a pharmaceutical operational risk that intersects with the supply chain (Beaulieu et al., 2014; Carvalho & Cruz-Machado, 2011).

In the Purchasing process, the main risks are more related to procurement execution, vendors, fulfillment, and CITO. The highest risk arises in vendor mapping that has not been validated based on items, active substances, and levels of criticality. This condition makes the search for alternative vendors still potentially running on a case-by-case basis when the main vendor cannot meet the needs.

The findings are in line with Kusreni et al. who stated that pharmaceutical supply chain performance is related to reliability, response speed, procurement accuracy, fulfillment, flexibility, cost, and lead time. They also emphasized that supplier performance and qualification need to be part of the risk analysis, as poor suppliers can be a risk to hospitals. Thus, Purchasing risk at Husada Hospital needs to be directed at strengthening vendor mapping, vendor evaluation, lead time monitoring, and fulfillment rate (Kusreni et al., 2023).

Partial fulfillment is also an important risk. Goods that come in part do not necessarily solve the needs of Pharmaceuticals. If the remaining PO is not followed up immediately, a shortage of stock can still occur even if some goods have been received. Therefore, Purchasing mitigation is not enough just to ensure that POs are delivered to vendors. Purchasing also needs to monitor fulfillment status, aging PO, remaining needs, and escalation to alternative vendors.

Overall, the FMEA results show that the main critical point of the drug supply chain and BHP is in the Pharmaceutical process. Pharmaceutical risks mainly arise at the stages of planning needs, stock parameters, critical items, and availability monitoring. Purchasing risk has a lower RPN, but it is still important because it relates to PO execution, vendor coordination, fulfillment, lead time, and response to CITO needs.

By reading the results of FMEA alongside previous research, the main mitigation direction becomes clearer. Pharmacies need to strengthen item classification, min-max/ROP parameters, minimum buffer critical items, risk registers, and availability dashboards. Purchasing needs to strengthen vendor mapping, vendor performance evaluation, partial fulfillment monitoring, SLA follow-up, and CITO flow. The mitigation strategy is the basis for the preparation of a supply chain development strategy in the next subchapter.

Strategic Implications of Drug Supply Chain Development

The results of IFE, EFE, IE Matrix, and SWOT/TOWS show that the development of the drug supply chain and BHP Husada Hospital do not need to be directed at a total change in the process. IE Matrix's position is in the hold and maintain category. This means that the ongoing process already has a foundation, but it still needs to be strengthened in the most at-risk areas.

The main strategic implication is in strengthening the inventory planning system. The highest risk in FMEA is more in the Pharmaceutical process, especially in stock parameters, critical items, and availability monitoring. Therefore, priority strategies need to be directed to UOM standardization, item classification, min-max/ROP calculation, safety stock, and recommended order quantity.

The strengthening does not have to start directly from major changes to the main system. RS Husada can use a phased approach through ICS/MyHospital optimization, data export, or Excel-based help modules. This module can be used to calculate average usage, lead time, safety stock, minimum stock, maximum stock, inventory coverage, near-expiry, stockout, CITO, and recommended order quantity. In this way, planning decisions can still be strengthened without waiting for the full development of the system.

The next strategy is to strengthen the classification of critical slow-moving items. Items with low demand cannot always be considered less important. Some items still need to be available because they have a high clinical impact. Therefore, Husada Hospital needs to have a list of critical items or never-stockout that are given a special minimum stock even though the usage is historically low.

In the Purchasing process, the strategic implications are mainly related to vendor mapping and vendor performance. Purchasing needs to have vendor data based on items, active substances, lead time, fulfillment rate, partial fulfillment, response time, price history, and backorder or discontinue risk. This data can help Purchasing determine key vendors and alternative vendors more proactively.

The CITO pipeline also needs to be strengthened. Urgent needs cannot be completely eliminated because clinical demand is dynamic. However, the number and impact can be

reduced by recording CITO patterns, a list of repeating action items, alternative vendors, and a clear escalation path. Since Purchasing does not run 24/7 like Pharmaceuticals, the PIC mechanism of the category, communication groups, and support of the head of unit is important to maintain a response to sudden needs.

Overall, the drug supply chain development strategy and BHP Husada Hospital needs to be directed at strengthening the existing system. The goal is not only to reduce the value of inventory, but to maintain a balance between inventory efficiency, service availability, and risk control. With more data-driven planning, more routine monitoring, and more structured Pharmaceutical-Purchasing coordination, the drug supply chain and BHP can become more stable and adaptive to service needs.

CONCLUSION

The results of the process mapping show that the drug supply chain and BHP at Husada Hospital already have a structured workflow. The flow includes needs planning by Pharmaceuticals, approval processes, procurement by Purchasing, receipt of goods, storage, distribution to satellites/units, and fulfillment of CITO or urgent needs. However, the practice of planning drug needs and BHP has not fully used the formal ROP, EOQ, safety stock, and min-max methods. Actual practice is more accurately understood as a combination of periodic review, consumption-based replenishment, and manual buffer adjustment. The inventory coverage of drugs and BHP is indicatively in the range of 1.5-1.6 months, though this figure needs to be validated with average inventory and actual usage/COGS data. FMEA results show that the main risks are more concentrated in the Pharmaceutical process, particularly related to inflexible stock planning systems, minimum buffer parameters, critical items with low usage, informal availability risk documentation, and manual PO reviews. Purchasing risks, while having lower RPN, are still important as they relate to procurement execution, vendor mapping, and fulfillment. The IFE score of 2.481 and EFE score of 2.427 show that the position of the drug supply chain is in the medium category, in cell V of the IE Matrix (hold and maintain). The recommended strategy emphasizes strengthening data-driven planning, standardizing inventory parameters, implementing risk-based approval, and developing vendor databases. This approach aims to maintain service availability while controlling inventory costs and mitigating operational risks. For future research, several directions are recommended. First, a quantitative validation of inventory efficiency using actual average inventory and usage/COGS data would strengthen the findings. Second, implementation research could evaluate the effectiveness of the proposed strategies in real hospital settings. Third, comparative studies across multiple hospitals could identify best practices and contextual factors affecting supply chain performance. Fourth, longitudinal studies could track the impact of system improvements on key performance indicators such as stockout rates, inventory turnover, and patient satisfaction. Finally, research exploring the integration of digital technologies such as artificial intelligence and predictive analytics in hospital supply chain management would contribute to advancing the field.

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