

# The anti-hepatitis drug use effect and inventory management optimization from the perspective of hospital drug supply chain

Zhanyu Liu<sup>1,2,3</sup>

<sup>1</sup>School of Business Administration, Henan Polytechnic University, Henan, China

<sup>2</sup>Energy Economics Research Center, Henan Polytechnic University, Henan, China

<sup>3</sup>Taihang Research Institute, Henan Polytechnic University, Henan, China

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**Abstract:** By analyzing the current hospital anti hepatitis drug use, dosage, indications and drug resistance, this article studied the drug inventory management and cost optimization. The author used drug utilization evaluation method, analyzed the amount and kind distribution of anti hepatitis drugs and made dynamic monitoring of inventory. At the same time, the author puts forward an effective scheme of drug classification management, uses the ABC classification method to classify the drugs according to the average daily dose of drugs, and implements the automatic replenishment plan. The design of pharmaceutical services supply chain includes drug procurement platform, warehouse management system and connect to the hospital system through data exchange. Through the statistical analysis of drug inventory, we put forward the countermeasures of drug logistics optimization. The results showed that drug replenishment plan can effectively improve drugs inventory efficiency.

**Keywords:** Pharmaceutical supply chain, operation mode, drug inventory, pharmacy.

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## INTRODUCTION

Pharmaceutical management is a branch of hospital management, which reflects the level of drug use and management in hospital (Cahill *et al.*, 2015). The purpose of this study was to strengthen the rational use of drugs, reduce drug adverse reaction, while ensuring the supply of drugs on the optimization of inventory management. According to the actual clinical medication rules combined with epidemiological studies of drugs, reduce drug funds, prevent excessive backlog of drugs and reasonable drug inventory (Chen *et al.*, 2009). The long-term objective of pharmaceutical administration is to regulate the use and management of drugs. It should work as a whole strategic goal of hospital pharmacy management development, the use of standardized hospital medicine, to ensure the rational use of drugs; standardize the drug procurement plan, determine the reasonable drug inventory (Dindo *et al.*, 2004). Drug utilization evaluation is the study of drug safety and economy, through study the prescription and use of drugs; it can predict demand and structure of drugs (Ghoneum *et al.*, 2015). In addition to strengthening the study of the use of drugs, drugs will be kept in hospitals. According to the storage index of drugs, the management of stock drugs should be carried out under the condition of ensuring the quality of drugs.

In the practice of pharmacy, promulgated by the State Pharmaceutical Administration Department of drug research, production, circulation, use and Drug Administration and other relevant laws and regulations, rules and regulations are to ensure that all relevant units to

normalize their pharmaceutical basis and guidelines (Altorki *et al.*, 2016; Bergmann *et al.*, 2016). The position and function of its own, also called in to ensure that these laws and regulations, rules and regulations formulated seriously at the same time, it is necessary for new ideas, new phenomena and new methods in pharmacy practice, make a scientific and systematic study and analysis of its theoretical basis, to more fully legal laws and regulations regulate the pharmacy the behavior of the corresponding departments (Chen *et al.*, 2009; Cahill *et al.*, 2015). The pharmaceutical logistics, on the one hand, provides a rare opportunity for the medical and health industry, the traditional medical industry to re shuffle the various interest groups on the other hand, also put forward a great challenge to China's current pharmaceutical laws and regulations (Hu, 2013).

In China's traditional mode of pharmaceutical logistics, pharmaceutical drug dealers and related units are in various regions of hospitals, pharmacies, clinics do delivery, as an overlapping business relation (Dindo *et al.*, 2004; Ghoneum *et al.*, 2015). Compared with the traditional mode of pharmaceutical logistics, modern pharmaceutical logistics can reduce the cost and reduce the business management of pharmaceutical retail terminal purchase cost. Also it could improve enterprise credit, solve the long-term medical arrears, then reduce the cost of sales orders, centralized, standardized management. Modern pharmaceutical logistics could reduce the risk and restore the smooth flow of public traffic, formation through the sharing of logistics facilities, logistics and financial system combined with the formation of network operation, promote the enterprise growth efficiency, and increase market share (Liu, 2013).

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\*Corresponding author: e-mail: lzy@hpu.edu.cn

At the same time, logistics can share the benefits of resource sharing and the resource sharing, and modern logistics model plays an important role in the logistics provider and pharmaceutical logistics (Liu *et al.*, 2016). In addition, also relates to drug flow regulation, various drugs in regulating season through their quest to reduce the total transportation cost, enhancing the efficiency, but also timely research and adjust the relevant legal norms, effective protection of these new roles, new situation and recent problems, to ensure the healthy and sustainable development (Liu, 2013; Hu, 2013). At present, scholars began to study medicine logistics, but there is little literature from the medical logistics supply chain management perspective, the pharmaceutical industry of different interest groups linked to the system to study its effect on drug supervision and management.

### **Drug purchasing**

In accounting, according to the actual purchase price, to get the drug is more difficult in the import and sales of the corresponding flow swivel link different purchase batch purchase price. Because most hospitals now use HIS to get factual information of drug batch material transfer process, the cost of transfer will be the default the FIFO principle, according to the weighted average method or FIFO for pharmacy drug sales are theoretically costing, this may make the information flow and logistics is not consistent(Liu *et al.*, 2016). In this case, the design of the new hospital drug management system and upgrade the current HIS, it has become an urgent matter of drug accounting management reform. To be specific, it is necessary to get the real batch number in the real circulation of drugs, to carry out the cost accounting by the individual valuation method and to realize the comprehensive and meticulous management (Mellotte *et al.*, 2015). This paper analyzes the design, implementation and effect of supply chain in pharmaceutical services. Pharmaceutical services reform will construct the integrated supply chain logistics system based on modern hospital internal medicine, in order to achieve the drug procurement socialization, specialization and information, improve overall operational efficiency and service level of hospital pharmacy.

## **MATERIALS AND METHODS**

### **Data sources**

We randomly selected 20000 prescriptions data from year 2016. Data includes clinic, prescription analysis of anti hepatitis drug prescription, patient information, clinical diagnosis, antiviral drugs in the prescription of single information collection and use, recording and sorting. The collected information is classified, summarized and analyzed to analyze patient information and medication patterns in prescriptions, drug use information, and statistical analysis using software respectively. Approved by the ethics committee of the hospital, all patients signed informed consent.

Aiming at the existing problems in the hospital warehouse replenishment, we establish a supply chain management platform. Through the collection of the data, supply chain management platform could improve the drug management functions such as supply chain management platform test before and after the operation of the number and amount of replenishment. By testing varieties of same varieties before and after the trial operation before and after the replenishment quantity, inventory management evaluation index, carries on the reorganization, and statistical analysis was performed using SPSS statistical software. At present the common hospital information system (HIS) on drug procurement decision is still lacking effective support, the emphasis on the individual management and the lack of an overall concept of supply chain; although it can provide drugs, the storage of data, but not the drug dosage on the next period of procurement forecasting for dependence in the purchasing and warehouse keeper experience to considerable extent drug purchase plan, it is difficult to achieve timely and accurately. The design of supply chain of pharmaceutical services includes supply chain management system (SCM), part of the warehouse management system of suppliers in the platform (WMS), and through HIS data exchange and hospital docking.

The essence of the implementation of the supply chain of pharmaceutical services, is the hope that through the regulation of business, from the business and inventory storage of drugs, to achieve comprehensive batch management of drugs, quality inspection, inventory management and real-time inventory management, so as to effectively control and track the drug circulation and cost management of the whole process, in order to achieve the hospital drug information management comprehensive (Shim, 2010). In this way, the supply chain of pharmaceutical services is the core part of WMS and HIS hospital can transmit data through the interface, provide a complete and comprehensive drug circulation information and financial cost management information for the hospital (Qin, 2015; Tsiaras *et al.*, 2016). All the data were derived from a sample of case hospital HIS from January 2015 to June 2016 warehouse and supply chain management platform trial operation stage of the drug purchase orders, purchase amount, data record (Xuan, 2015).

## **STATISTICAL ANALYSIS**

This paper adopted SPSS19.0 statistical package for statistical analysis. Measurement data were described by mean and standard difference ( $\bar{X} \pm s$ ). The measurement data were analyzed by single factor variance, while enumeration data were represented by case number and percentage and tested by  $\chi^2$  with test level of  $\alpha = 0.05$ .

**Table 1:** The use of anti hepatitis drugs in patients

	Content	Number	Proportion
Gender	male	2610	52.6
	female	2407	47.4
Age	<16	20	0.4
	16-30	421	8.1
	30-45	2432	48.4
	45-65	2013	40.3
	>65	131	2.8
clinical diagnosis	Chc	417	8.3
	Chronic hepatitis B	3256	64.9
	compensated cirrhosis	1190	23.7
	decompensated liver cirrhosis	154	3.1

**Table 2:** Drug therapy model

Treatment mode	Number	Proportion
Monotherapy	4082	81.4
Combined treatment	935	18.6

**Table 3:** The use of antibiotics

medicine		Number	Proportion
Monotherapy group	Recombinant human interferon a2b	826	16.4
	Peginterferon a2b	405	8.0
	Peginterferon a2b	197	3.9
	Lamivudine	783	15.6
	LdT	268	5.3
	Entecavir	914	18.2
	Ade Phu Vee Cool	689	13.7
Combined treatment group	Lamivudine +adefovir dipivoxil	694	13.8
	Telbivudine + Adefovir dipivoxil	61	1.2
	Entecavir + Adefovir dipivoxil	93	1.8
	Interferon + Nuclear seedling analog	87	1.7

**Table 4:** Pharmacy drug classification

Drug classification	Breed number	Percentage of total product	Amount	Percentage of total amount
A	204	12.14%	1891487.8	65.13
B	315	19.58%	461020.6	19.05
C	689	68.28%	354892.3	15.82
Total	1208	100	2707400.7	100

## RESULTS

### *Analysis of the use of anti hepatitis drugs*

In 5017 cases the use of anti hepatitis virus drugs in patients, more men than women, the youngest is 10 years old, the biggest 81 years old, 16 years of age accounted for 0.4%, more than 65 years accounted for 2.8%, chronic hepatitis B patients than in patients with chronic hepatitis C. Analysis showed that some 4082 patients were treated with single drug antiviral therapy, and only 935 received joint antiviral therapy. In monotherapy, 826 were treated with interferon, 197 of whom received long-acting

interferon therapy, and 60% received nucleoside analog therapy. In combination therapy, 7% were treated with interferon plus nucleoside analog, and 90% were treated with nucleoside plus nucleotides. The frequency of entecavir use was higher in monotherapy, followed by adefovir dipivoxil, lamivudine, recombinant human interferon a-2b, and pegylated interferon a-2a.

### *Improvement of automatic replenishment process*

ABC classification is based on the main characteristics of things in the technical or economic aspects of the classification queue, to distinguish between the focus and

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**Table 5:** Drug parameter setting

Drug classification	Warning point (days)	Purchasing point (days)	Purchase days
A	7	14	16
B	7	14	20
C	14	20	25

**Table 6:** Pharmacy store performance evaluation

Project	Warehousing acceptance time	Entry time	accuracy rate	Drug shortage rate	Supplementary variety
Before optimization	64.2±2.4	32.1±2.9	96.5±2.0	6.8±0.8	14.6±1.9
After optimization	21.7±1.5	8.5±0.8	99.5±0.5	1.6±0.5	2.9±0.7

**Table 7:** Drug param

Department	Before optimization		After optimization	
	Inventory ratio	Sales ratio	Sales	ratio
Outpatient Pharmacy	40.6±5.0	23.4±2.3	36.2±1.9	23.8±1.6
Inpatient pharmacy	47.2±3.4	43.1±1.8	45.2±2.6	52.0±1.9
Intravenous drug	17.5±2.1	18.3±0.7	12.1±1.8	19.6±1.4

**Table 8:** Replenishment system

Drugs	Platform	HIS
Insulin Glargine	20	130
Glimepiride tablets	20	100
Oryz-Aspergillus Enzyme And Pancreatin Table	50	220
Mosapride hydrochloride tablets	50	220
Keppra	100	180

the general, to identify a different way of management. In practical application, we will define the cumulative consumption of these drugs accounted for about 60%, total consumption amount varieties accounted for about 15% of a number of varieties; the cumulative consumption of these drugs will define the amount of total consumption amount of about 35%, the number of varieties accounted for about 15% of the number of varieties for the B class; remove the definition of emergency medicine the drug market shortage and temporary purchase of medicines for the rest of the class C. A class of drugs, clinical consumption is very large, in order to reduce the occupation of funds, should reduce the supply of these medicines, accelerate its circulation; supply under normal circumstances for the lower limit of the 10 day average amount, high limit 15 days of consumption, the purchasing cycle for purchasing 1 times a week. B drugs, clinical consumption is relatively large,

the number of drugs accounted for the proportion of the total amount of medication although very small, but it is the most commonly used clinical drugs, must ensure that the stock is not out of stock; in practice, our hospital to supply the drug normally for 12 days, the low limit high limit for 20 days. The procurement cycle for purchasing 1 times a week. C drugs, clinical consumption is very small, take long time standby consumption of funds will not be too much; in practice, supply of these drugs in our hospital normally for 15 days, the consumption of low limit high limit of 30 days, the procurement cycle for purchasing once a week.

The drugs according to the parameters and automatic replenishment: HIS although the replenishment plan cannot be generated automatically, but the hospital management system, records the consumption data of drugs; production and supply chain management platform

of automatic replenishment plan is to HIS the drug consumption data as the basis, every time for data synchronization. In view of the commonly used ABC 3 kinds of drugs, combined with the actual supply situation of supply chain management platform.

For drugs, carry out regular replenishment, namely every Monday to regularly check the system of drug consumption, when the drugs were used to indicate that the drug procurement point should be replenishment, supply chain system with blue tips and automatic replenishment quantity, is higher than the purchase amount of the drug point does not need replenishment. When the amount of drug use below the warning point when the computer with red alarm and automatically generate replenishment plan, then we should take emergency replenishment plan. Under normal circumstances, the middle two replenishment cycle is not red alarm, but in special cases, the Treasury should immediately take temporary replenishment plan, human intervention and complete replenishment.

#### ***Drug replenishment effect***

Can be seen from table 5, HIS platform and drug list of common replenishment with the replenishment cycle, the replenishment plan amount of the former is about 1/3. This is because the number of drug replenishment platform is based on the actual daily consumption of the drug, and the amount of current inventory by computer automatically, which can reflect the actual consumption of the recent drug procurement plan, make more accurate. Also the number of drug replenishment in HIS is the number of replenishment warehouse keeper experience artificially set limits with inventory warehouse inventory calculated. Because inventory limit is the same, so it can't reflect the actual consumption of drugs, resulting in increase in the number of drug replenishment, inventory increases, taking up a lot of liquidity.

## **DISCUSSION**

#### ***Therapeutic rationality***

Oral nucleoside (acid) drugs have been widely used in clinic because of their convenience. With the continuous emergence of drug resistance, the importance of entecavir has been more and more recognized by the clinical and patient (Cahill *et al.*, 2015). Adefovir dipivoxil is the best partner for the drug resistance. The combination of interferon and Leigh Bhave Lin has become the gold standard for hepatitis C treatment. The prescription analysis found that 16 patients under the age of 0.3% were treated with antiviral therapy (Dindo *et al.*, 2004; Chen *et al.*, 2009). Although IFN- $\alpha$  and LAM are approved for the treatment of chronic hepatitis B in children, there is limited efficacy in the treatment of chronic hepatitis B in children (Ghoneum *et al.*, 2015). Although the food and drug administration has approved

pegylated interferon and Leigh Bhave Lin for pediatric patients, large prospective clinical studies have found that drugs have an impact on children's growth and development. Chinese pharmaceutical prospectus for interferon over the age of 16 adult patients with liver disease, nucleoside (acid) drugs range is adult patients, so the application of antiviral drugs in pediatric patients should be cautious, to strengthen the monitoring, to prevent the occurrence of medical disputes (Hu, 2013; Liu *et al.*, 2013).

About combination therapy, no cross resistance between sites of nucleotide adefovir and other 3 kinds of nucleoside drugs, become the preferred drug combination therapy (Mellotte *et al.*, 2015; Liu *et al.*, 2016); combined treatment of nucleoside analogues between can prevent drug resistance, but in improving the HBeAG seroconversion rate effect but did not reflect its advantages (Qin *et al.*, 2015). Therefore at present, combined treatment of similar nucleotide the only recommended for patients with drug resistance has occurred or will occur in the event of resistance to irreversible exacerbations such as initial treatment of patients with decompensated liver cirrhosis. Interferon combined with nucleoside (acid) on the treatment of analogues should be used with caution, in the application of LAM, LdT, ADV, ETV treated patients, there were varying degrees of rise phenomenon (Shim *et al.*, 2010; Tsiaras *et al.*, 2016). In short, the hepatitis B antiviral treatment, single drug and combination therapy of entecavir monotherapy, the use of high frequency entecavir, is consistent with the selection of drugs at home and abroad guidelines recommend, for Nuo Fuwei vinegar due to higher prices, but also in clinical trials, clinical only for several other non-drug alternative antiviral drug resistance after salvage treatment, so the use of low frequency (Xuan, 2015). The combination therapy of interferon and nucleoside analogues is still the choice of clinical treatment, and the choice of antiviral drugs in hepatitis is basically reasonable.

#### ***Operation mode***

The overall operation mode of supply chain of pharmaceutical services is to establish supply chain operation management center hospital (Zhu *et al.*, 2015). The hospital supply chain management center platform and drug supply enterprise integrated management system (ERP), the levels of the hospital pharmacy store WMS docking, through the bar code technology, product planning and management to achieve the entire process of drug logistics management and inventory of drugs (Chen *et al.*, 2009). The core business model, is built in the center of supply chain operation management of the hospital as the endpoint, regional supply chain operations management center for pharmacy service operation management platform of public support (Liu, 2013). Relying on this platform, to participate in the

management of supplier inventory, timely delivery and inventory means, change the original database of drug procurement, storage, distribution function, the center of supply chain operation management of hospital drug management center hospital become unified drug information integration center, drug inventory center and unified clearing center (Shim *et al.*,2010).

### Deficiency

Due to the limitations of HIS, it can only manage a single department and cannot form the overall management of the supply chain between pharmacy and warehouse (Cahill *et al.*, 2015). The inventory parameters into HIS replenishment procedures in the warehouse only based on the data, can not reflect the actual amount of drug in hospital ownership (Dindo *et al.*, 2004). Warehouse according to the warehouse inventory of drugs to make a purchase order will cause the pharmacy and warehouse inventory, lead to drug inventory is too large, or appear broken, lack of medicine, and occupy a large amount of liquidity (Ghoneum *et al.*, 2015).

### CONCLUSION

The purpose of inventory management in the hospital drug supply chain is to speed up the turnover of funds, reasonable procurement, reduce inventory, and ensure the supply of drugs. From the above results, it is easy to see that the supply chain management platform to make up for the deficiencies of HIS, to achieve the purpose of inventory management optimization. Although HIS is a management information system of the hospital, but the warehouse replenishment this link is insufficient and the supply chain management platform can make up the shortage of the. The platform is the biggest characteristic of the recent history of drug consumption of the average daily volume calculation of the next cycle replenishment quantity and then automatically generated by computer. The replenishment plan to ensure the normal supply and reduce the inventory, the rational use of funds to continue to reduce the rate of out of stock. With the increase of the trial time of the platform, we continue to improve the loopholes in the program, as far as possible to achieve zero inventory management of drugs, can improve the efficiency of the warehouse. The mode of supply chain management platform is a new management mode of supply chain management platform. Compared with the traditional replenishment process has many advantages, is worthy of popularization and application, such as purchasing, inventory warning dynamic setting limits, accurate prediction of purchase quantity etc.

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