Management and Control Platform of Auxiliary Drugs Based on Big Data

Shasha Wang\textsuperscript{1}, Huixia Wang\textsuperscript{1}, Miaomiao Miao\textsuperscript{1}, Juan Li\textsuperscript{1}, Dianjie Gu\textsuperscript{1}, Li Ding\textsuperscript{1,*}

\textsuperscript{1}The Second People's Hospital of Lanzhou, Lanzhou, 730046, Gansu, China

*Corresponding author E-mail: dingli123@lzseyy.org

Abstract: In recent years, with the introduction of national, provincial and municipal policies, rules and regulations, and the introduction of big data technology, drug control personnel have further increased their awareness of data. However, in practice, how to carefully control drugs and make full use of big data technology to improve the level of control has become a new confusion for drug control personnel. Therefore, the purpose of this paper is to study the platform of auxiliary drug control based on big data. Based on the actual situation of drug use, this paper analyzes the main problems in the process of drug control, and designs an auxiliary drug control platform based on big data. The auxiliary drug management and control platform based on big data proposed in this paper can collect data in real time, comprehensively analyze all kinds of information, and realize intelligent management and improve the efficiency of each specific application scenario. In this paper, through the research of drug use management and control platform, doctors can get scientific guidance in formulating drug use plan, and the efficiency of drug query is improved by about 80% compared with the traditional plan. At the same time, the drug use plan can be improved in time according to the patient's illness development in the process of drug use, which promotes the rational and standardized clinical application of drugs.

Key Words: Big Data, Auxiliary Drug Management and Control Platform, Multidimensional Data analysis, Data Warehouse

1. Introduction

In the medical industry, with the continuous development of information technology and the widespread use of big data technology, many hospitals at home and abroad have established hospital information systems centered on hospital internal data, which greatly improves the internal management efficiency of hospitals. However, with the gradual increase of medical data in hospitals, the data of various drugs are also increasing dramatically. Therefore, it is very urgent to study the management and control platform of auxiliary drugs based on big data.
At present, with the continuous development of hospital informationization, the information analysis system constructed by using big data and other related technologies has appeared in the informationization platforms of major hospitals and medical institutions. Forbes American medical institutions have developed a standardized medical business intelligence system, which stores the medical data of veterans in the United States and provides a platform for veterans' medical health data analysis [1]. In China, there are many similar technology platforms. Jianglei Qu introduced data warehouse into the field of chronic disease data analysis, and combined with the characteristics of chronic disease medical data, new data sources need to be added into the data warehouse system. [2].

In this paper, aiming at the research problem of auxiliary drug management and control platform based on big data, starting from the actual situation of drug use, the main problems existing in the process of drug management and control are analyzed, and an auxiliary drug management and control platform based on big data is designed. After real-time data collection, the big data platform comprehensively analyzes all kinds of information, improves the efficiency of intelligent management and specific application scenarios, meets the needs of hospitals for scientific drug management, and has important reference significance for further exploring the information development of intelligent drug management and control.

2. Technical Research of Auxiliary Drug Management and Control Platform Based on Big Data

2.1 Big Data Technology

Big data refers to a data collection that cannot be captured, managed and processed by conventional software tools within a certain time range. It is a massive, high-growth and diversified information asset that needs a new processing mode to have stronger decision-making, insight and discovery and process optimization capabilities [3].

The strategic significance of big data technology lies not in mastering huge data information, but in specialized processing of these meaningful data. According to the analyst team, big data is often used to describe a large amount of unstructured data and semi-structured data created by a company, which will take too much time and money when downloaded to a relational database for analysis [4].

2.2 Data Warehouse

The storage architecture of data warehouse is mainly composed of storage layer, storage mapping layer and access control layer.

(1) Storage layer

The storage layer is mainly composed of database clusters. The database cluster adopts the traditional relational database scheme. The use of relational database is mainly based on the following two points:

1) At present, most hospital information systems are based on relational data as storage carrier. After migrating to the cloud platform, the relational database can be better compatible with each hospital subsystem, and at the same time, it can reduce the data format inconsistency caused by migration.

2) With the continuous development of big data, the data warehouse architecture scheme of big data represented by Hive has appeared, but in actual use, there is still the problem of low query efficiency, and the multidimensional analysis ability is insufficient compared with the traditional data warehouse scheme based on relational database [5].

(2) Storage mapping layer

The storage mapping layer mainly designs the storage and placement scheme for business data and multidimensional data. At the same time, combined with the characteristics of multidimensional data and the perspectives of health departments at all levels, we store multidimensional data stored in each node in blocks, so that the related data in dimensions can be placed together as much as possible to
increase the efficiency of data access [6].

(3) Access control layer

The access control layer is used to analyze and process the user's access request and verify the authority. However, the query requests of health departments at all levels will involve the data of multiple hospitals, which are distributed in different storage nodes, so it is necessary to provide appropriate access strategies to reduce response time[7].

2.3 Auxiliary Medication Management and Control Platform

(1) Functional requirements

1) It can accurately collect medication related data, and provide access interfaces for various medical institutions, allowing them to access their data stored in the cloud platform through the interfaces.

2) Using multi-dimensional analysis of data warehouse, the drug use situation is analyzed in different dimensions, including analysis in different regions and overall analysis.

(2) Performance requirements

1) The system needs to meet a large number of data storage requirements: the information needs to store the relevant information of drug use of medical institutions at all levels in the region, and the storage space of these data is quite large.

2) Meet the high concurrent access requirements: the system needs to provide query access requirements of different hospitals and different levels of health institutions, and provide multi-dimensional data analysis function of data warehouse [8].

(3) Relevant theories of designing and constructing platform

1) Markov chain

Management and control based on medication needs more workload, so we start from the historical data of medical treatment, and cluster different medication event sequence examples. In this paper, Markov chain model is applied to the clustering of medication flow sequence, and an event sequence clustering method based on Markov transition matrix is proposed.

Firstly, we give the definition of Markov chain. Markov chain is defined as a finite set state set $S = \{S_1, S_2, \ldots, S_n\}$, $s(t)$ represents the state at time $t$, and the state of $s(t)$ is only related to the state of $s(t-1)$. That is, satisfaction

$$P(X_{n+1} = x \mid X_0, X_1, X_2, \ldots, X_n) = P(X_{n+1} = x \mid X_n)$$

(1)

In which $x$ is a certain state in the $s$ set. This Markov chain is also called discrete-time Markov chain. The future state is only related to the current state, but has nothing to do with the previous historical state[9].

2) Medication management and control clustering

First, we extract the medication flow sequence from the case sequence and cluster it according to the example of medication flow sequence. First, we express each cluster with such a transfer matrix $M$, and then assign the case sequence corresponding to the medication flow sequence instance to the corresponding cluster. We use $d = \{d_1, d_2, \ldots, d_n\}$ to represent a group of process sequence instances, the cluster set $C = \{c_1, c_2, \ldots, c_i, \ldots, c_k\}$, where $c_i$ represents the $i$ cluster, and the transition matrix is represented by $M_i$. Then the probability that sequence $d$ belongs to cluster $c_i$ is $P(d \in c_i)$, and
its calculation formula is as follows:

$$P(d \in c_i) = P(d_1 | \text{start}) \cdot \left[ \prod_{i=2}^{k} P(d_i | d_{i-1}) \right] \cdot P(\text{end} | d_k)$$  \hspace{1cm} (2)$$

3) Medication model
In the traditional medical aid decision-making system, the analysis and prediction of patients' drug consumption are mostly based on statistical numerical analysis methods. Therefore, based on the clustered case sequence set, the drug use process suitable for different populations and disease development is found through the process mining method [10].

The following gives the definition of the relevant model of drug administration process. We use A as the name of the drug, B as the dosage of the drug, and c=(a,b) as the combination of ab. Use a to represent the names of all drugs, b to represent all dosage, and c to represent the combination of all drug dosages. As shown in the following formula:

$$C = \{c = (a,b) | a \in A, b \in B\}$$  \hspace{1cm} (3)$$

3. Experimental research on the Management and Control Platform of Auxiliary Drugs Based on Big Data

3.1 Experimental Data
We simulated the data of 8 hospitals, and established 8 databases, with database numbers A to H. There are two dimension tables and one fact table in each database, including drug dimension table, hospital dimension table and use intensity fact table.

3.2 Experimental Process
Firstly, we import multidimensional data from 8 hospitals into 6 databases numbered A to H. We set up four storage nodes for multidimensional data. Then 8 pieces of data are placed in 4 multidimensional data storage nodes, and we limit the capacity of each storage node to 4 pieces of data at most.

4. Experimental analysis of Auxiliary Drug Management and Control Platform Based on Big Data

4.1 Query Performance of Auxiliary Drug Control Platform
We tested the query performance difference between the auxiliary drug management and control platform proposed in this paper and the traditional related schemes under different query conditions. First, we inquired about the average use intensity of cephalosporins and penicillins in all hospitals in the experiment, and tested the total response time under different concurrent inquiries. The experimental results are shown in Table 1 and Figure 1.

| Number of concurrent queries | 1   | 20  | 40  | 60  | 80  | 100 | 120 | 140 | 160 |
|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Response time of new scheme(ms) | 0   | 50  | 110 | 180 | 230 | 480 | 570 | 740 | 820 |
| Response time of traditional scheme(ms) | 0   | 100 | 1800| 2100| 3000| 3700| 4500| 4900| 5400|
From the experimental results of querying cephalosporins and penicillins, it can be seen that the query response time of the auxiliary drug management and control platform proposed in this paper is faster than that of the traditional scheme, and with the increase of the number of concurrent queries. Therefore, in the face of a large amount of data, the auxiliary drug management and control platform proposed in this paper can still deal with these data in an orderly manner, with high query efficiency.

4.2 Actual Control Effect of Auxiliary Medication Control Platform

Based on the actual medication process and medical data of the hospital, this paper verifies the actual control effect of the auxiliary medication control platform proposed in this paper. We visualized the disease development of mice in group A and B. We fit the temperature series of all mice in A and B groups according to the mean value, and get the temperature development and change diagram of mice in A and B groups. As shown in figure 2.

From the experimental results, it can be seen that there are some differences in the change trend of body temperature between group A and group B. The general change trend of group A is to increase at first, then decrease, and then return to the normal value. In group B, the overall change trend was first decreasing, then increasing, and then returning to the normal value. This is because the auxiliary medication management and control platform proposed in this paper can start from the events and corresponding physiological states of the medication process in the case sequence.
5. Conclusions

Based on big data, this paper proposes an auxiliary drug management and control platform. According to the actual situation of drug use, this paper analyzes the main problems in the process of drug control, and designs an auxiliary drug control platform based on big data. Through real-time data collection and comprehensive analysis of all kinds of information, the platform can realize intelligent management, improve the efficiency of specific application scenarios, and meet the needs of hospitals for scientific drug management. It can not only realize the choice of medication process, but also analyze the dosage, which is convenient for clinical control of antibacterial drugs. This has important reference significance for further exploring the information development of intelligent drug management and control.

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