Research on environmental management of medical waste in the 14th Five-Year Plan

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Abstract. Aiming to promote environmental management in the field of medical waste, based on the analysis of the current situation of national medical waste production and disposal, problems existing in the current system of concentrated disposal of medical wastes were identified, namely, the insufficient of centralized disposal capacity of medical waste in some areas, insufficient emergency disposal capacity reserve of medical waste, weakness of of medical waste supervision level and unperfect of technical standards. It is suggested to promote the environmental management of medical waste during the "14th Five-Year Plan" period by strengthening the centralized disposal capacity of medical waste in key cities, improving the disposal capacity of medical waste in rural and remote areas, speeding up the allocation of emergency disposal capacity of medical waste, and improving the environmental supervision capacity of medical waste.

1. Introduction

The safe disposal of medical waste started late in China, and the SARS epidemic in 2003 was a watershed to promote the standardization of medical waste disposal in China. In the same year, the National Construction Plan for Hazardous Waste and Medical Waste Disposal Facilities was approved and implemented by the state [1], which greatly improved the standardization level of medical waste disposal in China and basically formed the safe disposal capacity of medical waste covering the whole country. After more than ten years of development, the layout and capacity of the disposal facilities built in the original plan have gradually been unable to meet the requirements. Considering the present situation of medical waste management, the survey found that the standardization of medical waste packaging process, staging, and medical sewage treatment facilities in Anhui province are lower than 60% [2]. The proportion was 64% of medical waste temporarily stored for more than 2 days in Wuhan's basic medical institutions [3]. The qualified rate of classified storage of medical waste in remote areas was lower than 66.1% [4]. Zhang Zheng et al. [5] pointed out that enterprises face great difficulties in sustainable operation due to the improper choice of operation mode for construction of some medical waste centralized disposal facilities. After the outbreak of covid-19, the production of medical waste surged, and the weakness of emergency treatment capacity of medical waste was also exposed [6, 7]. The state urgently issued the requirements for the control of medical waste during the epidemic period, and increased the disposal capacity through various ways, so that the medical waste in the epidemic area can be properly disposed. How to make up the weak points effectively and promote the comprehensive improvement of medical waste collection and disposal, this paper puts forward...
suggestions on the environmental management of medical waste during the "14th Five-Year Plan" period, so as to provide reference for relevant departments to make decisions.

2. **Current status of medical waste generation and disposal**

2.1. **Overall national situation**

In 2018, a total of 98 x 10^4 t of medical wastes were collected and disposed of nationwide, up 7.5% year on year. By disposal methods, 58.8 x 10^4 t of medical wastes were incinerated nationwide, accounting for 60.1% of the total; 39.1 x 10^4 t were disposed by non-incineration, accounting for 39.9%, of which high-temperature steam treatment account for 84.9%.

![Figure 1. National medical waste generation in 2014-2018.](image1)

![Figure 2. Distribution of medical waste disposal methods in 2018.](image2)
2.2. Status quo of key regions and major cities
In 2018, 6.9 x 10^4 t of medical wastes were collected and disposed of in Beijing-Tianjin-Hebei region, accounting for 7.0% of the total nationwide; medical wastes collected and disposed in Yangtze River Delta region and Greater Bay Area were 16.3 x 10^4 t and 10.9 x 10^4 t respectively, accounting for 16.6% and 11.1% respectively. In recent years, the amount of medical waste generated in supercities and megacities such as Shanghai, Beijing, Chongqing, Guangzhou, Tianjin, Hangzhou and Wuhan has basically maintained a linear growth (Fig.3). In 2018, 47.7 x 10^4 t of medical wastes were generated in 28 supercities, megacities and type I big cities, accounting for 48.7% of the total medical waste generated nationwide.

![Figure 3. Changes of medical waste output in some supercities.](image)

2.3. Current status of medical waste disposal facilities
By the end of 2018, 407 business licenses (128 for incineration facilities, 255 for non-incineration facilities and 24 for cooperative disposal facilities) have been issued nationwide, with an approved business scale of 1.29 x 10^6 t/a. The scale of disposal facilities is generally small, with that of 61% incineration facilities smaller than 10 t/d. According to the operation of centralized medical waste disposal facilities in 31 provinces and cities in 2018, the average load rate of facilities in Beijing, Shanghai, Fujian and Guangdong has exceeded 100% (Fig.4).
3. Analysis of existing problems

3.1. Insufficient of centralized disposal capacity of medical waste in some areas
In 2018, the average load rate of centralized medical waste disposal facilities nationwide reached 76.0%. Specifically, over 1/3 cities had a load rate of more than 90%, 1/5 medical waste disposal facilities were in full or overloaded operation, and the load rate of medical waste disposal facilities in supercities and megacities was generally high. In addition, some centralized disposal facilities are in poor operation and need to be upgraded urgently. The actual disposal capacity may not reach the approved operation scale.

3.2. Insufficient emergency disposal capacity reserve of medical waste
During the COVID-19, the amount of medical waste generated in some cities in China rose rapidly. The daily amount of medical waste generated during the peak period in Wuhan, the city hit by the epidemic most severely, reached 247.3 t, which was 5-6 times that of the normal amount. The amount of medical waste generated in Xiaogan, Huanggang and other surrounding cities also increased 4-5 times compared with that before the outbreak. Due to the overall high load rate of centralized medical waste disposal facilities, the capacity reserve for emergent disposal of centralized disposal facilities is not sufficient. At the same time, the emergency disposal capacity of directly deployable mobile disposal facilities, hazardous waste incineration cooperative disposal facilities, domestic waste incineration cooperative disposal facilities and other medical waste emergency disposal facilities is extremely limited [8,9], resulting in a shortage in emergency disposal of medical waste in some cities. Most of the medical waste disposal capacity increased during the COVID-19 is temporary and contingent, which is far from standard disposal.

3.3. Weakness of of medical waste supervision level
The supervision of the whole process of medical waste is still not perfect, and the application of modern scientific and technological means such as remote monitoring, real-time positioning and electronic transfer joint order in the supervision of medical waste is in its infancy. During the epidemic, a large amount of medical waste was disposed of in a temporary and decentralized manner, which brought great pressure to environmental supervision and law enforcement.
3.4. Unperfect of technical standards

The Plan for the Construction of Facilities issued in 2004 identified pyrolysis and incineration as the main technical methods for medical waste treatment. The Technical Specifications for Construction of Centralized Incineration and Disposal Engineering on Medical Waste (HJ/T 177-2005), Technical Specifications for Centralized Steam Treatment Engineering on Medical Waste (Trial) (HJ/T 276-2006), Technical Specifications for Chemical Disinfection Centralized Treatment Engineering on Medical Waste (HJ/T 228-2006) and Technical Specifications for Microwave Disinfection Centralized Treatment Engineering on Medical Waste (HJ/T 229-2006) and other technical specifications have been issued for more than ten years, which have weakened their guiding role in the selection of centralized disposal technology routes.

4. Suggestion on environmental management of medical waste

4.1. Strengthening the centralized disposal capacity of medical waste in key cities

To evaluate the existing capacity of medical waste disposal, take into account the impact of economy, society, nature and population on the production of medical waste, as well as the emergency reserve needs of different types of cities, and plan, design and build appropriately in advance. Hospitals for infectious diseases, tuberculosis and designated hospitals for medical treatment of public health emergencies have set up their own small decentralized medical waste treatment facilities or used mobile treatment facilities for on-site disposal. In terms of technical route selection, it is recommended to adopt non-incineration technology for new or renovated medical waste disposal facilities with a scale of less than 10 tons/day, taking into account technical applicability, cost-effectiveness, international compliance and other requirements.

4.2. Improving the disposal capacity of medical waste in rural and remote areas

Temporary storage facilities for medical waste can be set up in rural and remote areas. Measures such as spraying disinfection, refrigeration and sealing can be taken to extend the storage time appropriately. Medical waste can be collected step by step and sent to centralized treatment facilities for disposal. Remote areas that cannot be covered by the collection and transfer system of centralized disposal facilities can be dispersed through the construction of small non-incineration treatment facilities or the deployment of mobile treatment facilities.

4.3. Speeding up the allocation of emergency disposal capacity of medical waste

Cities shall be equipped with adequate emergency disposal capacity for medical waste in line with their size. It is also suggested that hazardous waste incineration facilities, domestic waste incineration facilities, cement kiln coordinated disposal facilities and other facilities in the region should be fully utilized for synergy disposal. The provincial government shall establish an overall resource list of emergency medical waste disposal facilities. The cooperative emergency disposal facilities included in the list shall be provided with special unloading areas, special loading equipment, cleaning and disinfection equipment, etc.

4.4. Improving the environmental supervision capacity of medical waste

It’s need to coordinate medical waste management with other businesses of the ecological environment, and coordinate the application of the self-established hazardous waste supervision information system established by ecological and environmental departments at all levels, so as to realize the joint prevention and control of medical waste and hazardous waste supervision. It’s need to build a management information system for intelligent medical waste applications, and build a regulatory cloud platform for the Internet of things at the national level by using technologies such as smart cameras and 5G technologies.
5. Conclusion
With the release of medical waste management policy documents, higher requirements will be put forward for the safe disposal of medical waste during the "14th Five-Year Plan" period. At present, there are still many shortcomings in the centralized medical waste disposal system. The existing centralized medical waste disposal capacity cannot meet the requirements of the "14th Five-Year Plan" for disposal, so it is urgent to improve the shortcomings. It’s suggested to focus on key areas, to promote concentrated disposal facilities of medical waste disposal capacity, improve the disposal capacity of disposal facility with a higher operating load rate, and promote the development of collection-transport-disposal systems in rural and remote areas. Municipal units shall be equipped with emergency disposal capacity of medical waste, improve the disposal technology route, and promote the construction of centralized medical waste disposal system during the “14th five-year Plan” period.

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