Intelligent Veterinary Drug Information Management System: Architecture, Technology and Application

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Abstract. Veterinary drugs are related to the health of the citizens, so it is necessary to supervise veterinary drugs. This paper synthetically uses modern information technology such as Internet of Things, Big Data, Cloud Computing and Mobile Interconnection to construct the whole process, all elements and whole system management system of veterinary drug production, circulation and use. The system not only has important application value and guiding significance for veterinary drug managers, producers, operators and consumers, but also will produce enormous economic, social and ecological benefits. It will vigorously promote the standardized production, standardized operation, precise use and intelligent supervision of veterinary drugs, and will effectively improve the level of information development of veterinary drugs in our country.

1. Introduction

The state attaches great importance to the quality and safety of veterinary drugs. In recent years, the requirements of veterinary drug safety supervision in China have become stricter and stricter, and the formulation of standards for veterinary drug quality has become more and more perfect. Experts and scholars have made relevant research on veterinary drug production, circulation and quality traceability construction, and made important progress. However, there are still some shortcomings [1]. Existing veterinary drug information management systems mostly focus on a segment of veterinary drug supervision, and do not form a complete whole process of veterinary drug supervision industry chain.

At present, there are many problems in the supervision of all industries in China, such as after-the-event supervision and lagging supervision, which often lead to adverse consequences [2]. In order to protect consumers' rights and interests from the source, satisfy the public's right to know and strengthen the supervision of all links of veterinary drug industry chain, it is urgent to establish an intelligent management information system that can support the production and supervision of various veterinary drugs, so as to realize the whole industry chain supervision of veterinary drugs from production, circulation and use to quality and safety traceability [3]. Using modern perception technology, big data analysis technology and visual display technology, we can perceive the dynamic information of veterinary drugs in the whole process in real time, analyse the intelligent alarm mechanism of the prediction model, automatically predict the danger and grade of the alert and promote the change of veterinary drugs from traditional supervision to intelligent supervision. The key scientific problems to be solved in veterinary drug management system based on cloud platform are to realize the early warning and in-process control of veterinary drug supervision, to put the supervision gateway in front, to achieve early warning, early prevention and early control [4].
2. Overall objectives of the system
Through the innovation and application of veterinary drug management system, this paper explores the whole process traceability and intelligent management of veterinary drugs, and forms such integral technology system as national veterinary drug monitoring, analysis and service. Specifically, the objectives are as follows:

2.1. Intelligent traceability of veterinary drugs in the whole process
Applying modern information technology theories and methods such as Internet of Things, cloud computing and big data, and from the perspective of "one-code for one-drug, one-code for one-animal, one to one matching, tracing the source of the whole process", we have developed such integral dynamic information sensing technology and equipment as veterinary drug production, circulation, use and supervision, to form an information chain throughout the whole process of veterinary drugs; to improve GMP, GSP related technical standards.

2.2. Intelligence analysis and decision making of veterinary drug big data
To design national veterinary drug big data structure, research and build veterinary drug big data, develop veterinary drug quality and safety traceability big data processing system, and build the analysis and prediction model of animal epidemics and veterinary drug residues of animal products, to provide veterinary drug traceability services for the industry, and realize the traceability and responsibility investigation of veterinary drug products throughout the country.

2.3. Visualization display of veterinary drug intelligence supervision information
Using cloud computing technology, the architecture of veterinary drug management system and data interactive visualization technology are designed to realize the whole process simulation and APP traceability of veterinary drug management, to realize the comprehensive integration of monitoring and perception of big data in the whole process of veterinary drug management and cloud service, and finally to realize visual display of flow direction and volume information of veterinary drugs from multiple dimensions such as time, space and whole industry chain.

3. System architecture design
The architecture of veterinary drug management system based on cloud platform adopts the idea of "five horizontal and two vertical" design, which can be divided into five layers: (1) perception service layer, which senses the whole process data of veterinary drug in time according to the design strategy, and transmits and stores it to the cloud storage resource pool through the network link; (2) Data service layer, aiming at the structured, semi-structured and unstructured attributes of veterinary drug big data, studies the integration methods and technologies of multi-source heterogeneous data, to form a data integration scheme; (3) Platform service layer, develops and integrates the basic components and big data analysis components needed for veterinary drug intelligent supervision; (4) Service interface layer, to develop interface specification and design rules for veterinary drug data management, and realize integrated development interface for veterinary drug application system development; (5) the application system layer, according to the application requirements of veterinary drug management business, we develop a veterinary drug data interaction and dynamic extraction system, a simulation and 3-D display system of time-space distribution of veterinary drugs, and an intelligent terminal for veterinary drug information traceability, which can provide intelligent veterinary drugs comprehensive information "one-stop" service for users such as manufacturers, business enterprises, supervisors, agricultural technicians and farmers. In the meantime, the system architecture is divided into two parts vertically. It establishes the technical standard system and security guarantee system of veterinary drug big data, which runs through five layers of veterinary drug information management architecture to realize seamless data docking and information security.

The architecture of veterinary drug management system based on cloud platform is shown as Figure 1.
4. Key technologies of the system

The Veterinary Drug Management System based on cloud platform is based on the identification information of the minimum sales unit of veterinary drugs. It applies modern information technologies such as Internet of Things, big data and cloud platform, integrates the production and circulation norms of veterinary drugs such as HACCP and GMP, develops the information sensing technology and equipment of key points in veterinary drug production, circulation and use, and timely monitors and collects them. The dynamic information of veterinary drug in the whole process forms a data link throughout the whole industry chain, and constructs a comprehensive service platform integrating veterinary drug traceability, veterinary drug supervision, data analysis and 3-D display. It realizes the comprehensive query, multi-dimensional retrieval, traceability and following, procedure management, statistical analysis, and decision support and model prediction of the whole process information for veterinary drug production, transportation, storage, sales and circulation in a bid to provide technical support for intelligent supervision of veterinary drugs.

Cloud storage technology is used to collect and integrate real-time monitoring and intelligent perception of big data resources in the whole process of veterinary drug production, transportation, warehousing, sale, circulation and use. Data storage cluster technology is applied to manage multi-source heterogeneous big data resources in the whole process of veterinary drug management; It provides integrated information service interface and cloud service resources for the development of such 3 systems as data interaction and dynamic extraction system for veterinary drugs, veterinary drugs information source traceability system, space-time distribution simulation and 3-D display system of veterinary drugs, etc. and to provide one-stop solution for the digitalization, intellectualization and intelligent integrated management of veterinary drugs, so as to improve the efficiency and benefits of the construction of veterinary drug management information application system.

The veterinary drug management system based on cloud platform is based on "Veterinary Drug Data Interaction and Dynamic Extraction System", "Veterinary Drug Space-time Distribution Simulation and 3-D Display System" and "Veterinary Drug Information Source Traceability Intelligent Terminal". What it mainly researches and implements are as follows: the construction of intelligent management...
5. System function modules

The veterinary drug management system based on cloud platform has the following functions: (1) It can identify the HACCP key control points of veterinary drug production, analyze and evaluate the risk factors of veterinary drug production process, identify and determine the critical control points and their thresholds, and determine the monitoring frequency of the critical control points through the monitoring index system of the critical control points of veterinary drug production; (2) The dynamic real-time perception of key points based on GMP in veterinary drug production can be completed. The whole process of veterinary drug production can be sensed through the sensors of key control points and the sensing devices of key control points. (3) It is possible to complete the production operation specification recognition based on video analysis. According to the content of production operation video monitoring, the production process of veterinary drugs can be judged by the knowledge base of veterinary drug production operation and intelligent recognition algorithm of veterinary drug production operation specifications. (4) The traceability coding (2D code) for the minimum sales unit of veterinary drugs can be generated. According to the coding design specifications of the minimum sales unit of veterinary drug, the special 2-D code for veterinary drug is automatically generated, and the 2-D code is fed back to the manufacturer by using the anti-counterfeiting and encryption technology of veterinary drug accommodation watermarking. (5) The whole process of veterinary drug production and circulation can be traced back. It is divided into three parts: the first part, tracing the main veterinary drug production and circulation process via GSP veterinary drug circulation process traceability correlation model, the coding of minimum sales unit of veterinary drugs, veterinary drug traceability code watermarking anti-counterfeiting encryption technology, key information collection of circulation links, 2-D code scanning equipment of the Internet of Things; In the second part, the veterinary drug circulation process traceability is assisted by the aggregation/splitting transformation method of veterinary drug flow packaging label, the traceability correlation model of minimum unit of veterinary drug, the one-to-many splitting correlation model of large unit of veterinary drug packaging label and small unit of packaging label. In the third part, through the "one-to-one" correlation matching model of big livestock marking and veterinary drug marking, the association matching method of house group marking and veterinary drug marking, and the video monitoring network of veterinary drug use, the veterinary drug use process is monitored to achieve veterinary drug traceability. (6) It can monitor the whole process of veterinary drug transportation in real time, check the physical intensity of temperature, humidity, air pressure and illumination in the process of veterinary drug transportation through the Internet of Things, and ensure
that veterinary drugs are not polluted in the process of transportation. (7) It has the functions of veterinary drug big data, cloud storage and cloud computing. All data of veterinary drug production, management and use are stored in cloud platform, and all data integration and processing functions are provided by cloud platform. Providing display service of veterinary drug flow direction change in time and space, providing data comparative analysis service, providing food safety traceability service, providing animal disease prediction and analysis service, providing basic veterinary drug information query service, providing 2-D code traceability query service of veterinary drug products, providing veterinary drug product flow traceability query service; Providing animal disease prediction and analysis services based on veterinary drug big data, providing real-time dynamic detection services of animal disease, early warning services of animal disease; providing food safety traceability services based on veterinary drug big data; veterinary drug quality and safety big data traceability services, providing animal product quality and safety analysis services, and providing quality and safety traceability service of animal products. (8) It has the visualization function of veterinary drug flow information based on GIS, and can display the information of veterinary drug production, circulation and use in the form of map.

6. System popularization and application
The application demonstration of Veterinary Drug Intelligence Supervision Information Platform mainly chooses the above-mentioned five veterinary drug manufacturers, five veterinary drug business enterprises, and their provincial veterinary drug supervision departments and central supervisory offices in counties and municipalities as the application demonstration and promotion base of Veterinary Drug Intelligence Supervision Information Platform, carries out the application evaluation of equipment and system platform, and by further technological proficiency and upgrading, using veterinary drug information traceability intelligent terminal to strengthen the whole process of veterinary drug production monitoring and management, to achieve veterinary drug traceability and visualization of veterinary drug flow direction.

7. Conclusions
Early supervision of veterinary drugs mainly relies on human maintenance and investigation, which is time-consuming and laborious, and the intermediate process is uncontrollable, which is prone to missed detection and other phenomena, leading to the phenomenon of counterfeit and inferior veterinary drugs and abuse of veterinary drugs on the market. The emergence of technologies such as networking, big data and cloud platform has brought a new era of veterinary drug supervision. With the support of Internet of Things, big data and cloud platform technology, semi-automatic supervision of veterinary drug production, circulation and use can be carried out to minimize the use of human resources, which not only reduces the economic cost of veterinary drug supervision, but also reduces the phenomenon of omission or concealment due to human errors [5]. Veterinary drug management system based on cloud platform has the functions of veterinary drug supervision, traceability, big data analysis and visualization of veterinary drug information. Therefore, it has great social and economic value and is conducive to the green and sustainable development of veterinary drug industry, animal husbandry and food industry.

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