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Risk Mitigation Design for the Drug Supply Chain at the Pharmacy Installation of Hospital X in Surakarta Using the SCOR and House of Risk Methods

Viktorda S. Noti[1*], Jason Merari Peranginangin[2], Iswandi[3]
Master of Pharmacy Program, Faculty of Pharmacy, Setia Budi University Surakarta
Corresponding Author: Viktorda S. Noti viktornoti20@gmail.com

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A B S T R A C T

Hospitals must maintain medicine availability in the right type, quantity, quality, and time. This study mapped drug supply chain risks at the Pharmacy Installation of Hospital X, Surakarta, and prioritized mitigation using SCOR and House of Risk. A descriptive design was applied to four pharmacists directly involved in planning, procurement, compounding, distribution, and return processes. The study identified 21 risk events and 21 risk agents. The main risk agents were emergency time pressure, insufficient pharmacy staff, slow bureaucracy, recurring e-catalog problems, limited SIMRS support for e-prescribing, and weak distributor communication. The priority actions were routine cross-unit coordination, escalation of service barriers to leadership, and service quality standards for monitoring

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INTRODUCTION

Drug supply chain management in hospitals plays a central role in ensuring therapeutic success, operational efficiency, and compliance with pharmaceutical service standards. Medicine availability for the right patient, at the right time, and in the right condition is one of the most important indicators of hospital pharmacy performance (Mensah et al., 2015; Mehralian et al., 2015). In hospital settings, disruptions in supply continuity may directly affect treatment delays, patient safety, and the perceived quality of care.

The medicine supply chain involves interconnected activities that begin with demand planning and budgeting, continue through procurement from distributors, receipt and storage, compounding and dispensing, distribution to patients or wards, and end with return management. Because these stages are highly interdependent, risks can emerge from multiple points, including stock-outs, procurement delays, prescribing errors, compounding errors, information system failures, and weak communication with suppliers (Govindan et al., 2020; George & Elrashid, 2023; Kusreni et al., 2023).

Preliminary observations at Hospital X in Surakarta indicated recurring problems related to medicine availability, procurement delays, and constraints in the use of the national e-catalog system. These conditions suggest that hospital pharmacy operations require a structured risk management approach so that risk sources can be identified early, prioritized objectively, and addressed through measurable mitigation actions. In this study, the Supply Chain Operations Reference (SCOR) model was used to map the process structure, while the House of Risk (HOR) method was used to identify dominant causes of risk and determine mitigation priorities (Cahyani et al., 2016; Hadi et al., 2020).

Previous studies on pharmaceutical supply chain risk mitigation have largely focused on pharmacies or non-hospital organizations. Therefore, this study contributes to the literature by examining the pharmacy installation of a hospital and by integrating SCOR-based process mapping with HOR prioritization in the context of hospital pharmaceutical services. The study aimed to identify risk events and risk agents across the drug supply chain at Hospital X in Surakarta and to determine the most important risk mitigation strategies for managerial implementation.

THEORETICAL REVIEW

Pharmaceutical Supply Chain Management

Pharmaceutical supply chain management refers to the coordinated planning, sourcing, handling, distribution, and control of medicines to ensure uninterrupted and safe service delivery. In hospitals, this chain is more critical than in ordinary retail settings because medicine shortages, delays, or errors may affect therapy outcomes and patient safety. Effective supply chain management

therefore requires both logistical efficiency and clinical governance (Mensah et al., 2015; Campling et al., 2022).

SCOR Model

The SCOR model provides a process-based framework for mapping supply chain activities into plan, source, make, deliver, and return. In the context of hospital pharmacy services, SCOR helps locate operational vulnerabilities at each stage and supports structured observation of activities from planning and procurement to dispensing and returns. This study employed SCOR as the main process mapping tool because it enables risk identification to be tied directly to operational stages.

House of Risk (HOR)

House of Risk is a proactive risk management approach that links risk events with the agents that trigger them. HOR phase 1 is used to identify priority risk agents through Aggregate Risk Potential (ARP), while HOR phase 2 evaluates the effectiveness and difficulty of alternative mitigation actions using the Effectiveness to Difficulty Ratio (ETDk). This structure is suitable for hospital pharmacy operations because it supports managerial prioritization rather than merely listing risks (Hadi et al., 2020; Cahyani et al., 2016).

Research Framework

Based on the theoretical foundation above, this study used SCOR to map the medicine supply chain and HOR to transform identified risk relationships into managerial priorities. The framework links operational activities, risk events, risk agents, and mitigation options in a single analytical flow.

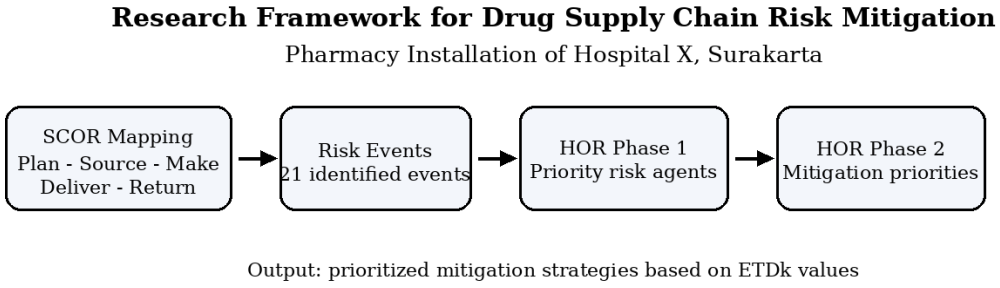

Figure 1. *Research Framework*

METHODOLOGY

This study applied a descriptive research design with qualitative and quantitative data collection. The SCOR framework was used to classify hospital pharmacy activities into plan, source, make, deliver, and return processes. After the process map was completed, House of Risk phase 1 was applied to list risk events, identify risk agents, rate severity and occurrence, and calculate Aggregate Risk Potential. House of Risk phase 2 was then used to select and rank mitigation alternatives according to their effectiveness and implementation difficulty.

The study involved four pharmacists who were directly engaged in the drug supply chain at the Pharmacy Installation of Hospital X in Surakarta. They represented the pharmacy head, the pharmacy warehouse coordinator, the compounding coordinator, and a compounding pharmacist. Qualitative data were obtained through in-depth interviews, while quantitative judgments were collected through a structured questionnaire completed by the respondents.

Severity and occurrence scores were assessed on a 1-5 scale. Correlations between risk events and risk agents, as well as between risk agents and mitigation actions, were rated on a 0, 1, 3, and 9 scale. The resulting ARP scores were used to determine the most critical risk agents, whereas ETDk values from HOR phase 2 were used to determine the mitigation actions that should be prioritized first by management.

RESEARCH RESULTS

The study identified critical risks across the hospital medicine supply chain and translated them into a clear order of mitigation priorities. The results are summarized in the tables below.

Table 1. Characteristics of Research Respondents

No.	Respondent	Sex	Position	Work Experience
1	apt. R. W	F	Head of Pharmacy	>10 years
2	apt. H	M	Compounding Coordinator	>10 years
3	apt. E	F	Compounding Pharmacist	>5 years
4	apt. E. K	F	Warehouse Coordinator	>10 years

All respondents were pharmacists with more than five years of work experience. Their long experience strengthened the reliability of risk identification because they were familiar with day-to-day operational constraints in hospital pharmacy services.

Table 2. Summary of Risk Events and Risk Agents by SCOR Process

Process	Risk Events	Risk Agents	Illustrative Findings
Plan	5	5	Budget constraints; non-formulary items; longer lead time
Source	5	5	Delayed delivery; e-catalog unavailable; distributor stock-outs
Make	4	4	Unclear prescribing; accumulated prescriptions; compounding errors
Deliver	4	4	Delayed ward delivery; poor patient understanding; identity mismatch
Return	3	3	Rejected claims; slow response; damaged or expired items not accepted

The findings show that risks were distributed across all SCOR stages rather than being concentrated only in procurement. Although plan and source each contributed five events, the most sensitive consequences appeared in the make and deliver stages because they were directly related to patient safety, service timeliness, and treatment continuity.

Table 3. Priority Risk Agents Based on ARP Value

Code	Risk Agent	ARP	Category
A14	Emergency time pressure with limited training or supervision	330	Extreme
A13	Insufficient pharmacy personnel	312	Extreme
A5	Unresponsive bureaucracy	259	High
A9	Recurring e-catalog problems	230	High
A12	SIMRS does not adequately support e-prescribing clarity	220	High
A8	Weak communication with distributors	173	Extreme

In HOR phase 1, the highest ARP scores were found in emergency time pressure and workforce limitations. These factors increased the likelihood of prescription accumulation, compounding delays, and service errors. Bureaucratic delay, unreliable e-catalog access, insufficient support from the hospital information system, and weak distributor communication also emerged as important causes of disruption.

Table 4. Priority Risk Mitigation Strategies Based on ETDk Value

Rank	Code	ETDk	Mitigation Strategy
1	PA3	1275.667	Routine coordination, escalation of service barriers, and new quality standards for monitoring
2	PA2	1266.000	Additional pharmacy personnel based on workload needs
3	PA6	1073.000	Stronger distributor communication and distribution support
4	PA1	850.500	Coordinate with service units, extend service time, open depots, and schedule monthly training
5	PA4	736.000	Formal system report to LKPP for e-catalog problems
6	PA5	732.250	Evaluate and strengthen SIMRS, vendor support, IT staff, network, and server

HOR phase 2 showed that PA3 was the most promising mitigation package because it directly targeted cross-unit coordination and governance problems that slowed planning, procurement, and service delivery. The ranking also indicates that workforce reinforcement, better distributor coordination, and stronger information systems are essential to improve pharmaceutical supply reliability in hospital settings.

DISCUSSION

The study confirms that medicine supply chain risk in hospitals is not merely a procurement issue. Instead, the risk structure extends across planning, operational execution, information support, and managerial coordination. This finding is consistent with the view that pharmaceutical supply chains require integrated governance because the impact of disruption is amplified by the clinical consequences of delayed or incorrect medicine delivery (Mensah et al., 2015; Campling et al., 2022).

The extreme position of time pressure and personnel shortage indicates that the make and deliver stages deserve close managerial attention. In emergency situations, high service intensity may compress verification, compounding, and handover processes. If staffing capacity does not match workload, the risk of delay and error increases. Therefore, human resource adequacy should be interpreted not only as an administrative concern but also as a patient safety issue.

The appearance of bureaucracy, e-catalog constraints, and SIMRS limitations among the major risk agents also suggests that service continuity depends on both external and internal systems. Procurement in hospitals is often shaped by formal governance procedures and public purchasing mechanisms. When those systems are slow or unreliable, local pharmacy teams may have limited room to respond quickly. Accordingly, mitigation should focus on escalation mechanisms, monitoring standards, and stronger coordination between pharmacy, management, IT support, and procurement units.

Communication with distributors emerged as another important risk factor. In practice, weak communication may reduce visibility into stock availability, delivery schedules, and return handling. This result supports the need for collaborative relationships with suppliers and more active information exchange. By linking supplier coordination with internal quality monitoring, hospitals can reduce uncertainty in the flow of medicines and respond more quickly to shortage threats.

Overall, the combination of SCOR and House of Risk proved useful because it connected process mapping with decision prioritization. SCOR clarified where risks were embedded in the operational chain, while HOR transformed those observations into an actionable sequence of mitigation priorities. This integrated approach can help hospital managers move from reactive problem solving to proactive risk governance in pharmaceutical services.

CONCLUSIONS AND RECOMMENDATIONS

This study found that the most important mitigation priorities for the drug supply chain at the Pharmacy Installation of Hospital X were stronger cross-unit coordination, routine escalation of service barriers to hospital leadership, and the establishment of service quality standards for monitoring. These actions were prioritized because they directly addressed the main bottlenecks affecting planning, procurement, and pharmacy service operations. Hospital management is therefore advised to strengthen governance mechanisms, improve inter-unit

communication, reinforce staffing capacity, and optimize information system support so that operational risk can be reduced more effectively.

FURTHER STUDY

This research was limited to a small number of respondents within one hospital pharmacy installation, so the findings represent an in-depth case rather than a broad generalization. Further studies may compare several hospitals, include additional stakeholders such as procurement staff and distributors, or integrate quantitative performance indicators such as service time, stock-out frequency, and prescribing accuracy to enrich the mitigation model.

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