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Development Problems and Countermeasures of Pharmaceutical Cold Chain Logistics in Xianyang City

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Abstract: Firstly, based on the fishbone diagram, the existing problems of pharmaceutical cold chain logistics in Xianyang City were quantitatively analyzed. Then the AHP method is used to make a quantitative analysis of the relevant causes of the problem, through the weight and consistency test, the key factors leading to the problem, and finally put forward mitigation measures.

1. Introduction

With the continuous improvement of national health awareness, the importance of the field of pharmaceutical cold chain logistics is also increasing. As we all know, the effectiveness of specialty drugs needs the efficient operation of cold chain logistics along with the circulation of production, transportation, storage and other activities. Through research from 2013 to now, Xianyang City has integrated and divided its industrial clusters in order to accelerate its development, among which the pharmaceutical industry is one of the three main industries. Xianyang pharmaceutical enterprises are mainly concentrated in the high-tech Zone, where there are more than 50 standardized pharmaceutical enterprises, including nearly 25 pharmaceutical enterprises and nearly 16 medical device enterprises. In addition, there are 2 specialized in the preparation and storage of "stem cells" in the life science industry encouraged by the state, including Zhonggang Wanhai and so on. As one of the three industries, the pharmaceutical industry plays a vital role in the economic development of Xianyang City. The application of pharmaceutical cold chain logistics is an important part of the development of pharmaceutical industry. Therefore, this paper is expected to promote the rapid development of pharmaceutical industry in Xianyang city through the research of this topic.

2. Analysis of the Current Situation of Pharmaceutical Cold Chain Logistics in Xianyang City Based on Fishbone Diagram

By using fishbone diagram, the general level of pharmaceutical cold chain logistics in Xianyang City is not high in detail analysis, respectively from three aspects of basic equipment, management methods and personnel[1], as shown in Figure 1:

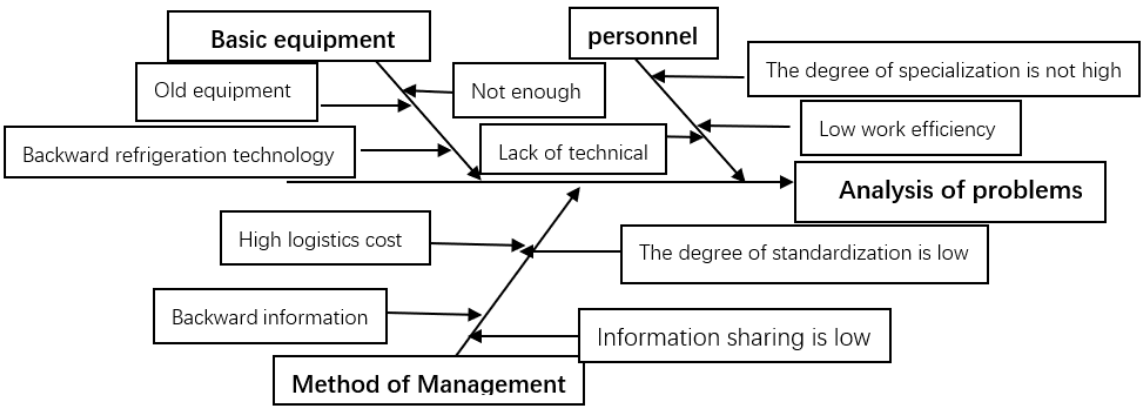

Figure 1: Causal diagram of problem analysis

1) Basic equipment. The basic equipment of cold chain logistics is divided into three parts: refrigerating truck, refrigerating equipment and cold storage. First of all, in terms of refrigerated vehicles, highway refrigerated thermal insulation vehicles only account for 0.3% of the total freight vehicles, and railway refrigerated vehicles only account for about 2%, and most of them are old and advanced refrigerated vehicles have not been popularized. Secondly, in the aspect of refrigeration equipment, the number of medical cold chain logistics related equipment is insufficient and old, and the refrigeration technology is backward, which often leads to the occurrence of "broken chain" phenomenon. Finally, the construction of cold storage still has the problem of unreasonable resource structure: more in the east and less in the west; There are far more freezers than refrigerators.

2) Management methods. In the management link analysis, on the one hand analyzed the logistics cost, this part is high. The pharmaceutical cold chain logistics market is characterized by "small, scattered and disorderly", and a unified socialized collaborative system has not yet been formed, which leads to a large amount of social resource waste, reduces the storage utilization rate and the turnover rate of the refrigerator, and intensifies the risk of medical chain break. In addition, due to the lack of standardized operation process, medical products in the transport, sorting, storage links lack of efficiency, low efficiency will inevitably bring high costs, pharmaceutical cold chain logistics costs remain high. On the other hand, it analyzes the degree of management informatization, which is generally low. The occurrence of drug safety incidents is largely due to the impromptness of information exchange. In the field of pharmaceutical cold chain logistics, due to technical restrictions, it is difficult to realize information sharing among all nodes in the supply chain from drug manufacturers to end users, and real-time monitoring and tracking of drugs in transit cannot be carried out. Low degree of informatization brings great challenges to demand prediction and implementation of temperature monitoring. It is one of the major measures for the transformation and upgrading of pharmaceutical cold chain logistics to establish a set of perfect drug traceability system relying on high level of informatization.

3) Personnel. There is a shortage of professionals. Professionals in the field of pharmaceutical cold chain logistics should have both medical knowledge and logistics knowledge. In recent years, although major colleges and universities have increased their efforts in personnel training, the supply of pharmaceutical and logistics talents is still in short supply, and the emerging talent gap of pharmaceutical cold chain logistics is more serious. The on-site technical personnel currently possessed by enterprises need a long period of early training before they can be trained. Due to unskilled technology, the operation efficiency is low, and it is easy to cause product quality problems.

3. Analysis of Key Factors of the Current Situation of Pharmaceutical Cold Chain Logistics in Xianyang City Based on AHP Method

When AHP method is applied, it includes four parts: constructing evaluation index system, constructing pairwise comparison matrix, calculating weight and consistency test. On the basis of the above fishbone diagram analysis, the index system was established, and the research targets were divided into first level index and subdivision index. Then the pairwise comparison matrix is constructed for weight calculation.

1) Construct the evaluation index system (Table 1).

Table 1: Index system of influencing factors

Analysis of problem factors	Basic equipment(A1)	Old equipment(B1)
		Backward refrigeration technology(B2)
		Insufficient equipment quantity(B3)
	personnel(A2)	Lack of technical proficiency(B4)
		Not very professional(B5)
		Low work efficiency(B6)
	Method of Management(A3)	High logistics cost(B7)
		The degree of standardization is low(B8)
		Backward information technology(B9)
		Information sharing is low(B10)

2) Construct a pairwise comparison judgment matrix. As shown in Table 2. The integer between 1 and 9 and its reciprocal were selected as the factor importance index of delivery delay. Pairwise comparison forms a judgment matrix $M=(m_{ij})_{nxm}$ the quality of being:

a)$m_{ij}>0$

b)$m_{ji}=1/m_{ij}$

c)$m_{ii}=1$ For any i,j=1、2、3…,n

Table 2: Pairwise comparison judgment matrix[2]

Scale of comparison	define
1	Compared with the two influencing factors, they are of equal importance
3	Compared with the two influencing factors, the former is slightly more important than the latter
5	Compared with the two influencing factors, the former is significantly more important than the latter
7	Compared with the two influencing factors, the former is more important than the latter
9	Compared with the two influencing factors, the former is more important than the latter
2,4, 6, 8	the middle values of two adjacent influencing factors
The bottom	Two influential factors compared, the latter than the former importance scale

3) Calculate the weight[2]

In the evaluation process of index system, each influencing factor is relative to the criterion $W_i$the weight is denoted asW_i^0, After normalization, the calculation formula is as follows:

$$W_i^0=\frac{W_i}{\sum_i W_i}=\frac{(\prod_{j=1}^{n} c_{ij})^{\frac{1}{n}}}{\sum_i(\prod_{j=1}^{n} c_{ij})^{\frac{1}{n}}} \quad \text{for any one i,j=1、2、3…,n} \quad (1)$$

4) Calculate the consistency index[2]

$$\lambda_{max}\approx\frac{1}{n}\sum_{i=1}^{n}\frac{\sum_{j=1}^{n} c_{ij}W_j}{W_i} \quad (2)$$

$$C.I=\frac{\lambda_{max}-n}{n-1}<0.1 \quad \text{for any one i、j=1、2、3…,n} \quad (3)$$

According to the above hierarchical structure of the evaluation system, the weight of the influencing factors causing the delay of the delivery time was calculated by combining the formula (1), and the consistency test of the calculated results was carried out according to the formulas (2) and (2).

The pair-to-pair comparison matrix is constructed according to the criterion layer, as shown in Table 3 below:

Table 3: pair-to-pair comparison matrix of criterion layer

	A1	A2	A3
A1	1	5	3
A2	1/5	1	5
A3	1/3	1/5	1

According to the calculation criteria in Table 3, the weights of A1, A2 and A3 are added, as shown in Table 4. The calculation formula is shown as above (1):

Table 4: Criterion layer factor weight values

	b1	b2	b3	Vi	Wi
b1	0.652174	0.806452	0.333333	1.79	0.60
b2	0.130435	0.16129	0.555556	0.85	0.28
b2	0.217391	0.032258	0.111111	0.36	0.12

Then continue to construct the fine-layer pairwise comparison matrix of A1, A2 and A3, as shown in Table 5, Table 6 and Table 7:

Table 5: Fine layer pairwise comparison matrix of criterion A1

A1	B1	B2	B3
B1	1	1/5	3
B2	5	1	5
B3	1/3	1/5	1

Table 6: Fine layer pairwise comparison matrix of criterion A2

A2	B1	B2	B3
B1	1	1/5	3
B2	5	1	5
B3	1/3	1/5	1

Table 7: Fine layer pairwise comparison matrix of criterion A3

A3	B1	B2	B3	B4
B1	1	1/3	1/4	1/5
B2	3	1	1/5	1/2
B3	4	5	1	3
B4	5	2	1/3	1

Calculate the weights of A1, A2, and A3 based on Table 5, Table 6, and Table 7, as shown in Table 8, Table 9, and Table 10:

Table 8 Weight values of criterion layer A1 factor

A1	b1	b2	b3	Vi	Wi
b1	0.16	0.14	0.33	0.63	0.21
b2	0.79	0.71	0.56	2.06	0.69
b2	0.05	0.14	0.11	0.31	0.10

Table 9 Weight value of factor A2 in criterion layer

A2	b1	b2	b3	Vi	Wi
b1	0.16	0.14	0.33	0.63	0.21
b2	0.79	0.71	0.56	2.06	0.69
b2	0.05	0.14	0.11	0.31	0.10

Table 10 Weight values of A3 factors in the criterion layer

A3	b1	b2	b3	b4	Vi	Wi
b1	0.08	0.04	0.14	0.04	0.30	0.07
b2	0.23	0.12	0.11	0.11	0.57	0.14
b3	0.31	0.60	0.56	0.64	2.11	0.53
b4	0.38	0.24	0.19	0.21	1.02	0.26

Consistency tests were carried out on Table 4, Table 8, Table 9 and Table 10 respectively according to formula (2) and (3). The values of the final test number C.I were all less than 0.1, indicating that the pair-based matrix was assigned a reasonable value.

According to the weight of the criterion layer and the weight of the fine layer, the weight value of each fine layer factor is finally calculated as shown in Table 11:

Table 11 Weight values of factor indicator system

Analysis of problem factors	Basic equipment(A1)	Old equipment(B1)(0.13)
		Backward refrigeration technology(B2)(0.41)
		Insufficient equipment quantity(B3)(0.06)
	personnel(A2)	Lack of technical proficiency(B4)(0.06)
		Not very professional(B5)(0.19)
		Low work efficiency(B6)(0.03)
	Method of Management(A3)	High logistics cost(B7)(0.01)
		The degree of standardization is low(B8)(0.02)
		Backward information technology(B9)(0.06)
		Information sharing is low(B10)(0.03)

After calculating and sorting the weight of the above influencing factors, it is found that the key factors leading to the problem are: the backward refrigeration technology in the basic equipment, the weight of this factor is 0.41, the weight of the personnel with low professional and technical

degree is 0.19, and the weight of the obsolete professional equipment is 0.13. For the above three influencing factors continue to improve.

4. Problem Solving Strategies

4.1 Improve the Management System in the Pharmaceutical Cold Chain

Cold chain acceptance management: When receiving goods, the delivery party's mode of transportation, transportation time, transportation equipment and temperature conditions should be checked and recorded. Those that do not meet the requirements of transportation temperature should be rejected. Those that use refrigerated trucks for delivery should directly unload the drugs into the refrigerated warehouse[3].

Cold chain storage Management: According to the current GSP requirements (Drug Trade Quality Management Practice) and other requirements, all kinds of refrigerated storage drugs should be placed reasonably according to the specified variety, batch number and classification requirements. Protein assimilation preparations and polypeptide hormone drugs should be temporarily placed in the special box inventory. All kinds of refrigerated storage drug facilities should be repaired and maintained according to the quality Check, should make relevant refrigerated drug storage management and emergency support plan as soon as possible, in case of abnormal system outage, equipment failure and leakage emergency emergency measures can be promptly taken[5-6].

Cold chain outbound management: The selection of refrigerated drugs should be carried out in the cold storage in the use of refrigerated truck transport distribution, should first start the refrigerated car pre-cooling, when reaching the specified temperature, and then directly from the refrigerated truck loaded with refrigerated boxes or thermal insulation box transportation, should be refrigerated or thermal insulation inside the pre-cooling, when reaching the specified temperature, placed in the box refrigerant, and then put drugs after the box sealed distribution car start, When the refrigerated box or incubator is loaded into the truck for the commission transportation and distribution of cold chain drugs, the transportation quality assurance agreement shall be signed, and the operation condition and temperature of the transportation facilities shall be checked. The truck shall not be loaded if the temperature fails to meet the requirements of the specified temperature[8-9].

4.2 Introduction of new Facilities and Equipment

Pharmaceutical cold storage equipment: The number and area of the warehouse should be in line with the scale of the varieties: cold storage should be equipped with automatic monitoring, regulation, display, record temperature and humidity conditions and alarm equipment, equipped with a spare generator set or double circuit installation, or equipped with a spare refrigeration unit, each door of the warehouse should be equipped with air curtain and other isolation measures. The warehouse structure is subcompact, the ground and walls are smooth and smooth. Warehouse door airtight warehouse equipped with necessary storage shelves or goods floor MATS[4].

Refrigerated transportation equipment for medicines: refrigerated trucks and vehicle-mounted refrigerated containers should be equipped in accordance with business varieties and distribution scale; The refrigerator or incubator shall be tested for its thermal insulation performance according to different materials, distribution time, configuration mode and ambient temperature, and transported within the range supported by the test results. The test data and report shall be retained. The refrigerator or incubator shall be equipped with the function of displaying and reading the temperature inside[8-9].

4.3 Training Professional and Technical Personnel

Cold chain logistics ensures the safety of national drug production and ensures people's normal production and smooth life. At present, there is a serious shortage of personnel training technology for cold chain logistics in our country, and the total amount of personnel for cold chain logistics is relatively insufficient, which restricts the continuous development of cold chain logistics[7]. In the whole domestic cold chain logistics industry system, the most scarce occupation is the professional warehousing and management compound talents. The warehousing and management position requires you to be proficient in all kinds of warehousing and logistics field operation management positions, understand the actual warehousing operation process, and have enough ability to cooperate with the logistics related departments and guide the completion of the warehousing field practical work[10].

5. Conclusion

Through this study, it is concluded that there are problems in basic equipment, management methods and personnel of pharmaceutical cold chain logistics in Xianyang City. Through detailed analysis, it is found that the key factors leading to these problems are as follows: The refrigeration technology of basic equipment is backward, the weight of this factor is 0.41, the weight of personnel with low professional and technical degree is 0.19, and the weight of professional equipment is 0.13. Then, according to the above three factors, the improvement strategy is proposed to carry out continuous optimization.

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