Research on the Construction of Rural Medical Waste Recycling
Multi-level Collaborative Information Technology Platform

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Abstract. With the wide application of information technology, its effective utilization in the rural medical waste recycling process has become a serious problem. Information platform is of great significance for the effective prevention of loss of medical waste, medical waste recycling process optimization, participation and oversight role of the public. This paper analyzed status and problems of rural medical waste management in information technology application, and designed the application of information technology in all stages of waste management, and built for the rural cooperative medical waste multi-level information technology platform.

1. Introduction

Application of Information Technology has more research in the field of logistics, such as Xu Chengliang[1], Chenglu[2], Feng Xi[3] and other studied of modern logistics used in information technology. Information technology is seldom used in rural medical waste recycling, such as Zhao Hui, Hu Shuyu[4] studied of medical waste industry chain in the Internet of things era, information technology. It is lack of integrating medical waste sorting and recycling, transport and disposal as a whole to build information platform. This paper combines problems of rural medical waste management and designs information technology application in the medical waste recycling process and built a multi-level information technology collaboration platform.

2. Method

Through literature analysis and semi-structured interviews, current rural medical waste management technology is mainly used in GPS positioning system and video cameras, but it is lack of information collaboration platform in the medical waste generation, classification, and recycling. It is for the following several aspects.

(1) The recovery record is chaos; there are some phenomenon such as recycled medical waste free to deal in village clinics and township hospitals, oversight supervision infectious medical waste collection and transport, confusion log of recovering transfer and transporting waste in no time. They resulted to security risks.

(2) There is lack of scientific basis for medical waste temporarily stored at the location and choice of transport path resulting to a longer recovery time and low recovery efficiency.

(3) The county, township and village health bodies have each data records, but there is no sharing of information and even some medical data records only pro forma, no substantial records. These brought difficulties to government supervision and management, as well as conveniences for unreasonable recovery.
3. Result and Discussion

3.1 Application of information technology in rural medical waste recycling each process

![Diagram of information technology in each process]

Figure 1. Application of information technology in each process.

It is issued in 2011 on the further strengthening of hazardous waste and medical waste regulatory comments on the work of our country that hazardous waste should be monitored electronic from generate to disposal of the whole process of electronic surveillance, to prevent leakage of spreading and dumping etc., to improve the efficiency of supervision. The whole system is designed in fig from generation to last stage, which every link is monitored in the network completed real-time, dynamic, scientific management of medical waste. It is details as follows.

1) Electronic monitoring application in classification link
   It is done in Medical waste classification, such that sharp sharps should be placed in a special box, disposable plastic infusion bags should be recycled in a special container for recycling. Medical waste need to be classified where cameras should be installed to monitor the behavior of medical personnel to prevent that medical waste is not classified as rule and disposed.

2) Labeling and selecting the container
   The classification waste should be placed in a special container, compared the economic conditions of rural medical institutions, the cost of RFID tags is higher, so it is possible to choose a lower-cost one-dimensional code technology, which is simple operation, low cost and easy to implement. One-dimensional code is easier to identify the placing waste bags and plastic containers. With the level of economic development and improvement, and RFID tags cost reduction and technological progress; it can be gradually implemented in the future.

3) Collection and the information registration of temporary storage
   The specialized terminal computer should be equipped at each point of collection and temporary storage and accessed the LAN. The amount of medical waste and types of information should be shared directly to the environmental authorities, health authorities, and medical waste disposal facility and so on.

4) Transportation of the vehicle
   GIS map visualization capabilities and GPS satellite positioning and tracking combined, Rural medical position, the staging point latitude and longitude location queries and visualization vehicle transport path can achieve. It is easy to optimize path. At the same time, GPS, wireless communication technologies and computer network combined to achieve real-time transmission of vehicle information and monitor the location and path of the vehicle dynamically. The loss of medical waste, leakage Caesar and other conditions will not occur.
3.2 Medical waste recycling IT multi-level collaboration platform of rural

According to rural medical waste recycling system problems, combined application of key information technology, government-led rural medical waste recycling information technology platform were established. The platform have well constrained supervisory role to medical institutions, enterprises recycling and Medical waste treatment enterprises.

(1) Multi-level Collaboration platform of rural medical waste Sites

![Multi-level Collaboration platform of rural medical waste](image)

Rural multi-level Collaboration platform is composed of the waste medical management centers, medical institutions, recovery enterprises and the storage, of which the management center is dominant, which was composed of the health bureau of government departments, the Environmental Protection Agency and the monitoring unit, etc. it plays the management and supervisory role. The platform includes the perception layer, network layer and application layer, which are responsible for data and information perception, transmission and provide specific application services.

1) The perception layer and the network layer

The Perception layer is mainly responsible for the medical waste container information, medical waste recycling vehicle loading and transport information and conduct personnel recovery information to real-time collect. It is composed of the bar code and radio frequency identification, global positioning and geographic information systems, cameras and sensors.

The network layer is responsible for transmitting the collected information to the application layer.

2) The application Layer

As shown, the application layer includes medical waste management centers platform, medical information platform, recycling enterprise information platform, temporary storage. The various data of each information platform can be shared, where medical waste management center information platform composed by three units: the local government departments, the Environmental Protection Agency and the health Bureau. It plays the management and supervisory role for the entire information platform and also is responsible for the development of emergency plans.
(2) The technology platform

![Diagram of technology platform]

Medical waste recycling enterprises are responsible for medical waste of rural medical institutions to collect. Information technology platform is in favor of recycling enterprises to better grasp the situation of medical waste generated, vehicle operating status and other information, and to better collect efficiency waste. At the same time, it is also conducive to the supervision and management of government departments. The IT platform can be divided into three parts: the data layer, decision support and application layers.

- **Data layer** collects related data of rural medical waste, GPS and GIS data. The data is subjected to extraction, transformation, filtering and loading into the data warehouse.

- **Decision support layer** is responsible to process data and realize mining and other applications. It includes emergency measures, VRP models and dangerous goods logistics.

- **Application layer** includes the vehicle scheduling, vehicle information management, vehicle tracking and alarm and Recycling schemes of temporary storage. It optimizes the vehicle routing and controls the real-time data such as vehicle running mileage, fuel consumption, loading, etc. by the platform. It will timely alarm to some issues such as the vehicle no required routes, overloading, waste omissions, thus it realizes the supervision of the transport process.

**References**

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