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Application of Modern Computer Technology in Adverse Drug Reactions

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Abstract: To explore the application of data mining technology in adverse drug reaction (ADR), and provide reference for exploring new methods in the field of ADR monitoring in China. Searching for database related documents such as China Knowledge Network and Data with keywords such as “data mining”, “adverse drug reaction”, “electronic medical record” and “hospital information system”, data mining in spontaneous reporting system and electronic medical treatment the current status, common methods, advantages and disadvantages of ADR monitoring are reviewed. Data mining technology can effectively detect ADR signals in both spontaneous reporting systems and electronic medical records. It has excellent data analysis and ability to discover patterns and will play an important role in the field of ADR monitoring.

1. Introduction

Although there are clinical studies before the drug is marketed, some unexpected, unknown[1], and low incidence of adverse reactions can only be found in large-scale use after listing; timely detection of major phytotoxic events can be prevented from spreading and expanding. Some kind of adverse reactions may become a new therapeutic effect, providing new ideas for the development of new drugs. It can help improve workers' vigilance against adverse reactions and promote clinical rational drug use[2].Because animal experiments and clinical trials before drug marketing have significant limitations, the safety of drug use is not fully understood[3]. The re-evaluation of drugs after listing is aimed at discovering the risk factors not found before the new drugs are marketed. Therefore, the monitoring of adverse drug reactions (ADR) has become an important part of the re-evaluation of drugs after they are listed[4]. The main way to monitor the adverse reactions of drugs after the market is based on China's spontaneous reporting system for adverse drug reactions (national or regional special adverse drug reaction registration, the establishment of a special adverse drug reaction committee or testing center to collect and organize Analyze spontaneously reported adverse drug reactions and be responsible for feedback). Traditional ADR signal discovery methods mainly come from spontaneous reporting systems, electronic medical records, and so on. With the advent of the era of big data in the medical field, the limitations of the traditional signal discovery path are becoming more and more obvious[5]. In order to reduce the harm caused by adverse drug reactions to human health, and timely and effectively curb the occurrence of some adverse drug reactions, data mining research on adverse drug reaction signals based on medical big

data has received more and more attention.

2. Traditional Ways of Finding Adverse Drug Reaction Signals

The so-called adverse drug reaction (ADR) signal, WHO is defined as information that may or may not be causally related to an adverse or unrecognized drug[6]. The discovery of adverse drug reaction signals mainly comes from the spontaneous reporting system, which is the most classic and mainstream ADR signal mining channel recognized in the world. With the continuous improvement and development of hospital HIS, the research on the use of electronic medical records for ADR has gradually attracted attention. In addition, scientists can obtain relevant ADR information through clinical trial data, scientific literature, social media, search engine logs and other information sources.

2.1 Spontaneous reporting system (SRS)

At present, most countries have established a system of adverse drug reaction/event reporting, among which the US FAERS (FDA Adverse Event Reporting System) is highly utilized. China joined the WHO International ADR Monitoring Cooperation Program in 1998 and became a member of the program, and formally established the National Center for Adverse Drug Reaction Monitoring[7]. As of December 2002, ADR monitoring centers have been established in 31 provinces, autonomous regions and municipalities across the country. In March 2004, the State promulgated and implemented the Measures for the Reporting and Monitoring of Adverse Drug Reactions. At present, the reporting system for adverse drug reactions in China has gradually improved, the scope of monitoring has been continuously expanded, and the number and quality of case reports of adverse drug events have been continuously improved. The monitoring system for adverse drug reactions has made great progress. In China, doctors, nurses, pharmacists, and patients are obliged to promptly report the observed adverse drug reaction information through the national drug adverse reaction spontaneous reporting system[8]. However, it is not optimistic that problems such as underreporting, false positives, delayed reports and uneven quality of reports still exist. At present, China's use of SRS for adverse reaction signal detection is still lagging behind, but some scholars have begun to use some algorithms to detect and utilize SRS data. There is no gold standard for these methods, and different algorithms have their own advantages and disadvantages. The most common method is the proportional imbalance measurement method. In addition, ADR monitoring using a spontaneous reporting system is a category of passive monitoring. Adverse events that are actually related to drugs that are not related to drugs are often overlooked. In this case, the ADR signal cannot be detected in time using SRS[9]. To compensate for this deficiency, the concept of active monitoring has gradually been introduced and used.

2.2 Electronic medical record (EMR)

The process of using AMR to detect ADR signals belongs to the category of active monitoring of adverse reactions, and it is still not widely used in China Hospital HIS[10], which is being vigorously promoted at this stage in China, provides data support for ADR active monitoring, which contains a large amount of EMR data. Because HIS preserves the long-term observation and traceable original drug information of large sample populations in medical practice, it provides a good data foundation for the study of clinical safety of drugs after marketing. At present, most hospitals in China have implemented HIS system construction. The Guangdong Provincial Adverse Reaction Monitoring Center developed an HIS-based rapid reporting and intelligent search ADR service platform, and carried out active monitoring of 15 key monitoring varieties in 34 pilot

hospitals across the province[11]. The HIS data of ectopic pregnancy patients from 15 tertiary hospitals nationwide were selected, and the association rule algorithm was used to analyze the clinical drug association of patients with ectopic pregnancy. Some scholars also monitor the target population of related drugs in some medical institutions within a certain period of time, and obtain active monitoring data of the incidence of ADR, so as to conduct safety analysis of the drug.

As the owner and provider of EMR data, the hospital determines the quantity and quality of EMR data on the one hand, and determines whether EMR data can be maximized to promote and utilize data for ADR prediction research[12]. Achieve the purpose of rational drug use for patients. At present, hospitals have begun to develop applications for this resource in the field of ADR active monitoring. From the current research in the field of ADR active monitoring in hospitals, on the one hand, hospitals can use their own resource advantages to directly obtain relevant EMR data to monitor ADR; on the other hand, it is also possible to re-develop ADR related information. Other computing systems are connected to better aid clinical rational drug use. The ADR active monitoring and evaluation warning system mentioned above is a good application[13].

3. Research on ADR Signal Mining Based on Medical Big Data

3.1 The concept of medical big data

The current accepted definition of big data is that big data is a large-capacity, high-speed, or high-variation information asset that requires a new processing model. This new processing model must enable decision making, insight discovery, and process optimization. accelerate. The characteristics of big data can be expressed as 4V, that is, volume, variety, velocity, value, that is, the data is massive, diversified, fast, and valuable. The performance of 4V features in the field of big data in the medical field is that data is heavily quantified, storage forms are diversified, services are real-time, and high-value. With the explosive growth of information, the era of big data has arrived, and more and more data accumulated in the field of medicine will also receive attention. The medical big data mentioned here refers not only to the expansion of data in one aspect, but to the amplification of all relevant or potential medical-related resources, which can be the source of ADR signal discovery.

3.2 ADR signal mining method and application based on medical big data

It can be seen from the foregoing description that the current mainstream methods for obtaining adverse reaction signals from SRS have various defects, and signal mining from other sources has problems such as small data volume and difficult data acquisition[14]. As a result, more and more scholars are turning their attention to medical information big data, rather than getting the information they are interested in from a single data set. There are already many applications in this area. For example, Federer et al. extract adverse event data from databases such as Sider, Offsiders, and MetaAdedb, and combine them from ClinicalTrails. The clinical trial adverse event data extracted from the gov database was used to study the relationship between drugs and adverse events, thus making up for the shortcomings of traditional research limited to FDA-approved drugs. Based on HIS and Clinical Laboratory Information System (LIS), Pan Yan et al[15] designed a monitoring software for hematologic adverse reactions of chemotherapy drugs, and implemented hematological adverse reaction monitoring for common lung cancer chemotherapy drugs, providing early warning for serious adverse reactions. In addition to making up for the shortcomings of a single data source, combining ADR's possible sources of information, such as scientific literature and social media, to supplement clinical data can also improve ADR signal discovery capabilities, providing a good early warning for clinical treatment and diagnosis. For example, when Xu and

Wang combined 21 million biomedical articles with 4 million records in FAERS in the United States, they found that the number of adverse reaction signals increased significantly; Sarker[16] used drug names as keywords, supplemented by specific The algorithm, which retrieves a corpus of ADR-related information from social media Twitter, has been verified to be useful for aiding the discovery of ADR signals. In addition, when multiple data sets are utilized, it is easier to discover the association between drugs and drugs, drugs and diseases, and other adverse reaction information. For example, Duke selected MedLine and cross-reference information on drug interactions related to myopathy in EMR, and found that when used in combination with five drugs, it would increase the probability of adverse reactions to myopathy; Ferrajolo selected three countries. The 7 EMR databases, a possible association between the explorer and acute liver injury (ALI), eventually found a link between 20 drugs and ALI combinations. It can be seen that the use of big data for the discovery of ADR signals, in addition to other sources or even other areas of data to complement the mainstream data, makes the ADR source more abundant and comprehensive, more importantly, can improve the ADR signal strength. To make the detected signal more accurate; at the same time, it is easier to find the correlation between the drug and other adverse reaction information.

In the case of big data in the medical field, hospital data sources are currently the main channel. Due to the complexity of the hospital information management system, information management systems are sometimes difficult to integrate with each other between different departments of the same hospital and even between different hospitals in the same area[17]. Sometimes there are too many subsystems. This makes it practical for many hospitals to apply and adopt clinical information management systems for some of these departments. This obviously does not fully play the role of big data. On the one hand, it is not conducive to hospitals in its internal or multiple hospitals in the same area. Communication and communication are realized in the information management system; on the other hand, the division of these data makes it difficult to capture many related information between them. More and more hospitals in China are accelerating the implementation of the overall construction based on information platform to improve hospital management level, business level, service level and strengthen core competitiveness. The state has also introduced relevant policies to encourage the use of medical big data to strengthen and promote market supervision, and improve scientific decision-making and risk prediction capabilities. Therefore, it is a general trend for hospitals to use their own large resources to conduct active monitoring of ADR.

4. ADR Signal Mining Using Machine Learning Technology in the Background of Medical Big Data

4.1 Opportunities brought by pharmaceutical big data to ADR

While medical big data brings new ideas to the signal processing of adverse reactions, it also brings new challenges to medical workers[18]. The traditional adverse drug reaction signal algorithm involves a large number of manual screening and statistical work. With the rapid development of artificial intelligence, how to use efficient and intelligent methods to study the discovery of adverse drug reaction signals is also an urgent problem to be solved. There is a lot of interaction between a large amount of information in different fields of the big data era. How to extract the knowledge of human beings from real, messy, modeless and complex medical big data, and make full use of various information existing in big data. There is an urgent need for more in-depth machine learning techniques to guide.

4.2 Introduction to Machine Learning Technology

Machine learning is a kind of artificial intelligence. It refers to computer simulation of human

learning process, feedback, in-depth analysis, reasoning of incomplete information, so that computers have the ability to extract features from a large amount of information and discover hidden laws. Capabilities, and allow computer programs to automatically improve their performance as experience accumulates. The goal of machine learning is to explore ways to automatically discover patterns of data, predicting future data or other interesting outcomes through discovered patterns. Therefore, machine learning is closely related to the field of statistics and data mining.

4.3 Progress and Advantages of Deep Learning in ADR Signal Mining

The advantages of deep learning in the monitoring of adverse drug reactions have attracted the attention of more and more medical scholars. Deep learning excels at discovering complex structures in high-dimensional data. Compared with other machine learning, it also has outstanding advantages in predicting potential drug molecule activity, analyzing particle accelerator data, and reconstructing brain circuits, predicting non-coding DNA mutations for gene expression and disease effects. From the current application of deep learning in the field of ADR, it is mainly used to predict the mechanism of drug toxicity or adverse reactions, and to solve some complex calculation and screening problems in the model. With the deepening of human research on genes, the application of deep learning techniques to genomics research will also provide shortcuts for solving complex problems. Xu used deep learning techniques to establish a model for predicting drug-induced liver damage (DILI), and combined it with three data sets used by the predecessors, and divided them into DILI-positive and DILI-negative datasets for analysis. Compared with previous models, this model can more effectively predict drug-induced adverse effects of liver damage. This study is to predict the adverse reactions of liver damage caused by drugs, it can be said that the drug is monitored before the market. In recent years, some scholars have used deep learning techniques to start from the drug production link and control the toxic side effects of drugs. For example, in view of the fact that epoxidized metabolites often affect the production of drug toxicity, Hughes et al. use deep convolutional network technology to model the prediction of drug epoxidation sites, thus effectively preventing drug toxicity and adverse reactions. Significantly reduced pharmaceutical costs.

In addition to using a single deep learning technique to study adverse drug reactions, many scholars have also tried to combine shallow learning techniques in machine learning with deep learning techniques to explore ADR. For example, Vougas uses deep learning and correlation. The combination of rule mining techniques predicts drug response in cancer treatment. The specific implementation process is that the data collected from the cancer database is randomized and divided into a training set and a test set. First, the association rule algorithm is used to select features of the training set data, and the unfiltered association rules are separated by dynamic threshold separation. After useless rules, significant association rules are obtained, which are used to cluster drugs and on the other hand to train deep learning algorithms to predict whether the pharmacological response of drugs is sensitive or resistant in the test set, and finally use the tree shape. The graph predicts drug synergy and provides guidance for clinical drug use.

5. Conclusion

From the above words, it can be found that many statistical and computational problems are involved in the application process of data mining and machine learning. For different research purposes, different algorithm combinations or research protocols should also be chosen. This requires relevant statistical experts or mathematical calculation experts to screen, calculate and analyze these data after determining the research direction, and then draw conclusions based on

relevant medical knowledge. The application of deep learning technology in the field of ADR signal discovery can be said to make use of the powerful computational and analytical capabilities of applied mathematics and computer science to discover the value of a large amount of data in the medical field, and finally provide medical advice and medication for experts such as doctors and clinical pharmacists. guide. The research on ADR discovery using deep learning technology is still in its infancy, and many deep learning methods that are well used in other fields have not yet fully played a role in the medical field. They also need to be based on existing theories and resources. Improvements, so that they can fully exploit the advantages of discovering valuable signals from complex and widely-sourced information data, thereby accelerating the process of drug adverse reaction discovery and truly reducing the occurrence of adverse drug reactions from the source.

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