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Research on RFID Application in the Pharmacy Logistics System

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Abstract

The quality and safety of pharmacy, which have become essential for the lives of the residents, directly concerns people's health and security. The pharmacy logistics is still at the starting stage and exists a lot of problems at present in our country, so it would affect the management and monitoring of the pharmacy quality, bringing the security menace. The first section of this paper analyses the characteristics of radio frequency identification (short for RFID) technology and the pharmacy logistics system. Then RFID technology is introduced into the Pharmacy Logistics System, that is to expound the application of RFID in the pharmacy logistics system; the service level of the pharmacy logistics system would be upgraded, and the supervision of the pharmacy would be strengthened.

Index Terms: RFID; Pharmacy Logistics; Information System

1. Introduction

In recent years, the public has cast doubts on the processing technique and the quality safety of the pharmacy in varying degrees because of the frequent pharmacy accident. Some of them are caused by the imperfect pharmacy logistics system. Accordingly, the Commerce Department of Chinese Government will introduce a whole set of industry standard to pharmacy logistics enterprises, such as Classify Evaluation Index System of Pharmacy Logistics Enterprises, Pharmacy Logistics Service Practice, Pharmacy Selling Practice and Pharmacy Logistics Enterprises Standard. So it is very exigent for us to improve pharmacy logistics information systems and upgrade their service levels, strengthen government's capacities of the pharmacy supervision, maintain the order of pharmacy markets.

2. Basic Conception of RFID

RFID is commonly known as electronic tag; actually, it is a target recognition technology for data interchange in a non-contact duplex communication, which is performed using the space coupling of signals such as electromagnetic induction, radio waves and microwaves and so on. [1]

RFID has been widely used in many areas of military, navigation, transportation, logistics, manufacture,

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automotive industry, retailing, pharmacy, animal management, food management, ticketing, garment industry, books, colliery and anti-counterfeiting and , since its own outstanding advantages, such as non-contact data interchange, long read-write distance, quick read-write speed, the capability of identifying high speed of motion object, huge storage, high data security, repeated use and the excellent capability against adverse circumstances.

The prototype of RFID is Bit electronic tag in Electronic Article Surveillance, which could be dated back to as early as the 1960s. Stepping into the 1970's, the technology and the production of RFID entered a fast development period, as RFID was integrated into the Animal Track Recognition System and the Electronic License-plate System. In the 1980s, the technology and the production of RFID came to a new stage of commercial application, while RFID systems of various scales began to appear; from then on the technology and the production of RFID became a part of daily life, and the public paid more and more attention to the standardization issues of RFID. Ever since early this century, RFID has penetrated into logistics and supply chain.[2]

A complete RFID system consists of data acquisition unit, middleware, application system software and information management platform; the data acquisition unit contains tag, chip, reader and antenna. The uniqueness of the chip, which is used for data storage, distinguishes RFID from the traditional barcode.

The operating principle of RFID System is shown in Fig. 1: the effective magnetic space is the basic premise of RFID system. The electronic tag with information enters into the magnetic space while the antenna of the reader outputs query radio signals at a certain frequency; at the same time, the electronic tag, which is activated by the power derived from the faradic current, sends messages stored in the chip through the built-in antenna after decoding. The receiving antenna conveys these signals to the reader. The reader decodes received those signals; all the decoded signals are conveyed to the information management platform through the application system software for processing and controlling. [3]

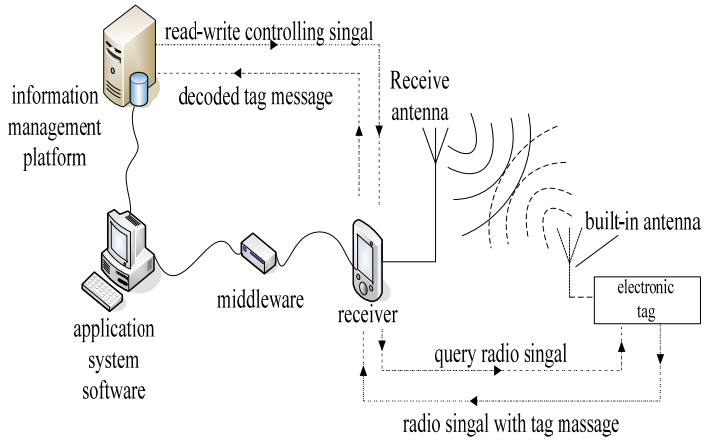

Fig. 1. Operating principle of the RFID system

3. Analysising the Pharmacy Logistics System

Depending on logistics equipments, logistics technologies and logistics management information systems, the pharmacy logistics should optimize operations in supplying, marketing, distributing and transporting of pharmacies by integrating upstream resources with downstream resources together, such as inspection, storage, sorting and distributing; in addition, a perfect pharmacy logistics system could improve the order processing, reduce the sorting mistake, decline the inventory level and shortening the distribution time, furthermore it could reduce the logistics cost, upgrade the service level and enhance the cost effectiveness through the application of the automated, informationalzed and profited technologies. The typical pharmacy logistics system is shown in Fig. 2:[4]

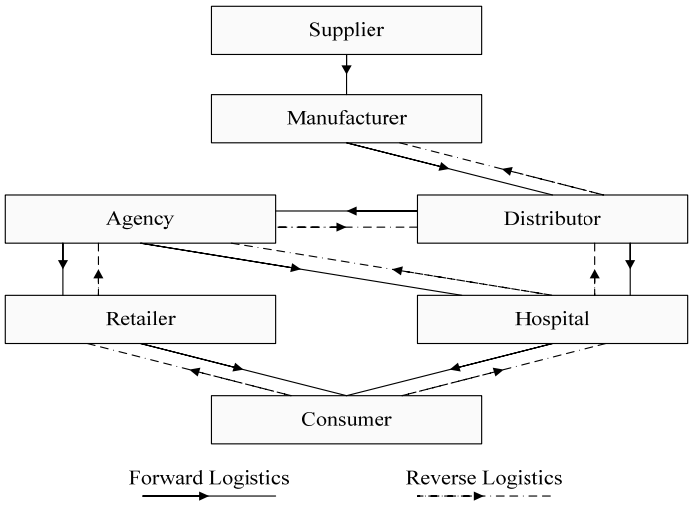

Fig. 2. Example of pharmacy logistics system

In 2009, the State Council issues *Planning of Logistics Restructuring and Revitalizing*, in which developing the pharmacy logistics is one of the chief tasks. Because of some characteristics of the pharmacy logistics system, the reverse logistics is more important in comparison with other logistics systems.

3. 1 High Complexity

Pharmacy is combined with high investment, high technology and high yield. The pharmacy logistics has two outstanding characteristics: one is complex in classification; another is wide in variety. The classification of pharmacies as shown in the Table 1:

TABLE I. CLASSIFICATION OF PHARMACIES

No.	Designated Value	Types
1	Nature	Chemical Active Pharmacies, Chemical Pharmacies, Medical Devices, Chemical Reagent Health Care Product and so on
2	Source and Character	Chinese Medicinal Materials, Prepared Chinese Medicine, Chemical Active Pharmacies, Antibiotics, Biochemical Pharmacy, Serum Vaccine, Blood Products, Radioactive Pharmacies and so on
3	Storage Temperature	Normal, Low-temperature, Frozen and so on
4	Pharmacy Management System	RX, OTC
5	Hazardous Property	Psychotropic Drug, Narcotic Drugs, Inflammable and Explosive Drugs

Each pharmacy has its characteristic; even if these pharmacies in the same kind, they are also different in characteristics. Thus pharmacy systems are complex. And pharmacy systems will be more complex for the intricate and complicated pharmacy net, which would increases the difficulty of pharmacy's supervision.[5]

3. 2 Pharmacy Calls for High-level Logistics Specialization

Different from the ordinary commodity, the safety of pharmacy is always the most important character. Between production and circulation, the pharmacy needed to be packed. Proper package can prevent the pharmacy from being polluted in the processing of logistics; hence ensure the quality, health and safety. No matter what kinds of the package, the basic function should be protective, separated, closed and can keep the light away, in order to avoid the pharmacy being affected by external environment and harmful microorganisms. Firstly, it is necessary to make sure that the package material, which should accord with health rules and standards, will not interact with the pharmacy during the material selection. Besides, the material should prevent the pharmacy from interacting with others. What's more, the package material or the container must be intact, clean, harmless, unpolluted, and no smell.[5]

The pharmacy logistics is a dynamic processing, in which smoothness of the pharmacy must be assured. The logistics operation demands high-level in mechanization and automation. Furthermore, the pharmacy logistics operation calls for the corresponding Standard Operation Procedure, which is short for SOP, as well. In less elegant terms, a reference standard could be found for these operators' every work, so as to an integrated, smooth and safe logistics processing would be ensured.[6]

In the circulation, the pharmacy calls for high-quality environment, such as temperature, humidity, radiancy during transportation and storage. Temperature and humidity in the warehouse and conveyance should be selected and adjusted according to the species and characteristic of the pharmacy. Some pharmacies can be stored and transported in room temperature, while the others strictly need insulated warehouse and refrigerated transportation. In addition, cleanliness is also necessary, so it is absolutely needed for warehouse and conveyance to be cleaned and disinfected.[7]

Therefore, in the whole logistic circulation, not only the selection of logistics facilities and packaging materials, environmental control of circulation, but also the operations, require high specialization.

3. 3 Pharmacy Calls for High-level Logistics Informationization

Different from the ordinary commodity, the quality and safety of pharmacy is closely related to human's health and security. Before pharmacy purchasing, consumers should have a thorough knowledge of detail information, such as manufacturer, pharmacy approval number, manufacturing date and effective date. As we are mentioned, the logistic information not only includes this basic information, but also the storage information, the transportation information, the distribution information, the market information and so on.

Through the information inquiring in the whole logistics circulation, such as manufacturer information, distribution information, sales information, we can distinguish that whether the pharmacy is qualified or not. Moreover, once accidents occur, a perfect logistics information system can help us to trace reasons forward to the source, and find out where other unqualified pharmacies flow. Hence, we can take recycling measures to prevent accidents expanding in time.[8]

3. 4 Pharmacy Calls for High-level Reverse Logistics

Considering the different reasons for the reverse logistics, we can divide it into returned logistics and recycle logistics.

The main reasons causing the pharmacy returned purchase contains: (1) after accidents arising, the government requires the sale banning, and withdraws the related pharmacies. Or manufacturers execute initiatively; (2) In the processing of R & D stage, components of pharmacy materials are judged to be off grade, or the R & D technology is found to be improper; (3) Backlog of poor sales. The major object of pharmacy recovery is the expired pharmacies from families.

Handled improperly, these expired pharmacies would probably do great harm to our living environment. What is more serious is that, if unscrupulous traders obtain those expired pharmacies, they are likely to distribute them to pharmacies and clinics located in countries or remote areas, which will seriously affect the patients' health. Slightly, the illness would be delayed; seriously, the life would be threatened. In the early time, statistic data demonstrate that 2/3 expired pharmacies in country markets exactly come from these medicine cabinet sitting in urban families. Establishing perfect pharmacies reverse logistics is one of the most effective measures for holding back the useless pharmacies' vicious circle mentioned above.[9]

4. Application of RFID in the Pharmacy Logistics System

According to the China RFID and Development Report 2009 of Things, which is released by China Information Industry Chamber of Commerce, the RFID market of China reached RMB 8.51 billion, ranking the third in the world after United Kingdom and United States in 2009. It means that china's industrial chain of things began to take shape, the application of IOT step by step.

From the function analysis of the pharmacy logistics system, its difficulty industries logistics of automobile and manufacturing, etc. However, the degree of Information technology needed for the pharmacy logistics system is far exceed other logistics systems.[10]

The information system on pharmacy logistics is the specialized information system, which served to pharmacy industry. The logistics information system of pharmacy industry must be a public system for object oriented suppliers, manufacturers, agencies, distributors, retailers, hospitals and consumers. According to the circuit of pharmacy, the pharmacy logistics information system, which is shown in Fig. 3, could be divided into several sub-systems, such as purchasing sub-system, manufacturing sub-system, transport sub-system, storage sub-system, distribution sub-system, sales sub-system, after-sale services sub-system:

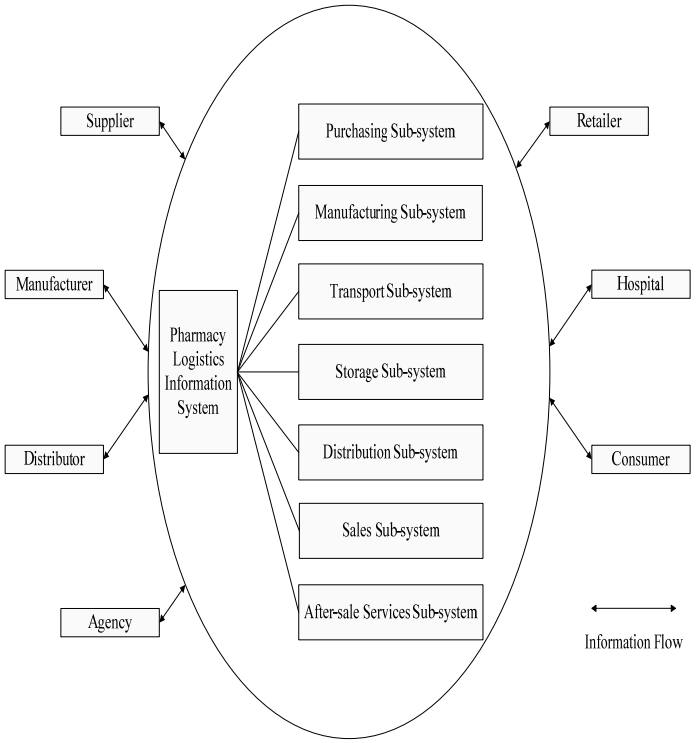

Fig. 3. Pharmacy logistics information system

All enterprises and individuals of each link in the pharmacy supply chain need different pharmaceutical information. For example, information on pharmacy safety such as manufacturers, drug approval number/ registration No, production date, valid date, standard and batch are usually caught by consumers. However, beside these information mentioned above, agents, dealers and retailers also emphasize transportation, storage, dispatch and sales information. Meanwhile, in the whole logistics system, not only pharmacies' own information, but also information on corporations and individuals are specially kept as highly confidential. Moreover, these information and date need to be read and wrote repeatedly during circulation. Accordingly, with unique excellences, RFID can especially meet all the high-level needs of information system.

From the link of material entering warehouse, RFID tags begin to be used to record some basic information such as suppler, date storage, supplying source, in order to control pharmacies quality fundamentally.[11]

Coming into the link of manufacture, like other production line, manufacturing information of materials recorded in RFID tag, greatly help manufacturers to control product quality conveniently. In the last stage, the finished medicine is produced, and new package, sales package and transportation package, appears logically, which the beginning for finished medicine to flow into society. At the same time, it is required to add RFID tag to every packaged pharmacy, which records the unique product code No. The coding is also the unique coding used in circulation, sales and recycle in the near future. Based on the technology, pharmacy manufacturers, agencies, distributors, retailers, hospitals, even the consumers can strictly verify the legality of pharmacies just through a reader matching these codes.

In the processing of transport, storage and distributing, some information is gradually written into the RFID tag, contains temperature and humidity, transport route, storage quantity and so on. Controlling the operating environment and processing, we can control the quality and safety indirectly.

In the processing of sales, RFID help to write down the information of consumers, which promotes to find out the trace of some prescription drugs and dangerous drugs and then ensures the safety. Meanwhile, when reverse is needed, inquiring consumers' information plays an important role in looking for the pharmacy asking for being recalled. It is a great step to promote the development of reverse logistics.

In the processing of after-sales, no matter what the reason is, accidents or exceeding the time limit, it is all needed to trust RFID tag to indicate the target location and recycle immediately. In addition, consumers can also inquire purchasing pharmacies' information, distinguishing the authenticity.

Analyzing the application of RFID in all the pharmacy logistics system, we can be aware of the fact that only if the same public information system used in the whole supply chain can seamless exchange be achieved.

Promoting the logistics information system, at the same time, can also regulate suppliers, manufacturers, agencies, distributors, retailers, hospitals and clinics. Every enterprise and hospital will gain a permission to enter the public information system only if they register depend on related documents. Generally speaking, these illegal agencies and retailers then lose the standing place.[12]

5. Conclusion

The most outstanding function achievement of RFID is raising the service quality and operational efficiency of pharmacy logistics system. Tracing the trace of pharmacies with the help of RFID can not only regulate the pharmacy market but also recycle unqualified pharmacies and overdue pharmacies, which with significant meaning on safeguarding public health and life.

Although the RFID technology is just in its take-off step, it is believable that RFID will inevitably give rise to a revolution, and grow to be a new kind of economic growth with creating considerable worth.

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