A Research to Assess the Logistics Solutions for Pharmaceutical Companies in Outbreak Situations Based on Fuzzy TOPSIS

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ABSTRACT

With the outbreak of the COVID-19 in early 2020, logistics research has gradually become a major issue for material protection during the pandemic. This article focuses on the importance of medical logistics risk response under the pandemic. It proposes a risk evaluation method for the risk control plan of medical enterprise logistics transportation in a fuzzy and uncertain environment.

Firstly, a combination of fuzzy decision-making theory, group decision-making, and TOPSIS methods were used to propose an evaluation method framework for pharmaceutical companies' response to the epidemic logistics plan. Secondly, consideration and establishment of a risk evaluation index system for pharmaceutical companies from the perspective of emergencies such as the pandemic was considered. Finally, the method verification was carried out on a pharmaceutical company's three logistics solutions in Linyi City as an example.

KEYWORDS: Fuzzy TOPSIS; Risk assessment; Epidemic risk; Medical logistics

1 INTRODUCTION

1.1 Research background

The pharmaceutical logistics industry actively promotes the construction of logistics information by developing pharmaceutical cold chain logistics. It is more and more adapted to the trend of rapid economic development and technological progress in the world today.

At the beginning of 2020, the sudden new crown epidemic brought a significant impact to all walks of life. During the epidemic, medical logistics' development determines whether medical supplies can be supplied to the disaster-stricken areas in time, which has become the logistical support for the nation's fight against the epidemic. Firstly, the awareness of information communication is weak, and the flow of information is slow. The lack of a unified and standardized material management information platform for emergency medical supplies has led to the inability to effectively share and match the demand for medical supplies and logistics services such as production, storage, procurement, supply, and donation with supply information promptly. Secondly, the advantages of modern logistics are not prominent, and logistics costs are high. During the epidemic, the medical logistics supply chain monitoring and response plan lacked lower-level transparency. This is because digital platforms' application is not widespread in the entire supply chain, which brings difficulties to the timely response and dispatch of medical supplies. The logistics information network coverage is not comprehensive enough, which affects the effectiveness and efficiency of transportation.

1.2 Domestic and foreign research

Based on the existing literature review, there are relatively few studies on supply chain risk management locally and abroad. This narrative mainly focuses on extending the theory and technology of risk management to supply chain management. Therefore, supply chain risk management is a relatively new concept. The source of supply chain risk is due to the existence of various uncertain factors. Since the enterprises on the supply chain network are interconnected, problems in any one enterprise will cause other enterprises on the supply chain network to be affected. The problems would lead to the rupture of the supply chain. Therefore, supply chain risks can also be referred to as supply chain vulnerability. As early as 2000, some scholars researched supply chain risk management. For example, Christopher and Towill (2000) pointed out that many economic development trends have made the supply chain's fragility more and more evident in year after year. In 2003, Svensson also believed that there are many interference factors in the supply chain. For a stable development of the supply chain, it is necessary to deal with these interference factors. This requires supply chain companies to understand the existing interference and the source of the interference to understand themselves and their competitors and achieve victory in all battles. Zimon (2019) research shows that no matter what role it plays in the supply chain, a standardized management system is useful in supply chain risk management. According to the general evaluation, few respondents among logistics operators have a low assessment of the legality of implementing a standardized management system. Thus, logistics companies should consider implementing standardized management systems to improve supply chain management, enhance supply chain risk management, and achieve sustainable development of supply chains.

Based on existing literature and studies, an enterprise's strategic and tactical decisions determine the extent to which it can reduce or aggravate the impact of enterprise risk events. However, public health emergencies are inevitable, and their influence can be reduced by building an efficient emergency logistics system.

Various scholars have studied the impact of major public health emergencies on the industry and the corresponding countermeasures. However, there are few systematic studies from the perspective of logistics enterprises. The research on supply chain risk management is presently mainly concentrated on qualitative aspects, with few quantitative research results. Therefore, this article is based on logistics companies' research across the country during the COVID-19 pandemic. First, it analyzes the impact of the construction of the epidemic, such as a public health event, on logistics companies. Secondly, it analyzes and proposes three logistics risk management plans under the epidemic. Lastly, it uses the TOPSIS method to evaluate and rank the three projects to get the best strategy.

1.3 Thinking about risk management under the epidemic

Since medicines are not generally stored like ordinary commodities, they need to meet certain storage conditions, and they can be transported promptly when required. However, the current storage equipment is not developed enough, such as simple refrigeration equipment. The shortage of equipment makes it more challenging to store medicines, and it is impossible to transport medicines to areas where they are needed quickly. Besides, the logistics operation process is not formal enough. When a crisis occurs, the logistics and transportation that are not formal will become more chaotic, the cost will increase significantly, and the work efficiency will decrease. With the rapid development of big data, artificial intelligence can also be used to realize the informatization of emergency logistics of pharmaceutical storage. Big data to discover drug storage supervision ensures the quality of drug storage and carries out large-scale scientific and reasonable storage. In a public health emergency such as an epidemic, the required medical supplies can be quickly dispatched. Secondly, improve and optimize the pharmaceutical logistics center's functions, connect pharmaceutical companies, hospitals, and pharmacies, share information promptly, accurately and flexibly respond to requirements, and control the supply chain in advance. Finally, a better network storage plan can be improved, enabling the scientific design of drug storage in the area to be covered.

2 Evaluation framework and index system of pharmaceutical companies under the epidemic situation based on fuzzy TOPSIS

2.1 Evaluation methods based on fuzzy decision theory, group decision-making, and TOPSIS study decision-makers' priority in a fuzzy environment.

For example, given a fuzzy order (reflexive, transitive binary fuzzy relation), or a non-transitive ordinary binary link, how to arrange a total order approximately; for the problem of multi-index and multi-utility function, how to use the method of fuzzy set theory synthesizes an optimal charge and how to order multi-level decision problems. These questions have been initially answered. Group process is a discipline with a long research history and modern application value in decision science. It studies how to combine the preferences of each member of a group of individuals for certain things into group preferences so that the group can sort or select all items in this category. As a means of selection, group decision-making is a powerful tool for dealing with major qualitative decision-making problems. CLHwang and K. Yoon in 1981 first proposed the TOPSIS method. It is a sorting method according to the proximity of a limited number of evaluation objects to the idealized target. It is based on existing objects—evaluation of pros and cons. Among these decision-making methods, TOPSIS has become one of the most commonly used multi-objective evaluation methods because of its simplicity and intuitiveness. However, the general TOPSIS method has many shortcomings, especially in the calculation formula of closeness. If there are some unique sample points in the TOPSIS method, it may cause an unreasonable ranking. The virtual worst-case end is introduced, and the closeness calculation formula is improved. There are some problems in the calculation formula of the TOPSIS method, which leads to sorting errors. Based on two reference points close to the ideal point and far from the ideal negative point, a new formula for calculating the relative closeness is defined. The fuzzy TOPSIS method can competently deal with the quantitative, qualitative, and fuzzy uncertain factors that affect the evaluation of the pharmaceutical enterprise's logistics plan and objectively evaluate the choice of the pharmaceutical enterprise's logistics plan.

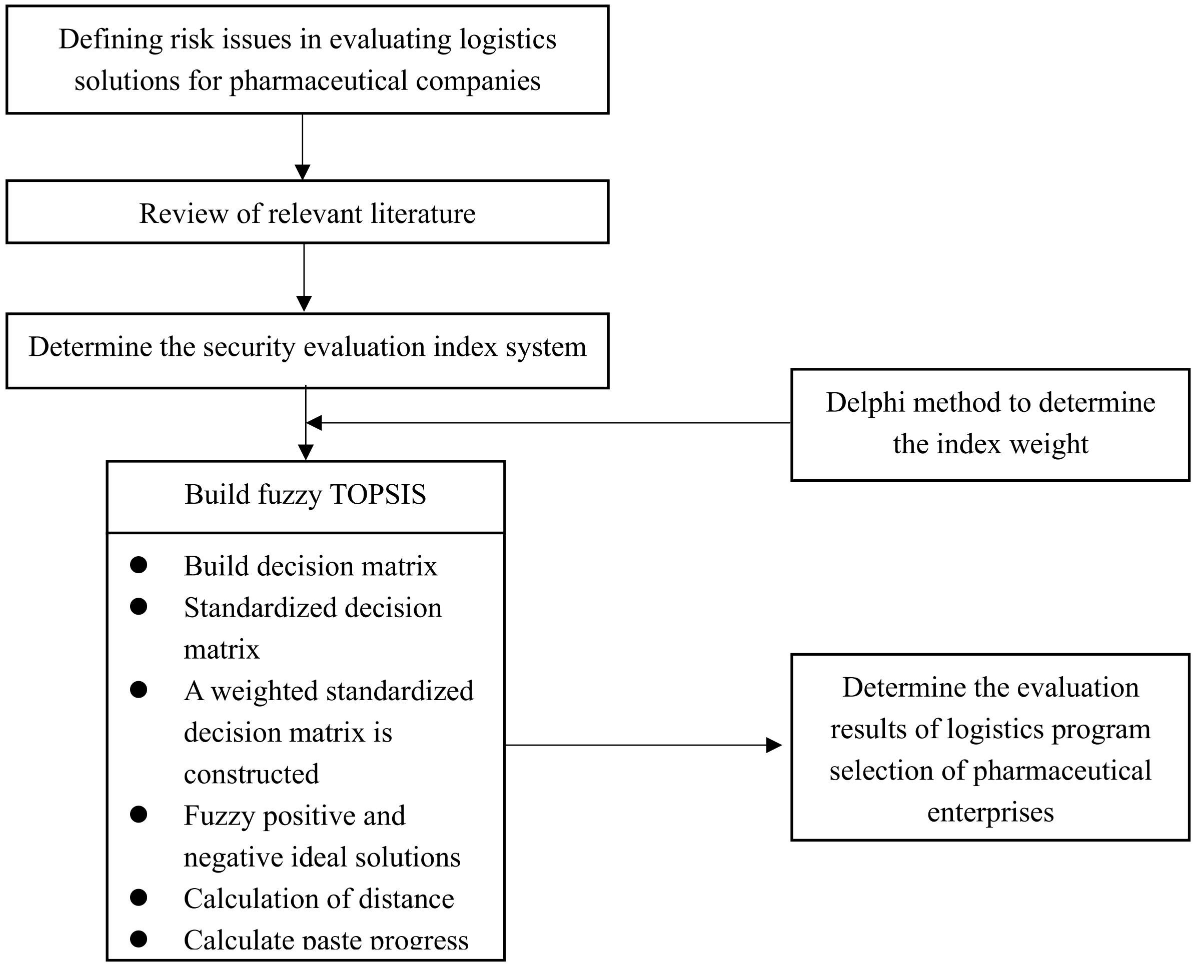

Figure 1: A fuzzy TOPSIS-based evaluation framework for pharmaceutical enterprise management programs

`2.2 Constructing an evaluation index system

The aging risk lies in the fact that there are particularly many uncertain factors in logistics transportation, which lead to long periods and low efficiency of logistics transportation, and delays in order processing, transportation, and distribution.

Information risk is embodied in two aspects: real-time tracking capability and information security. Information errors or difficulties in real-time tracking during logistics information delivery and medicines may be damaged or lost. Nowadays, logistics is gradually relying on network technology to develop. The network itself has certain security risks and even suffers from malicious attacks, which may cause information and data leakage.

Logistics losses are expected and challenging to solve in both domestic and foreign industries. The causes are mainly divided into force majeure factors such as natural disasters and customer satisfaction.

Pharmaceutical logistics involves a variety of transportation methods and logistics nodes. It has high requirements on the packaging technology, storage conditions, and return and exchange procedures of the goods, which increases the logistics costs of packaging, inventory, and transportation in the logistics process.

According to existing literature, logistics management investment refers to the funds invested in the supply chain transportation management process. The amount of funds is closely related to the standardization of supply chain management, which also impacts logistics transportation efficiency.

The environmental risk of pharmaceutical logistics refers to the risk of cross-border e-commerce logistics caused by the external environment's uncertainty, including force majeure, economic environment, policy environment, and industry environment.

Based on the above literature data, the evaluation index system shown in Table 1 was proposed. All the indicators will have a particular impact on the performance of logistics transportation of pharmaceutical companies.

Table 1: Evaluation of index system

Assessment level	Indicators	Index significance
Risk limitation	Order processing efficiency	Refers to the speed and efficiency with which orders are processed
	Transport efficiency	Speed and efficiency in transportation
Information risk	Real-time information tracking capability	Refers to the real-time tracking of logistics information in the process of transmission
	Logistics information security degree	Refers to the security degree of logistics information relying on the network
Risk of loss	Cargo damage	Damage caused in the course of transportation of goods
	Customer returns and exchanges	Refers to the quality of goods and customer satisfaction
The cost of risk	The cost of transportation	The cost of transporting goods
	Inventory cost	The cost of keeping goods in stock
Logistics management input	Logistics management input	Refers to the funds invested in the transportation management of the supply chain
Environmental risk	Risk of Force Majeure	Risks arising from natural disasters and war
	Political risk	Refers to whether the policies formulated by the country in the field of pharmaceutical logistics are favorable

2.3 Decision-making process:

The TOPSIS method has seven main steps, which are as follows:

Step 1: Construct language variables and their corresponding trigonometric functions.

This paper uses fuzzy semantic words to characterize the fuzzy description of decision-making members' evaluation index weights and index values . It defines two sets of fuzzy semantic words: very unimportant, unimportant, medium important, important (first set), and very important, very dissatisfied, dissatisfied, Average, satisfied, and very satisfied (second set). These fuzzy semantic words have their corresponding triangular fuzzy numbers, as shown in Table 2.

Table 2: Triangular fuzzy comparison table

Index weight fuzzy semantic words	Indicator value fuzzy semantic words	Triangular fuzzy number
Very unimportant	Very dissatisfied	(0, 0, 0.25)
unimportant	Dissatisfied	(0, 0.25, 0.5)
Medium important	General	(0.25, 0.5, 0.75)
Important	Satisfied	(0.5, 0.75, 1)
Very important	Very satisfied	(0.75, 1, 1)

Step 2: Construct a decision matrix.

There are M risk control plans if P decision-makers make group decisions, and there are n risk evaluation indicators. Here, the group decision method is used to determine the evaluation index value. The triangular fuzzy number is used to represent the quantitative index. The fuzzy semantic word is used to describe the qualitative index. Therefore, the safety evaluation index values in decision-making $i(i=1,2,\cdots,n)$ can be expressed by $\tilde{x}_{ij}=(x_{ij1},x_{ij2},x_{ij3})$. I suppose $\tilde{x}_{ij}^{p}=(x_{ij1}^{p},x_{ij2}^{p},x_{ij3}^{p})$ represents the fuzzy evaluation of the i index of the $j(j=1,2,\cdots,m)$ risk control plan by the $p(p=1,2,\cdots,P)$ decision-maker. It $\tilde{x}_{ij}=(x_{ij1},x_{ij2},x_{ij3})$ can be calculated by formulas (1) and (2).

$$\tilde{x}_{ij}=\frac{1}{P}\otimes\sum_{p=1}^{P}\tilde{x}_{ij}^{p} \quad (1)$$

Among them, $$x_{ij1}=\frac{1}{P}\sum_{p=1}^{P}x_{ij1}^{p};x_{ij2}=\frac{1}{P}\sum_{p=1}^{P}x_{ij2}^{p};x_{ij3}=\frac{1}{P}\sum_{p=1}^{P}x_{ij3}^{p} \quad (2)$$

Fuzzy semantic words also determine the weight of the index. $\tilde{w}_{i}^{p}=(w_{i1}^{p},w_{i2}^{p},w_{i3}^{p})$ is assumed that represents the $i(i=1,2,\cdots,n)$ fuzzy evaluation value of the $p(p=1,2,\cdots,P)$ decision-maker on the index's weight. Equations (3) and (4) are used to integrate the weight evaluation value $\tilde{w}_{i}=(w_{i1},w_{i2},w_{i3})$ of each decision-maker.

$$\tilde{w}_{i}=\frac{1}{m}\otimes\sum_{p=1}^{m}\tilde{w}_{i}^{p}=(w_{i1},w_{i2},w_{i3}) \quad (3)$$

Among them, $$w_{i1}=\frac{1}{P}\sum_{p-1}^{P}w_{i1}^{p};w_{i2}=\frac{1}{P}\sum_{p-1}^{P}w_{i2}^{p};w_{i3}=\frac{1}{P}\sum_{p-1}^{P}w_{i3}^{p}。 \quad (4)$$

Step 3: Standardize the decision matrix.

If $\tilde{x}_{ij} = (x_{ij1}, x_{ij2}, x_{ij3})$ is a fuzzy number, then the normalized value is $\tilde{y}_{ij} = (y_{ij1}, y_{ij2}, y_{ij3})$, then the calculation formula is:

$\tilde{y}_{ij} = (\frac{x_{ij1}}{x_{i3}^{+}}, \frac{x_{ij2}}{x_{i3}^{+}}, \frac{x_{ij3}}{x_{i3}^{-}}), x_{i3}^{+} = \max x_{ij3}$ Is the maximum endpoint value of the fuzzy number in the efficiency criterion	(5)
$\tilde{y}_{ij} = (\frac{x_{i1}^{-}}{x_{ij3}}, \frac{x_{i1}^{-}}{x_{ij2}}, \frac{x_{i1}^{-}}{x_{ij1}}), x_{i1}^{-} = \min x_{ij1}$ Represents the minimum endpoint value of the fuzzy number in the cost-type criterion	(6)

Step 4: Calculate the weighted normalization matrix.

$\tilde{z}_{ij} = \tilde{y}_{ij} \otimes \tilde{w}_i = (z_{ij1}, z_{ij2}, z_{ij3}) = (y_{ij1} \times w_{i1}, y_{ij2} \times w_{i2}, y_{ij3} \times w_{i3})$	(7)

Step 5: Determine the fuzzy ideal solution and fuzzy negative ideal solution.

$\tilde{z}^{+} = (\tilde{z}_1^{+}, \tilde{z}_2^{+}, \cdots, \tilde{z}_i^{-}, \cdots, \tilde{z}_n^{+})$	(8)
$\tilde{z}^{-} = (\tilde{z}_1^{-}, \tilde{z}_2^{-}, \cdots, \tilde{z}_i^{-}, \cdots, \tilde{z}_n^{-})$	(9)

The fuzzy ideal solution and fuzzy negative ideal solution are determined by sorting the barycenter method's fuzzy number. The fuzzy solution is fuzzy according to the following formula $\tilde{z}_{ij} = (z_{ij1}, z_{ij2}, z_{ij3})$. The fuzzy positive and negative ideal solution is determined according to the magnitude of z_{ij} .

$z_{ij} = \frac{z_{ij1} + z_{ij2} + z_{ij3}}{3}, \quad \forall i, j$	(10)

Step 6: Calculate the distance between each candidate solution and the fuzzy positive and negative ideal solution.

Definition 1: The distance between the triangular fuzzy number $\tilde{B} = (b_1, b_2, b_3)$ and fuzzy number $\tilde{U} = (u_1, u_2, u_3)$ is:

$d(\tilde{B}, \tilde{U}) = \sqrt{\frac{1}{3}[(b_1 - u_1)^2 + (b_2 - u_2)^2 + (b_3 - u_3)^2]}$	(11)

According to Definition 1, the distance from the $\tilde{z}_{ij}$ to positive ideal solution $\tilde{z}^{+}$ is $d_{ij}^{+} = d(\tilde{z}_{ij}, z_i^{+})$, and the distance from the negative ideal solution $\tilde{z}_i^{-}$ is $d_{ij} = d(\tilde{z}_{ij}, z_i)$. Then, the distance from the $j(j = 1, 2, \cdots, m)$ risk control scheme to $\tilde{z}^{+}$ is $D_j^{+} = \sum_{i-1}^{n} d_{ij}^{+}$, and the distance to $\tilde{z}^{-}$ is $D_j = \sum_{i-1}^{n} d_{ij}$.

Step 7: Calculate the relative sticking progress with the fuzzy positive ideal solution, and sort it.

$T_j^{+} = \frac{D_j}{D_j^{+} + D_j^{-}}$	(12)

Where $T_j^{'}$ represents the relative closeness degree between the $j(j=1,2,\cdots,m)$ risk control scheme and the fuzzy positive ideal solution, and the greater the $T_j^{'}$ value, the higher the evaluation of the system.

3 CASE ANALYSIS

At the beginning of the epidemic, a charity's logistics operation in Wuhan was repeatedly criticized, mainly because of the opaque information, unbalanced distribution of materials, and unclear cargo information; hence, public opinion pushed it to the forefront. The problem reflected in this incident is that China's logistics has not fully utilized its advantages at this stage.

It can be seen that improving the logistics supply chain platform, improving the logistics warehousing system, and improving logistics efficiency has become a major issue that the academic industry needs to solve.

This paper will take a pharmaceutical company in Linyi City as an example to analyze the choice of logistics solutions for pharmaceutical enterprises under the epidemic, which still belongs to the growth trend in the general environment of the pharmaceutical industry development. 2019 pharmaceutical manufacturing business income will reach 263.27 billion yuan, an increase of about 8.5% over last year; 2020 pharmaceutical manufacturing business income will reach 2,817 billion yuan, an increase of about 7% over last year. In terms of sales, the pharmaceutical market sales will reach 178.16 billion yuan in 2019, up 4% from last year; the pharmaceutical market sales will reach 1,835.1 billion yuan in 2020, up 3% from last year. 2019 China's pharmaceutical market size has reached about 1.64 trillion yuan. China's pharmaceutical market will continue to maintain a growth rate comparable to previous years and reach about 2.13 trillion yuan in 2023. And a company in Linyi suffered from the epidemic in 2020, but the annual sales growth of 3% over the same period last year.

Among the industry dynamics, the outbreak of the Spring Festival in 2020 boosted the short-term demand for Internet healthcare in China, accelerating the development of the industry, and the pharmaceutical industry spurted. A pharmaceutical company in Linyi City uses a traditional logistics model to send drug sales agents to communicate with hospitals or pharmacies about the demand for medical supplies and further transport medical supplies to the hospital or pharmacy. Nowadays, the company insists on consolidating advantageous products, promoting potential products, implementing market development strategy, showing solid, sustainable and healthy development trend of product marketing, and further sales management by establishing drug supply chain management platform. Although a pharmaceutical supply chain management platform has been initially established, pharmaceutical transportation efficiency is still low due to imperfect platform construction, untimely, accurate, and flexible information transmission. Also, since the company has its headquarter in Linyi City, Shandong Province, medical supplies are mainly stored in Linyi City. The delivery of medicines in other areas cannot be done promptly, especially in remote areas outside the province. For its enterprises, a more scientific and reasonable network storage plan should be proposed.

To solve the risk problem of medical logistics under the epidemic situation, three options are provided. The first plan is to build a drug supply chain management platform. This will connect the modern logistics information system of drug circulation with hospitals or pharmacies' business management system through interface programs. The plan will use advanced logistics information methods to integrate the medical Logistics into a new management mode under a unified platform, thereby optimizing the entire drug supply chain and reducing circulation costs.

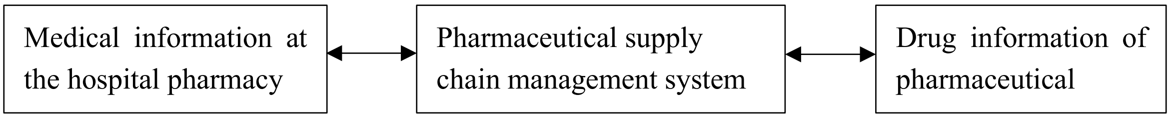

Figure 2: Drug supply chain management platform

The second plan considers that it is difficult for pharmaceutical companies to directly build a supply chain management platform with hospitals, so third-party logistics is used for distribution. According to the supplier management inventory concept, the third-party logistics company combines the hospital's actual situation. It uses modern logistics analysis methods to ensure the hospital's drug logistics' safety, accuracy, and efficiency. It mainly includes the construction of modern drug warehouses, automated logistics equipment, and the combination of logistics and information flow.

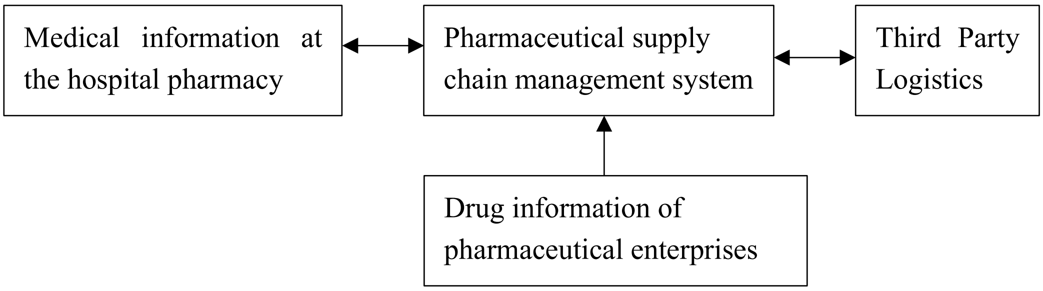

Figure 3: Third-party logistics supply chain management platform

The third plan is to design a networked storage plan. The networked warehousing plan essentially adopts a decentralized inventory strategy, placing a certain amount of inventory in a regional warehouse that can cover a certain distribution area based on regional sales and distribution frequency, forming a nationwide warehousing network, centralized management, and overall optimization. Thus, set up safety stocks according to the actual situation to ensure medical transportation response speed in emergencies. On the one hand, the networked warehousing solution can improve emergency warehousing efficiency in response to China’s new crown virus epidemic prevention and control. Besides, it can provide feasible ideas for the research on logistics warehousing theory.

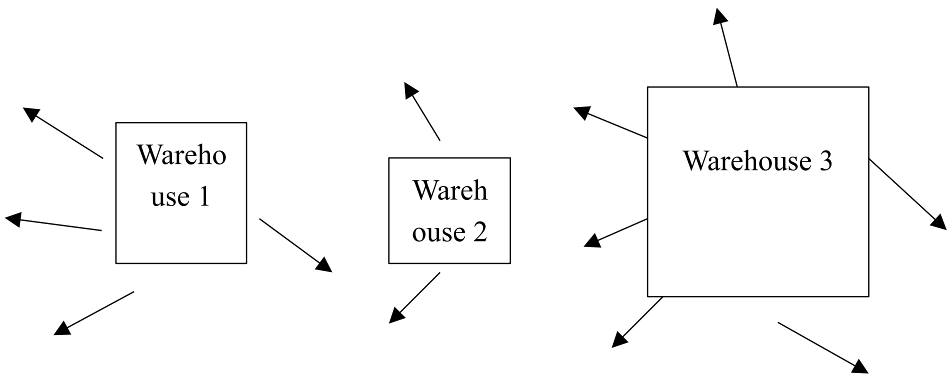

Figure 4 Networker warehousing

Take Linyi, a pharmaceutical company, for example. The company's pharmaceutical logistics business face the epidemic's challenge. It will now use the method proposed in this article to evaluate the three programs. Considering that choosing the most suitable solution is a difficult problem, to make the evaluation more scientific, the corresponding experts were selected to form a three-person decision-making group. The specific evaluation process was as follows:

Step 1: According to the content of Table 1, the group decision method was used to obtain each evaluation index value, and equations (1) and (2) was used to process the fuzzy numbers, as shown in Table 3.

Table 3: Risk assessment indicators for pharmaceutical transport schemes

Plans and decision-makers		Risk limitation	Information risk	Risk of loss	The cost of risk	Management input	Environmental risk
Plan1	Decision maker 1	General	Satisfied	Very unsatisfied	Very satisfied	（45，67，98）	Unsatisfied
	Decision maker 2	Satisfied	Very satisfied	Satisfied	Satisfied		General
	Decision maker 3	General	Very satisfied	Satisfied	General		General
Plan2	Decision maker 1	Very satisfied	Satisfied	Unsatisfied	Very unsatisfied	（87，98，100）	General
	Decision maker 2	Satisfied	Satisfied	General	General		Satisfied
	Decision maker 3	Satisfied	Unsatisfied	Very satisfied	Unsatisfied		Very satisfied
Plan3	Decision maker 1	Unsatisfied	Satisfied	Very unsatisfied	General	（60，65，70）	Very satisfied
	Decision maker 2	General	Satisfied	Satisfied	Unsatisfied		Satisfied
	Decision maker 3	Very satisfied	General	Unsatisfied	Unsatisfied		Satisfied

Step 2: Integration process of risk evaluation index weight.

Equations (3) and (4) was used to process the fuzzy numbers shown in Table 4 to obtain the evaluation indicators' integrated weights, respectively.

Table 4: Fuzzy evaluation and integration of evaluation index weight

Decision-makers	Risk limitation	Information risk	Risk of loss	The cost of risk	Management input	Environmental risk
Decision maker 1	Medium important	Important	Medium important	Very important	Medium important	Important
Decision maker 2	Medium important	Very important	Medium important	Important	Important	Important

Decision maker 3	Very important	Important	Unimportant	Very important	Important	Medium important
Integrated weight	(0.42,0.67,0.83)	(0.58,0.83,1)	(0.17,0.42, 0.67)	(0.67,0.92, 1)	(0.43，0.68，0.9)	(0.42,0.67, 0.92)

Step 3: Weighted decision matrix.

According to formulas (5), (6), and (7), the weighted decision matrix, as shown in Table 5 was calculated.

Table 5: Weighted decision matrix

The evaluation index /Plan	Plan 1	Plan 2	Plan 3
Risk limitation	(0.14, 0.39, 0.69)	(0.29, 0.56, 0.83)	(0.14, 0.46, 0.62)
Information risk	(0.39, 0.76, 1)	(0.19, 0.48, 0.83)	(0.24, 0.56, 0.92)
Risk of loss	(0.06, 0.21, 0.50)	(0.06, 0.24, 0.50)	(0.03, 0.14, 0.39)
The cost of risk	(0.34, 0.69, 0.92)	(0.05, 0.23, 0.50)	(0.05, 0.30, 0.58)
Management input	(0.18，0.44, 0.84)	(0.36，0.63，0.86)	(0.25, 0.42, 0.60)
Environmental risk	(0.07, 0.28, 0.62)	(0.21, 0.50, 0.85)	(0.24, 0.56, 0.92)

Step 4: Fuzzy positive and negative ideal solutions.

According to equations (7), (8), and (9), the following fuzzy positive and negative ideal solutions were obtained:

$\tilde{Z}^{+}$ ={(0.29,0.56,0.83),(0.39,0.76,1), (0.06,0.24,0.50), (0.34,0.69,0.92), (0.36,0.63,0.86), (0.24,0.56,0.92)}

$\tilde{Z}^{-}$ ={(0.14,0.39,0.69), (0.19,0.48,0.83), (0.03,0.14,0.39), (0.05,0.23,0.50), (0.18,0.42,0.60), (0.07,0.28,0.62)}

Step 5: Post the progress calculation result.

According to formulas (10) and (11), the post's progress between each evaluated plan and the positive and negative ideal solution was calculated.

Table 6: The progress of each evaluation scheme and the positive and negative ideal solutions

Evaluation scheme	D_j^+	D_j^-	$D_j^+ + D_j^-$	T_j^+
Plan 1	0.579	0.835	1.414	0.590
Plan 2	0.674	0.661	1.336	0.495
Plan 3	0.940	0.494	1.434	0.345

Judging from the calculation results in Table 6, the decision-maker determined the three risk control options' pros and cons: Plan 1> Plan 2> Plan 3.

Therefore, establishing a supply chain management service platform for the medical industry is the most appropriate logistics solution under the epidemic. A supply chain management platform can unify logistics, capital flow, information flow and service flow, and can generate relevant real-time transaction data, thus solving five problems faced by the current healthcare logistics supply chain.

Firstly, many health systems, if not independently operating departments, use different materials management information systems and agencies and departments with different processes. There would be multiple systems and multiple processes that lack cohesiveness and uniformity.

Next one, there will be high distributor fees. Most healthcare organizations spend hundreds of thousands of dollars a year on supply distribution with outside parties.

Besides, there will be a wholesaler-led pharmacy process that will obtain medications primarily from outside distributors and wholesalers, controlling the systems and processes for purchasing, ordering, receiving, and distributing medications

In addition, there is limited data available. In many health care organizations, the same products are known by different names depending on the facility or department. This reality limits the ability to aggregate data for decision making, volume purchasing, and volume ordering, thereby impacting profits.

Finally, many intermediaries or most distributors serve many customers and stock the products that are best for them to sell, but not necessarily what people need or want. This means that most healthcare organizations obtain supplies or purchase from many different distribution facilities to meet their needs.

4 CONCLUSION

This paper evaluates medical logistics' risk control programs under the epidemic and studies the risk evaluation index system. The paper also establishes a fuzzy TOPSIS evaluation method to solve multi-objective decision-making problems. Taking a pharmaceutical company in Linyi City as an example, the index selection was carried out, and three solutions were put forward according to the current logistics situation. The best solutions were evaluated and sorted out by TOPSIS method. Besides, the drug supply chain management platform was constructed. Although the matching process was carried out based on a limited number of solutions, it can still be seen from the optimization results that TOPSIS is a useful tool and has great potential in actual operations.

Compared with the existing research literature, this article has determined certain innovations based on two aspects: establishing evaluation indicators based on the possible risks caused by emergencies such as epidemics and using a pharmaceutical company as the research background. The examples show that this method has strong applicability and can provide effective decision-making support for industry authorities and enterprises' logistics management. Future research directions and development prospects: The relationship between enterprises and logistics suppliers has also risen from a simple transaction related to a strategic partnership, which can be regarded as a "shock absorber" for the entire supply chain. This can reduce the uncertainty of the supply chain and reduce the whole system's cost, thus helping increase the market’s response speed and enhance the market’s competitive position. How to scientifically evaluate and select third-party logistics providers that suit their own needs is an important topic for enterprises to strengthen their supply chain construction. It is also a hot and challenging research topic.

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