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STUDY OF THE CURRENT SITUATION OF TECHNICAL INFRASTRUCTURE RELATED TO ENVIRONMENTAL PROTECTION IN THUONG TIN GENERAL HOSPITAL

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Abstract

This study was conducted to assess the current status of medical waste generation from medical examination and treatment activities at Thuong Tin General Hospital. An on-site survey was undertaken in the area around the hopsital, to collect data to measure the current state of the hospital's medical activities as well as to take samples to evaluate the effectiveness of the management system of the hospital on solid waste and wastewater treatment. The study results showed that the current management of medical waste in hospitals is still inadequate, affecting the environment and human health. Based on the assessment and analysis of the causes, the study has proposed measures to improve the efficiency of medical waste management at Thuong Tin General Hospital, which are improving the wastewater treatment system, strengthening and rearranging the system of solid waste collection and hazardous solid waste storage.

Keywords: Medical waste; Environmental management; Hazardous waste; Technical infrastructure; Hospital.

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1. Introduction

Thuong Tin is a district of Hanoi, with the process of rapid urbanization, the population in this area is also increasing, putting pressure on the grassroots healthcare system. Thuong Tin General Hospital is the unit with the main task in providing medical examination and treatment for people and this leads to an increase in solid waste and wastewater generated in the hospital [5]. According to statistics of the World Health Organization (WHO), about 80% of waste from medical facilities is conventional waste and the remaining 20% is hazardous medical waste [8]. Therefore, the assessment of the situation of generation, collection and disposal of medical waste is a necessary requirement to strengthen the management of medical waste in particular and environmental protection in general [1].

With an important role of the hospital in Thuong Tin district, we have conducted a study to survey the current situation of hazardous waste generation at Thuong Tin General Hospital as a basis for analyzing and evaluating waste management activities as well as proposing measures to improve the quality of hazardous waste management in this hospital.

2. Current situation of Thuong Tin General Hospital

According to a report of Hanoi Environment and Natural Resources Department in 2018, Thuong Tin General Hospital was specified as a third-class public hospital of Hanoi with 220 beds, 12 departments and 4 functional rooms [2]. In which 9 departments directly participate in examination and treatment for patients. According to the treatment assignment, Thuong Tin General Hospital is currently in charge of medical examination and treatment for the entire people of the district and surrounding areas.

With the old facilities, cramped and degraded spaces, it is difficult for the hospital to meet the requirements of medical examination and treatment of the people. The layout of departments of the hospital shows irrationalities. For example, the Department of Emergency Medicine,

Cardiology, and Pediatrics is very far away from the Clinic and Subclinical Area, so the patient has difficulty in walking; The hospital has not yet built a bridge between departments, so it is difficult to transfer patients for testing and surgery in the rain; The internal road system is covered with concrete, but the surface is not smooth, so when the patient is put on a trolley, it is shocked; surface water drainage is not synchronized.

The population of Thuong Tin district is currently about 250000 people. With the aim of building and developing a medical examination and treatment network suitable to the socio-economic development conditions of the country and contributing to improving the quality of health care services on a par with that of advanced countries in the region, the Ministry of Health stipulates that the number of patient beds in hospitals must reach the minimum rate of 25 beds per 10000 people (including 5 separate beds). Thus, Thuong Tin General Hospital must have a size of 500 beds.

HDPE pipes, buried underground, are used for outdoor water supply networks. Water supply for the works is taken from the water supply network of the city, water is directly taken into underground reservoirs with a sufficient capacity to meet the needs of firefighting water and for other purposes (domestic water, water for plants, etc.) [6].

Sewerage and wastewater treatment system

Direction of rainwater drainage: The main slope direction for rainwater drainage of the planned area is the slope of the terrain after being levelled.

Direction of wastewater sewerage: Wastewater from the room of cesarean hysterectomy of the examination and treatment area will be separated from the domestic wastewater of the hospital. Wastewater from this area is collected by a separate sewer system and locally treated in each building, then both domestic wastewater and treated wastewater from the local treatment station will be discharged to the outdoor sewerage network to the centralized wastewater treatment plant.

Wastewater of the hospital is treated at a centralized wastewater treatment plant with a capacity of 200 m^3/day.

Environmental sanitation

The hospital has been issued a hazardous waste source owner with a number code QLCTNH:01.0010119.T dated 08/02/2012. Hazardous waste after being collected and stored will be transported and treated by Phu Ha Environment Co., Ltd. (in accordance with the contract). General solid waste, after being collected, will be transported and treated by the Environmental factory of Thuong Tin town. Recycled waste is transported and treated by Bao Ngoc Co., Ltd.

Current situation of medical examination and treatment

In response to continued hospital's yearly self-report, the hospital was scaled up to 325 care beds, 14 departments, 4 functional rooms and 1 Cardiology unit by the end of 2019. The hospital gets an average of 400 to 500 patients per day, eventually it sometimes peaks at more than 600 patients in a day [7]. The scale of hospitals for medical examination and treatment in recent years is shown in Figure 1. Despite an increase in the number of patients each year, the quality of examination and treatment is still guaranteed, absolutely no complications have occurred in treatment.

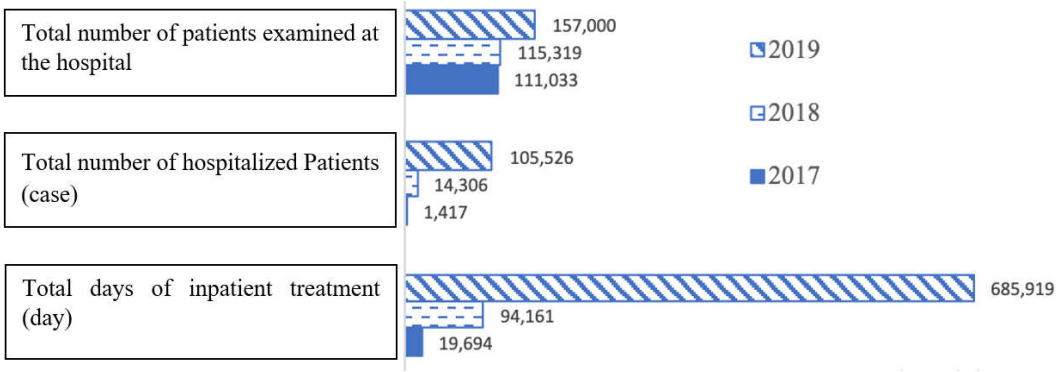

Figure 1: Number of visits for medical examination and treatment in the years of 2017 - 2019

3. Results of waste management survey in Thuong Tin General Hospital

3.1. Current situation of waste generation at Thuong Tin General Hospital

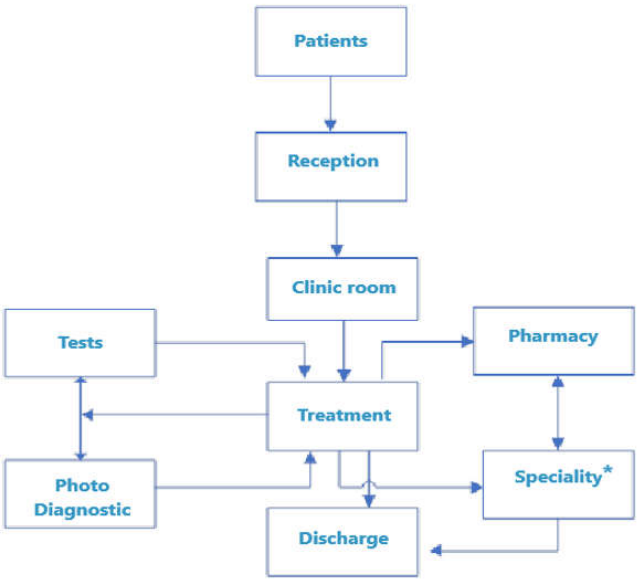

Figure 2: The diagram of movement of the patient in the process of examination

After the survey, we found that there are the following waste sources in the hospital.

Table 1. Sources of solid waste and wastewater generated from medical examination and treatment activities

Type of waste	Source of waste
Domestic wastewater	Activities of employees working in hospitals, patients visiting and treating; patient's family members who take care of sick people.
Medical wastewater	Wastewater containing chemicals from operating rooms, laboratories, testing areas, etc.
Radiation	Image diagnosis department
Domestic solid waste	Arising from activities of patients, their family members; employees working at the hospital.
Hazardous solid waste	Operating rooms, laboratories, patient rooms, pharmacy department
Non-hazardous medical solid waste	Arising from medical professional activities such as glass bottles, serum bottles, plastic materials, various kinds of powder in plaster cast, etc.
Domestic solid waste	Arising in departments, rooms, cafeterias

3.2. Current situation of waste collection and treatment in Thuong Tin General Hospital

Thuong Tin General Hospital is one of 19 hospitals under the management of Hanoi City that has a solid medical waste treatment by incinerator system before 2014. In particular, Thuong Tin General Hospital invested a medical waste incinerator using Austrian Howel technology. Through the field survey on the operation of incinerators at the hospital, we found that most of the incinerators were broken, such as cracked furnace body, low temperature in the furnace, not being thoroughly processed, solid waste after burning remains in shape. The hospital put the oil in the

furnace over and over again until the waste turned into ash. The operation of the incinerator has caused secondary environmental pollution such as black smoke emissions, bad odors, toxic emissions. The cost of burning is too high, each kg of medical waste needs 2 - 4 liters of oil, many incinerators always fail. The hole needs repairing many times. Hence, incineration was stopped for many years.

Instead of incineration, Thuong Tin General Hospital has signed the contract with Phu Ha Co., Ltd for transport and disposal of hazardous waste in the hospital. In the hospital, there is a collection system for collecting solid waste, and all rooms and departments are arranged with solid waste containers by types and distinguished by color according to the regulations of the Ministry of Health. However, according to the survey of us, solid waste is still thrown out of the containers. Some waste, such as bandages with blood is still discarded in general solid waste containers by patients.

Among types of solid waste, hazardous solid waste generated from departments, laboratories, etc. is collected separately in yellow bags or boxes and daily transported to the storage and disposal area for the medical waste in the back of the hospital. The volume of hazardous solid medical waste daily generated in the hospital fluctuates from 15 to 20 kg; then, the average volume of each month is from 450 to 600 kg/ month [8]. Due to the survey data, the hazardous solid waste in the hospital can be categorized into groups as follows.

- Non-sharp clinical waste: bloody materials, fluids and excretions of patients, fluid suckers, expired pharmaceuticals, contaminated pharmaceuticals; human tissues and organs; waste generated from isolation rooms, etc.

- Sharp clinical waste: needles, scalpels, glass culture plates, bloody glass vials, etc.

- Highly infectious waste from laboratories: gloves, slides, leftover specimens after biopsy, blood bags, red blood cells, etc.

- Harmful chemical waste: formaldehyde and disinfectants; optical chemicals; halogen free compounds, etc.

Domestic solid waste is generated from departments, cafeterias, etc. of the hospital, and this type of waste does not contain toxic elements [3]. This solid waste is collected separately into a separate container system and is daily gathered for being transported to the disposal area. Based on the manual of WHO, the volume of generated domestic solid waste daily is calculated about 250 kg/day [8].

Wastewater generated in the hospital (excluding rainwater) is collected to the wastewater treatment plant. The hospital now has a wastewater collection network in buildings. Domestic wastewater and medical wastewater (containing hazardous components) are separated.

Wastewater from the process of medical examination and treatment (through pre-treatment process), domestic wastewater (toilets, etc.), wastewater after the septic tanks and wastewater from kitchens after being passed through grease separation tanks are all collected to the current centralized wastewater treatment plant with a capacity of 200 m^3/day.

Taking into account the survey data, if it is estimated that each inpatient has one accompanied person, the amount of domestic wastewater generated from the patient is summarized in Table 2.

Table 2. Estimation of domestic wastewater from patients

	2017	**2018**	**2019**
Total days of inpatient treatment (days)	19,694	94,161	685,919
Total number of patients examined at hospitals (patients)	111,033	115,319	157,000
Generated domestic wastewater (m^3/day)	**161.81**	**204.41**	**553.33**

Thus, the capacity of the wastewater treatment plant of 200 m^3/day is not enough to serve the generated wastewater.

The wastewater treatment plant of the hospital was built in 2012, using biological treatment methods under CN-2000 technology. The wastewater treatment plant has been issued a license to discharge treated wastewater into the receiving body. Sludge of wastewater treatment process is gathered in sludge tanks and transported by Urban Environment Company [6].

Table 3. Results of measurement and analysis of wastewater quality

No.	Parameter	Unit	Results of wastewater quality		QCVN 28:2010/BTNMT (Column B)
			Before the WWTP	After the WWTP	
1	pH	-	7.2	7.5	6.5 - 8.5
2	BOD_5	mg/l	145	36	50
3	COD	mg/l	225	71	100
4	Total suspended solids	mg/l	156	55	100
5	Sulfur (H_2S)	mg/l	0.52	0.15	4
6	Ammonium	mg/l	19.8	7.8	10
7	Nitrate (NO_4^{3-})	mg/l	2.1	14.2	50
8	Animal and vegetable fat and oil	mg/l	4.6	1.4	20
9	Phosphate	mg/l	3.4	1.8	10
10	Total Coliform	MPN/100 ml	24,000	2,100	5,000
11	Salmonella	Bacteria /100 ml	NA	NA	NA
12	Shigella	Bacteria /100 ml	NA	NA	NA
13	Vibrio cholerae	Bacteria /100 ml	NA	NA	NA

Note: QCVN28:2010/BTNMT - National technical regulation on health care wastewater (Column B)

From the table above, it shows that the quality of treated wastewater of the hospital reaches column B of QCVN 28: 2010/BTNMT - National technical regulation on medical wastewater.

3.3. Proposing measures to improve the efficiency of waste management in Thuong Tin General Hospital

From the research results, we found that some main problems exist in waste management in Thuong Tin General Hospital are as follows:

- Solid waste collection system, especially hazardous solid waste, are not well controlled. In some cases, means of collection and storage are not in accordance with regulations.

- The capacity of wastewater treatment systems have not met the actual needs as well as quality requirements.

Therefore, the measures for improvement of the efficiency are also proposed to solve the above problems. In which, the problem of waste collection system can be solved immediately through the development of a medical waste management process in the hospital with the participation of healthcare staff, patients, patients' relatives, visitors (Figure 3).

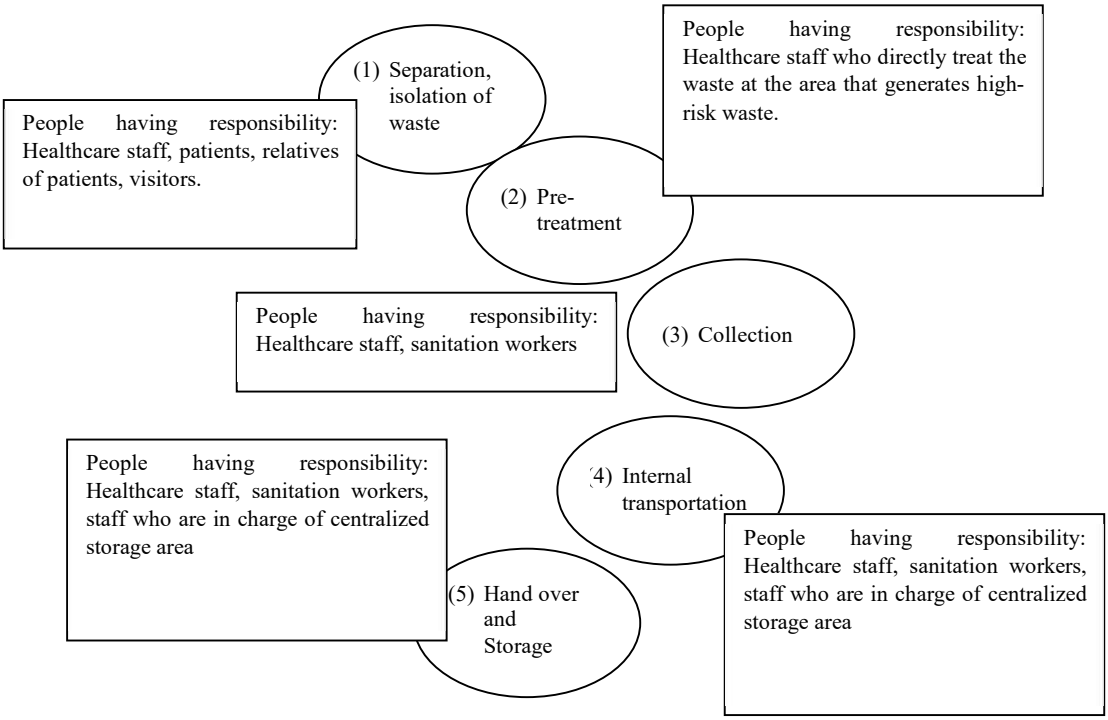

Figure 3: Diagram of medical waste management in the hospital

According to this process, at step (1), the people who have responsibility need to identify the groups of infectious, hazardous or general medical solid waste, and then classify the waste immediately after it is generated, dispose and isolate into suitable collection equipment for each type of waste as prescribed. At step (2), the work to be done is pre-treatment of the highly infectious waste at the place of generation by measures such as wet steaming, microwave, chemical disinfection. Wet steaming is implemented at 121^{o}C for 20 minutes or soaking waste in Chloramine B or Javel solution for a minimum duration of 30 minutes. Step (3), collect the waste into the appropriate bags and containers in the specified procedure and color. Step (4), transport waste from the place of generation to the storage place by specialized vehicles in accordance with prescribed time and route, vehicles must be cleaned and disinfected at the centralized storage area. Step (5), healthcare staff will hand over the waste to the staff of centralized storage area, each type of waste needs recording with the quantity in the hand-over book and signing for receipt, then it needs storing separately in labeled containers, and centralized waste storage places must always have all tools which ensure hygiene and safety against fire and explosion.

Addressing the problems of the wastewater treatment system requires a large amount of capital [4] as well as synchronization when building and expanding the hospital. It can be partially overcome by evaluating the treatment efficiency in case of exceeding the capacity of the plant, thereby changing the amount of chemicals added to solve the problem of improving treatment efficiency. However, this is also an issue that requires more intensive research.

4. Conclusion

Currently, the wastewater collection and treatment system at Thuong Tin General Hospital has been degraded, the capacity does not meet the requirements and this increases the risk of environmental pollution as well as the cost of reducing higher chemical disinfection. The management system of solid waste and hazardous solid waste still has some shortcomings from collection to separation and storage. In order to ensure safety for local communities and overcome pollution caused by ineffective management of wastewater and hazardous solid waste, the study team has proposed a number of improvements to the collection process and determine the need to expand the wastewater treatment plant. In which, the first priority solution is to complete hazardous solid waste collection and storage facilities. The construction and rehabilitation of the wastewater treatment system of the hospital due to the high capital requirement and the need of synchronization with the regional technical infrastructure can be implemented in the future

according to the general plan of the city.

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