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Case Study

Supply Chain Risk Management Assessment and Strategy: Case Study in a Hospital Pharmacy

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A B S T R A C T

Health service providers such as hospitals have a very diverse supply chain in quantity and type, one of which is medicine. Hospital Pharmacy Installation (IFRS) is one of the health support activity units responsible for planning, procurement, management, storage, distribution, use of drugs, equipment, and pharmaceutical services for medical devices related to the distribution of drugs used in hospitals. Pharmacy has several risks that need to be addressed to increase customer satisfaction. This study aims to determine the extent of the implementation of Supply Chain Risk Management, identify risks in supply chain activities, and obtain risk management strategies. In this study, the method used is the assessment of Supply Chain Risk Management and continued the evaluation of the drug chain in pharmaceutical installations with the House of Risk. It is divided into two stages, namely House of Risk Stage 1, which is used to decide the risk in each supply chain, and House of Risk Stage 2, to offers a decision-making strategy for each chosen decision. There are 20 risk events and 20 risk agents in the House of Risk stage 1, and 11 proposed risk management strategies in the House of Risk stage 2. Out of 20 risks identified in stage 1, 11 risks contributed to 80% highest risk, and the top three are drug shortage, inappropriate planning, and unclear doctor's writing. In stage 2, the three most prioritized strategies are e-prescription implementation, clear signs for LASA drugs, and conducting supplier performance evaluation.

INTRODUCTION

The industrial sector is one of the sectors that has progressed quite rapidly, thus encouraging companies in Indonesia to strive to become more competitive. One of the most critical activities in a company in this decade is Supply Chain Management (SCM). SCM is an activity that aims to facilitate the production process that includes all elements involved in various activities of a business movement, from the procurement of raw materials to the distribution process to buyers or consumers (Cooper et al., 1997). Currently, every supply chain activity carried out by the company is inseparable from uncertainty about the realisation of an unplanned situation or event and can affect the flow process and supply chain elements (Svensson, 2000). Therefore, it is necessary to have good supply chain management within a company.

Handling risk in supply chain management is called Supply Chain Risk Management (SCRM). SCRM is an event or event related to failure while supplying goods so that it cannot meet consumer demand (Zsidisin et al., 2004). In the healthcare industry, Healthcare Supply Chain logistics is a series of processes related to the workforce involved in various teams and movements of pharmaceutical drugs, medical equipment, and other products needed by healthcare professionals such as doctors and nurses (Heinbuch, 1995). Improving supply chain performance in health services is an essential issue due to the turbulent and dynamic business environment that has happened in the last five years, which resulted in unexpected disruptions (Ahmed & Huma, 2021; Borah et al., 2023; Kauppi et al., 2016). The COVID-19 outbreak was an example of how extremely important to manage the risk, where the production of some goods was halted, medical supplies was disturbed (Hebbar et al., 2020), and it even made an average loss of USD 50.7 billion per month in US hospital

context (Kaye et al., 2021). Thus, more research on how hospital dealing with the risk in supply chain is needed.

Health services have a very diverse supply chain in quantity and type, one of which is medicines (Isern et al., 2010). A good drug management system in hospitals can be seen from the overall service system established at the hospital pharmacy installation. One form of good drug management is achieving effectiveness and efficiency in drug management.

XYZ Hospital is a type B private hospital fully accredited by KARS (Hospital Accreditation Commission). Some of the health service facilities owned by XYZ Hospital are outpatient installations, inpatient installations, emergency departments, laboratories, radiology, special care rooms, and others. In addition, several health care services require support or assistance from the pharmacy installation in planning, procurement, management, storage, distribution, use of drugs, medical equipment, services, and drug consultation.

Based on the initial observation data results and interviews with pharmacy logistics pharmacists at XYZ Hospital, one problem of the drug chain in the hospital pharmacy installation is frequent shortages. According to the historical data, in the last five months (May to October), several drugs have experienced a lack, such as Pethidine (3 months), Morphin (3 months), Ca Gluconas (2 months), Aminophylline (2 months), Hydrochlorothiazide (2 months), and others. From the initial observations, this happened because of ineffective supply chain implementation. This will endanger the patients when they need in an emergency condition (Mohanty & Chakravarty, 2013). If the hospital management cannot address drug supply chain problems quickly, it will lead to more significant issues, such as prolonged treatment days, disability or even death. Therefore, XYZ Hospital needs to address the problem of drug availability immediately.

There are several previous research discussed about how supply chain risk management implemented on health context such as (Zepeda et al., 2016a) who examined the inventory risks of California Hospital, (Elleuch et al., 2014a) who used multi-approach (FMECA, DOE, DES, AHP, Desirability optimization) to evaluate the risks on hospital, (Riley et al., 2016a) who did survey research to examine the effect of internal integration, information sharing, and training on SCRM capabilities, and (Benazzouz et al., 2019a) who classified the risk and errors of the availability pharmaceutical products at public hospital in Morocco.

However, much of the research of SCRM on healthcare up to now has some limitations, such as as geographical limit (Zepeda et al., 2016b), narrow focus only on downstream supply chain (Elleuch et al., 2014b), less-depth study resulting on too large generalizability as it gathered data using questionnaire (Riley et al., 2016b), and the scope of research is quite narrow on drugs availability (Benazzouz et al., 2019b). The generalisability of much published research on this issue is problematic.

This research extends previous works from (Osorio Gómez & España, 2020) that has larger scope on operational risk management and used Ontologies and Fuzzy Quality Function Deployment (FQFD), while in this research we dug on more a depth case study and focusing on supply chain risk assessment and mitigation. It also extend some previous research who applied SCRM on other context such as on drink companies (Nugraheni et al., 2013), perishable food supply chain (Prakash et al., 2017), Blood (Boonyanusith & Jittamai, 2018), Wood Toys Industries ((Tanjung et al., 2019), fashion store (Aini et al., 2019), and global manufacturer (Ma & Wong, 2018).Although some research has been done in the same topics, there have been few empirical investigations into hospital pharmacy in developing countries context, such as Indonesia.

Therefore, this research has three objectives: (1) To find out the extent of implementation of Supply Chain Risk Management at XYZ Hospital; (2) To identify risks and to map the drug supply chain risk activities at the XYZ Hospital pharmacy installation; (3) To obtain priority risk agents and recommendations for effective risk management strategy during the drug supply chain process at the XYZ Hospital pharmacy installation.

Thus, from the aforementioned problem, what can be done is by assessing the SCRM system to determine the extent to which XYZ Hospital is implementing SCRM and identifying risks to obtain SCRM strategies in pharmaceutical installations so that XYZ Hospital can minimise the negative impact or effects of the risks that occurred.

LITERATURE REVIEW

Supply Chain Management
Supply chain management is an activity to achieve integration and gain efficiencies from suppliers, manufacturers, distributors, retailers, and customers (Simchi-Levi, David Kaminsky & Simchi-Levi, 2022), which means goods are produced with the right amount, time, and location with the aim of minimizing costs and achieve the desired service level. As for other expert opinions regarding the definition of supply chain management, namely an interconnected activity integrated to obtain services and material procurement, which is then

converted into semi-finished goods or finished goods, as well distributed to consumers (Heizer et al., 2022).

Achieving effective supply chain management requires development carried out simultaneously from upstream to downstream processes downstream. According to (N. Pujawan & Mahendrawathi, 2017), there are 3 types of chain flow supply that must be managed so that the company can be more sustainable, namely flow goods or products from upstream to downstream, the flow of money or the like from downstream to upstream, and the flow of information from upstream to downstream and vice versa.

Supply Chain Management in Healthcare

Supply chains in the healthcare industry are particularly special because their primary goal is lifesaving rather than financial gain. Hospitals and clinics that deal with patients are the facilities that create demand along the whole healthcare supply chain. Healthcare providers, whether public or private, need to be cost-effective for two main reasons: first, they need to be profitable to ensure that their business continues and they can continue to provide healthcare; second, public healthcare providers need to be cost-effective to guarantee that taxpayer funds are being used wisely (Senna et al., 2021).

Supply Chain Risk Management

According to (Ho et al., 2015), supply chain risk management is a collaborative activity between companies at the moment supply chain process by taking a quantitative and qualitative approach can minimize, identify, evaluate, mitigate and monitor activities activities that may occur risks at the macro and micro levels can have a negative effect on the company.

Overall, the supply chain risk management process consists of: risk identification, risk analysis, risk evaluation, and risk management (Urciuoli & Hintsa, 2018). House of Risk (HOR) is a method that can used to manage risks during the company's supply chain process with a development model from the FMEA and HOQ methods (I. N. Pujawan & Geraldin, 2009).

Supply Chain Operations Reference (SCOR)

Supply Chain Operation Reference (SCOR) is one of the tools used to identify/map existing activities in a company. Supply Chain Operation Reference is defined as a method that displays a business process framework, indicators for measuring performance activities, identifying best practices, and developing technology or software to support collaboration and communication between supply chains, so as to achieve effectiveness. and improving supply chain performance (Hopkin, 2018).

According to the (Supply Chain Council, 2010), SCOR can be used for measuring and improving assessments of performance, asset and inventory management, process costs, production flexibility, and several other factors that can impact the assessment of supply chain performance activities. In this way, this method can measure the company's supply chain performance and be able to identify improvements that need to be made.

METHODS

This research is categorised as qualitative research. Qualitative research aims to study the phenomenon in the research object (Näslund, 2002). In this study, researchers obtained two sources of data, including primary data, which received information from the head of the pharmacy unit at XYZ Hospital by conducting interviews or interviews. Next is secondary data, namely, SCRM report data in 2020, which was obtained to know how the existing conditions of the SCM business process flow at the pharmacy installation of XYZ Hospital.
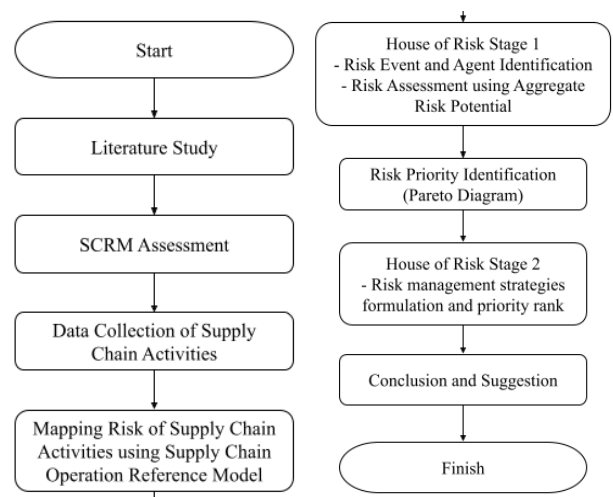

Fig.1. Research Flowchart

Several stages in this research are assessing the SCRM system, mapping SC risk activities using SCOR and preparing HOR to know the extent to which the company's Supply Chain Risk Management is being implemented. Next is mapping supply chain risk activities, learning how to handle some potential risks, and obtaining suggestions for effective risk management strategies used during the supply chain process.

RESULTS AND DISCUSSION

In assessing supply chain risk management, researchers used a questionnaire. This assessment aims to determine the extent to which XYZ Hospital implements SCRM. The questionnaire framework applied in this study is obtained from (El Baz & Ruel, 2021). There are several dimensions: risk identification, risk assessment, risk mitigation, and

risk control. Each dimension has its indicator that is assessed using a scale from 1 to 5. Table 1 shows the result of the SCRM assessment.

Table 1. Supply Chain Risk Management Assessment

Construct	Items	Indicator	Value
Risk Identification	Ident 1	The company is comprehensively informed about the risks in the supply chain.	5
	Ident 2	Companies are constantly looking for short-term risks in the supply chain.	5
	Ident 3	The company determines the relevant observation fields in risk analysis for suppliers and supply chain partners.	2
	Ident 4	The company determines warning indicators in conducting supply chain partner analysis.	5
Risk Assessment	Assess 1	Companies are looking for possible sources of supply chain risk	5
	Assess 2	Companies evaluate possible supply chain risks	5
	Assess 3	The company analyses the possible impact of supply chain risks.	5
	Assess 4	Companies classify and prioritise supply chain risks	5
	Assess 5	Companies evaluate the urgency of the supply chain.	5
Risk Mitigation	Mitigate 1	The company shows and demonstrates possible reaction strategies.	5
	Mitigate 2	The company evaluates the effectiveness of possible reaction strategies.	5
	Mitigate 3	For companies, supply chain risk management is an important activity.	5
Risk Control	Control 1	Company employees have sensitivity to the perception of supply risk.	3
	Control 2	The company has a level of risk management professionalism	4
	Control 3	The company has succeeded in minimising the frequency of supply chain risks over the last 3 years	4
	Control 4	The company has managed to minimize the impact of supply chain risk over the last 3 years.	4

After assessing the four dimensions, the SCRM system implemented by XYZ Hospital is good. However, there are

still areas that need to be improved, such as risk identification 3, when the company determines the relevant observation fields in risk analysis for suppliers and supply chain managers. This is because the company only does it once every six months. Figure 2 is an overall SCRM assessment.

Fig 2. SCRM Assessment Result

After knowing the SCRM system implemented by XYZ Hospital, the next step is mapping drug supply chain risk activities.

Table 2. Mapping SC Process Activity

Process Area	Supply Chain Management
Plan	Inventory planning calculation
	Drug formulary design planning
Source	Drug procurement process from the distributor
	Receipt of drugs from distributors
Make	Drug prescribing process
	Drug preparation process
	Giving rules of use
	Concocted Medicine
Deliver	Distribution of drugs between pharmacies to nurses
	Distribution of drugs between pharmacy to patients
Return	Drug withdrawal
	Patient drug return

Mapping supply chain activities using the SCOR model consists of several process areas: plan, source, make, deliver, and return. As explained in table 2, there are several drug supply chain activities at the pharmacy installation of XYZ Hospital, which were obtained from interviews with the Head of the Pharmacy Installation Unit.

This risk identification is carried out using HOR analysis, which aims to know what risk events and causes occur during drug supply chain activities. Based on the interview results with the Head of the Pharmacy Installation Unit, there are 20 risk events and agents. It is shown in table 3 below.

Table 3. Supply Chain Risk Management Assessment

Process & Sub Process	Risk Event	Code	Risk Agent	Code
Plan - Inventory planning calculation	Mismatch of drug needs with the initial calculation	E1	Frequently changing disease trends	A1
	Out of Stock	E2	Improper planning	A2
Plan - Drug formulary design planning	Requests for types of drugs outside the hospital formulary	E3	Doctor's non-compliance	A3
Source - Drug procurement process from the distributor	Drug delivery delay	E4	Scarcity of medicine	A4
Source - Receipt of drugs from distributors	Presence of broken/ crushed medicine	E5	Packaging error during delivery	A5
	The goods arrived not in accordance with the order letter and the quality of the goods was not up to standard	E6	There is no checking when receiving drugs from distributors and there are miss understandings when communicating	A6
Make - Drug prescribing process	Misreading Drug Prescription	E7	Doctor's writing is not clear	A7
	The medicine given is not in accordance with the doctor's prescription instructions	E8	Prescribed drugs are restricted	A8
Make - Drug preparation process	Incorrect drug taking (name of drug, dose, type of drug preparation)	E9	Inaccuracy of officers because drugs are not separated and marked	A9
	Long waiting time	E10	Writing prescriptions and etiquette is still manual, the number of officers is less	A10
	Inaccurate in the preparation of injection drugs	E11	Pharmacy officers do not double check	A11
Make - Giving rules of use	Error writing Rules of use	E12	Doctor's writing is not clear	A12
Make - Concocted Medicine	Dosage calculation error	E13	Incompetent officer (new employee)	A13
Deliver - Distribution of drugs between pharmacies to nurses	Medication delivery errors to inpatients	E14	Inaccuracy of nurses or doctors in providing patient identification stickers	A14
Deliver - Distribution of drugs between pharmacy to patients	The patients name almost similar	E15	Patient misheard	A15
Return - Drug with drawal	Damaged or expired medicine in the service room	E16	No withdrawal of drugs approaching the ED or damaged drugs from the service room	A16
	The quality of the medicine is reduced or damaged	E17	Withdrawal by distributor	A17
	Refund claim response to old distributor	E18	The process of making return invoices by old distributors	A18
Return - Patient drug return	The therapy method has been changed	E19	Doctor's request	A19
	Patients have allergies	E20	Unpredictable allergies from patients	A20

After identifying the events and causes of risk, the next step is to assess each event (severity) and causes of risk (occurrence). Severity assessment relates to how much impact is given or obtained if a failure or error occurs. While the occurrence assessment relates to how often errors occur.

Tables 4 and 5 are some results of the highest severity and occurrence assessment obtained from interviews with the Head of the Pharmaceutical Installation Unit using a rating scale of 1-10 adopted from (Bennett et al., 2017).

Table 4. Highest Severity Rating

Process Area	Risk Event	Code	Severity
Make	The medicine given does not follow the doctor's prescription instructions	E8	8
Deliver	Similar patient names	E15	8
Return	Damaged or expired medication in the service room	E16	8
Return	The quality of the medicine is reduced or damaged	E17	8
Plan	*Out of Stock*	E2	7
Source	Drug delivery delay	E4	7
Source	Presence of broken/crushed medicine	E5	7
Make	Incorrect drug taking (name of drug, dose, type of drug preparation)	E9	7
Make	Inaccurate in the practice of injection drugs	E11	7

Table 5. Highest Occurrence Rating

Process Area	Risk Agent	Code	Occurrence
Make	Prescribed drugs are restricted	A8	8
Make	Writing prescriptions and etiquette is still manual, and the number of officers is less	A10	7
Return	Improper planning	A2	6
Return	Scarcity of medicine	A4	6

Correlation assessment assesses the relationship between each risk agent (risk agent) that gives rise to each risk event (risk event). For example, in the correlation assessment, if the value = 0, 1,3, and 9, each review indicates no correlation, low, medium, or high. After calculating the correlation between risk sources and risk events obtained through interviews with XYZ Hospital Pharmacy Workers, and some stakeholders who were responsible for hospital operations, the Aggregate Risk Potential (ARP) value was calculated.

After that, Pareto diagram is generated to know the highest causes of risk happened in the hospital XYZ pharmacy, also to create a priority scale based on the pareto principal that 80% effects comes from 20% causes. Thus, we focus on the highest 80% rank of risks which has the highest contribution.
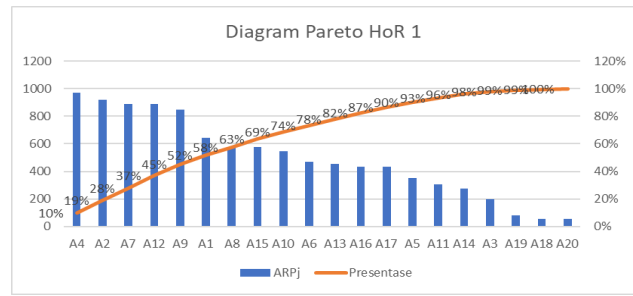

Figure 3. SCRM Assessment Result
(Source: Data Processing Results)

Based on the results of the Pareto diagram in Figure 3, if the priority of the selected risk causes is based on 80% of the high contributing risks, then there are 11 selected risk causes. Starting with the highest aggregate risk potential value caused by drug scarcity (A4), the ARP value is 972 or 10% cumulative, until the risk caused by incompetent officers or new employees (A13) gets an ARPj value of 456 or 78% incremental. Overall, the 11 risks are shown in table 6.

Table 6. Risk Identified

Code	Risk Agent	ARP
A4	Scarcity of medicine	972
A2	Improper planning	918
A7	The doctor's writing is not clear	888
A12	The doctor's writing is not clear	888
A9	Inaccuracy of officers because drugs are not separated and marked	850
A1	Frequently changing disease trends	645
A8	Prescribed drugs are restricted	576
A15	Patient misheard	576
A10	Writing prescriptions and etiquette is still manual, and the number of officers is less	546
A6	No checks were made when receiving drugs from distributors and there were misunderstandings when communicating	468
A13	Incompetent officer (new employee)	456

After getting risk agent priority by using House of Risk stage 1, it will proceed to the House of Risk stage 2, which is used to provide risk management to the risk agent's priority. If you look at the analysis of the previous Pareto diagram discussion in figure 3, there are 11 selected risk agents based on 80% of the risk contribution.

The next stage is correlation assessment between risk agents and proposing risk mitigation strategies. First, researchers get a correlation assessment from the adaptation of the House of correlation model Quality (HOQ) which is done by conducting direct interviews with the Head of the Pharmacy Installation Unit or expert staff who have a role in their respective fields. In the correlation assessment, if the value = 0, 1,3 and 9, each review

indicates no correlation, low, moderate, or high. After calculating the correlation, proceed to an assessment of the total calculation of the effectiveness of preventive measures (TEk).

After the House of Risk 2, several proposals for risk management that the Pharmacy Installation can immediately carry out to minimise risk based on the highest priority. The proposed risk management strategy is obtained from assessing the difficulty level's effectiveness ratio. The total value of the repair effectiveness ratio on the difficulty level ($ETDk$) can be calculated by the formula for calculating the total effectiveness of the action prevention (TEk) divided by the level of difficulty in performing each action (Dk). After knowing the calculation results of the effectiveness to problem ratio, a priority order of risk management strategies is obtained, which can later be applied by pharmaceutical installations, as shown in table 7. Following are managerial implications that the company can immediately implement:

1. Confirm with the doctor for prescriptions that are not clearly legible. The hospital can also consider starting e-prescription implementation thoroughly
2. Ensure storage of LASA drugs (look-alike and look-alike) with a yellow LASA sign and Tall Man Lettering (big, small letter).
3. Conduct supplier performance evaluation
4. Planning calculation by considering disease trends and seasonal cycles
5. Analysis of procurement planning is accommodated by the Information System sales update data management
6. Confirming the doctor for writing the rules for use that are not read. Start developing SIM RS e-etiquette.
7. Performing the calculation of HR needs by the average load work and the number of prescriptions served and recruiting personnel Pharmacy and Pharmacists Technical.
8. Receiving goods according to the SOP for Receiving Drugs/Alkes.
9. Carry out special orientation (training), scientific refresh for old employees, and routine credentialing (evaluation).
10. Conduct socialisation with doctors regarding drug restrictions and carry out educating patients about drug restrictions
11. Evaluating existing loudspeakers and system upgrade announcements.

Of the 11 proposed risk management strategies, the implications of managerial activities that can be implemented immediately by XYZ Hospital are it is necessary to establish a special division in the company, namely the management division risk. The establishment of a risk management team division helps carry out every proposed strategy that has been made. This is because house Hospitals today are more focused on the risks associated with the patient. Therefore, this risk management division team is formed to socialize 11 proposed risk management strategies so that it can be implemented immediately.

CONCLUSION

Based on the SCRM assessment and supply chain risk activity flow assessment, it can be concluded that:

1. The risk management system implemented by the pharmaceutical installation at XYZ Hospital is good overall. Still, there are indicators of assessment that are lacking in the risk identification dimension 3, because the company determines the relevant observation field in risk analysis for suppliers and supply chain suppliers only every six once a month.
2. Based on the House of Risk stage 1, 20 risks (risk events) and 20 risk agents (risk agents) affect supply chain management performance. After the House of Risk 1 has been compiled, the highest priority ranking of the causes of risk is carried out using the Pareto Diagram.
3. Based on the results of the House of Risk phase 2, 11 proposed strategies of risk management need to be carried out immediately by the pharmaceutical installation in XYZ Hospitals based on the highest ranking priority.

These findings have significant implications for the understanding of how to dealing with risks in supply chain context that is happened in the pharmacy hospital context. However, the generalisability of these results is subject to certain limitations, for instance, it only considers a single case from XYZ Pharmacy. Considerably, more work will need to be done, to increase the assessment scope, not only on pharmacy hospital, but also on the whole hospital, as supply chain works with entire organizational ecosystem. Besides that, this research also focusses on micro level. Future studies should involve more stakeholders on macro level, such as government, industries, also academic.

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