



## MANAGEMENT OF MEDICAL SOLID WASTE IN COVID-19 TREATMENT FACILITIES AT SOME GENERAL HOSPITALS IN THANH HOA PROVINCE

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### Abstract

*The objective research is evaluation the medical solid waste generation and management, thereby proposing solutions to improve the efficiency of medical waste management of Covid-19 treatment hospitals in Thanh Hoa province. The research methods are used, including: Method of document collection, interview method and method of comparison and evaluation. The research was carried out at 09 Covid-19 treatment facilities of Thanh Hoa city general hospital and Hoang Hoa district general hospital, from September 2021 to July 2022. The research results showed at the Covid-19 treatment facilities of both hospitals, the volume of solid waste increased sharply from December 2021 to March 2022 then gradually decreased from April 2022 to July 2022. Hundred percent of Covid-19 treatment facilities consider all solid waste as infectious waste and apply the same management process as infectious waste. On the other hand, Covid-19 treatment facilities also focus on ensuring occupational safety and hygiene issues during solid waste collection and treatment such as using personal protective equipment – PPE, using disinfectant solutions, .... However, sharp waste has not been stored in standard containers. Waste treatment has not yet been carried out in accordance with regulations. Therefore, hospitals need to adjust the system of waste collection and treatment in Covid-19 treatment facilities in accordance with the provisions of the issued circulars and decrees.*

**Keywords:** Hospital; Hospital solid waste; Classification; Management; Treatment.

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### 1. Introduction

During operation, Covid-19 treatment facilities emit a large amount of waste, including solid, liquid and gaseous waste, especially during the peak of Covid-19 pandemic, when the number of patients increased rapidly. In Thanh Hoa province, from September 2021 to the end of July

2022, the volume of medical solid waste arising from the operation of Covid-19 treatment facilities amounted to more than 180 tons [11, 12]. During the period from 2021 to 2022, 49 Covid-19 treatment facilities were established across the province, with a total of 8.095 bedsore [13, 14]. Therefore, at the hospital there is a separate management for wastes related

to Covid-19 treatment facilities, but there are still many drawbacks. The situation of joint storage of medical solid waste with a high risk of infection with other types of medical solid waste arising from other sources in the hospital still exists. Many hospitals still use manual incineration, or incinerators are damaged and substandard, polluting the environment and bringing low efficiency in waste treatment [7]. Most district hospitals of mountainous districts still use the landfills method that does not meet technical standards [7, 8]. With the emergence of more and more infectious diseases as well as the increasing demand for medical examination and treatment. If the medical solid waste management is not properly implemented, the local health and environmental management will be under great pressure. For the above reason, the study was carried out at the Covid-19 treatment facilities, belonging to Thanh Hoa city general hospital and Hoang Hoa district general hospital, during the period from September 2021 to July 2022 in order to evaluate the current situation of medical solid waste generation and the management of medical solid waste related to treatment of Covid-19. Based on that, highlight the shortcomings in medical solid waste management and propose solutions to improve the quality of medical solid waste management at Covid-19 treatment facilities in Thanh Hoa province.

## **2. Research methods**

The research was carried out during the period from September 2021 to July 2022. The author divided into 03 main phases:

Phase I - from September 2021 to November 2021: 02 hospitals have not yet implemented Covid-19 treatment

activities and Covid-19 treatment facilities at 02 hospitals have not been established.

Phase II - from December 2021 to March 2022: 02 hospitals set up Covid-19 treatment facilities outside the hospital campus in order to receive and treat for Covid-19 patients separately.

Phase III - from April 2022 to July 2022: Covid-19 treatment facilities were dissolved. 02 hospitals established Covid-19 treatment areas with functions equivalent to a department.

### ***2.1. The method of document collection***

Collecting the data related to the current situation of arising and management of medical solid waste in Covid-19 treatment facilities at: Thanh Hoa city general hospital; Hoang Hoa district general hospital; Department of Health of Thanh Hoa province; Thanh Hoa provincial Center for Disease Control.

### ***2.2. Interview method***

With the proposed research contents, the author developed a questionnaire focusing on 03 main issues, including: Current status of medical solid waste generation in Covid-19 treatment facilities; Current status of medical solid waste management in Covid-19 treatment facilities. The author focused on interviewing 03 main interviewees: Sanitation worker, health care worker and full-time environmental managers who have been working in the Covid-19 treatment facilities of Thanh Hoa city general hospital and Hoang Hoa district general hospital.

### ***2.3. Method of comparison and evaluation***

Scrutinizing and using Vietnam's legislative framework on medical solid

waste management for hospitals with Covid-19 treatment facilities in order to the medical solid waste management process at the study sites. At the same time, compare the level of legal compliance of hospital in medical solid waste management related to Covid-19. The author mainly focused on using: Joint circular No.58/2018/TT-BYT-BTNMT on Medical waste management; Circular No.20/2021/TT-BYT on Medical waste management within medical facilities and Decision No.3455/QD-BCDQG of the National Steering Committee for Covid-19 Prevention and Control on the promulgation of “Guidelines for waste management and hygiene in the prevention and control of the Covid-19 pandemic”.

## 2.4. Method of data processing

Collected data will be cleaned, entered, statistics and processed on Microsoft Excel software. Analysis results are presented in tables and charts used for reporting research results.

## 3. Research results

### 3.1. Characteristics of Covid-19 treatment facilities of Thanh Hoa city general hospital and Hoang Hoa district general hospital

Information about Covid-19 treatment facilities of Thanh Hoa city general hospital and Hoang Hoa district general hospital is shown in Table 1:

**Table 1. The Covid-19 treatment facilities of Thanh Hoa city general hospital and Hoang Hoa district general hospital**

Name of hospital	Phase	Number of Covid-19 treatment facilities	The established times	Size (number of beds)	Number of patients (person)	Location
Thanh Hoa city general hospital	Phase II	02	December, 2021	670	5.980	Outside hospital campus
	Phase III	01	April, 2022	46	84	Department of Infectious Diseases, 5 <sup>th</sup> floor, Thanh Hoa city general hospital
Hoang Hoa district general hospital	Phase II	05	December, 2021	1.005	3.822	Outside hospital campus
	Phase III	01	April, 2022	60	507	Department of Infectious Diseases, Hoang Hoa district general hospital

*Source: Research result*

In phase II, due to the rapid increase in the number of patients, all hospitals in Thanh Hoa province simultaneously established many facilities to receive and treat the Covid-19 patients. Both general hospitals took advantage of establishing Covid-19 treatment facilities from the headquarters of agencies and organizations

near the hospitals to maintain the normal operation of the hospitals and minimize the possibility of disease transmission to the other areas of hospitals. In phase III, the number of patients decreased, the Covid-19 pandemic is gradually controlled. Therefore, the hospitals dissolved the Covid-19 treatment

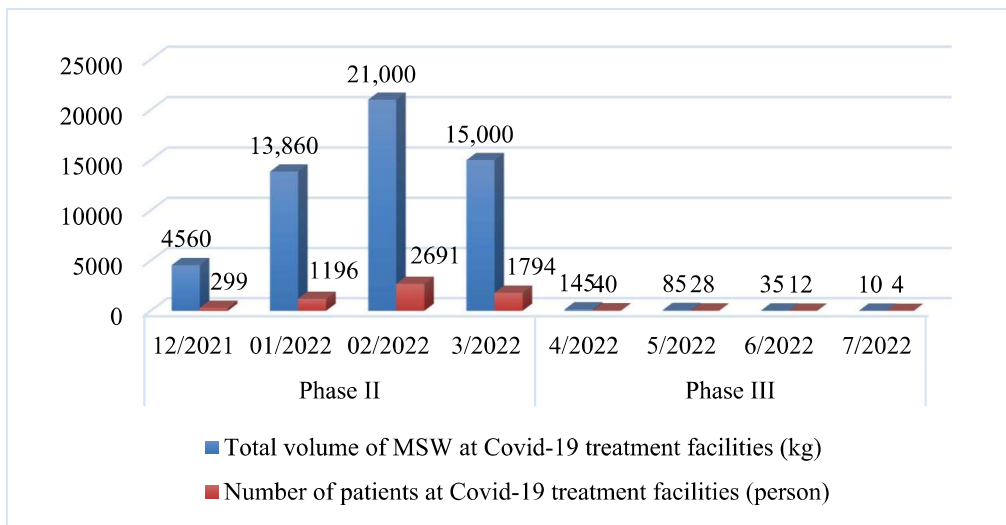
facilities and at the same time established the Covid-19 treatment area located in the hospital campus.

### 3.2. The status of medical solid waste generation in Covid-19 treatment facilities

#### 3.2.1. The status of medical solid waste generation in Covid-19 treatment facilities of Thanh Hoa city general hospital

In December 2021, Thanh Hoa city general hospital established 02

Covid-19 treatment facilities at Hong Duc University, with a total of 670 hospital beds (Phase II) [10]. On April 27<sup>th</sup>, 2022, these Covid-19 treatment facilities were dissolved and at the same time, a Covid-19 treatment area established, with 46 hospital beds, belonging to the Department of Infectious Diseases at Thanh Hoa city general hospital (Phase III) [12].



**Figure 1: Comparison of medical solid waste volume with the number of patients at the Covid-19 treatment facilities of Thanh Hoa city general hospital**

Source: Research result

As is observed, the volume of medical solid waste generated is proportional to the number of patients that Thanh Hoa city general hospital received and treated at 02 Covid-19 treatment facilities. In addition, the volume of medical solid waste in the Covid-19 treatment area of Thanh Hoa city general hospital in phase II and III has a relatively large difference. In which, the volume of medical solid waste goes up sharply in phase II and declines quickly in phase III.

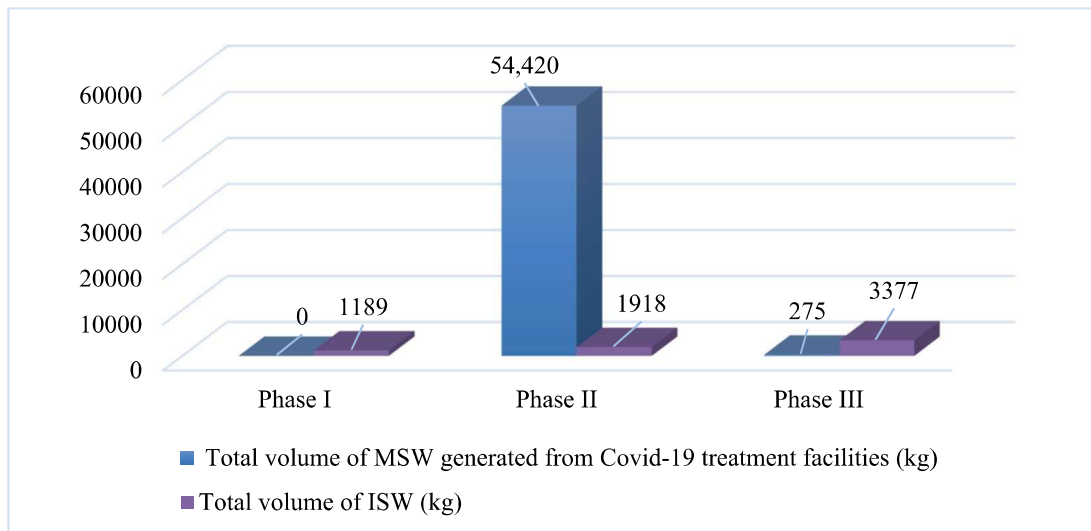
Phase II is when the Covid-19 treatment facilities of Thanh Hoa city

general hospital discharged the largest amount of medical solid waste, ranging from 4.56 to 21 tons. On November 18<sup>th</sup>, 2021, the first Covid-19 treatment facility of Thanh Hoa city general hospital was established [10]. Previously, patients who were infected with Covid-19 in Thanh Hoa city were treated at the Thanh Hoa hospital for Lung Disease [10]. Therefore, there is a huge difference between the volume of medical solid waste generated in December 2021 and the first three months of 2022.

In phase III, the volume of medical solid waste generated in April 2022

collapsed rapidly and was only 0.96 % of the volume of medical solid waste generated in March 2022. The volume of medical solid waste in the last 03 months

of phase III continued to decrease due to the change in the number of hospital beds and Covid-19 patients that the hospital received and treated.



**Figure 2: Comparison of the total volume of medical solid waste generated from Covid-19 treatment facilities with the total volume of infectious solid waste (ISW) generated at Thanh Hoa city general hospital**

Source: Research result

As is observed, the ratio between the volume of medical solid waste at the Covid-19 treatment facilities and the total volume of ISW at Thanh Hoa city general hospital has changed greatly over time. The generated volume of medical solid waste of Covid-19 treatment facilities is 28.37 times higher than the ISW generated at Thanh Hoa city general hospital in phase II and 45.77 times higher in phase I. In phase III, the total volume of medical solid waste from the Covid-19 treatment facilities goes down dramatically and at the same time, Thanh Hoa city general hospital returned to normal operation, so the total volume of ISW generated is 12.28 times higher than the medical solid waste from the Covid-19 treatment facilities.

hospital

In December 2021, Hoang Hoa district general hospital established 05 Covid-19 treatment facilities, with a total of 1005 hospital beds [9]. Like Thanh Hoa city general hospital, Hoang Hoa district general hospital simultaneously dissolved at the end of April 2022 and renovated the hospital's Department of Infectious Diseases to establish a Covid-19 treatment area, with 60 hospital beds [11].

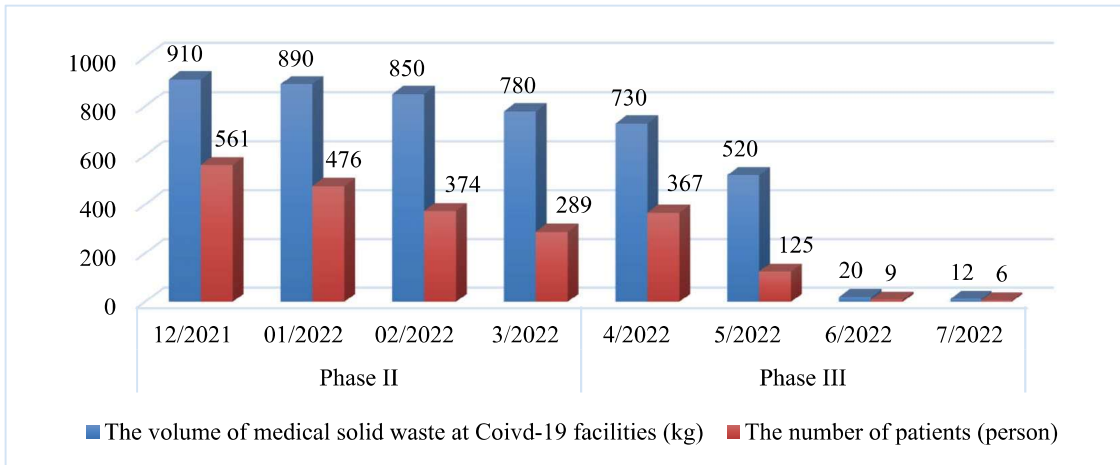
The Covid-19 treatment facilities of Hoang Hoa district general hospital has a very large volume of medical solid waste generated in phase II and tends to fall gradually in the following months. In phase II, in December 2021, Hoang Hoa district detected 05 outbreaks in 05 communes, including: Hoang Chau, Hoang Phu, Hoang Giang, Hoang Thanh and Hoang Ha. The source of infection are local people who work at Rollsport

*3.2.2. Status of medical solid waste generation at Covid-19 treatment facilities of Hoang Hoa district general*

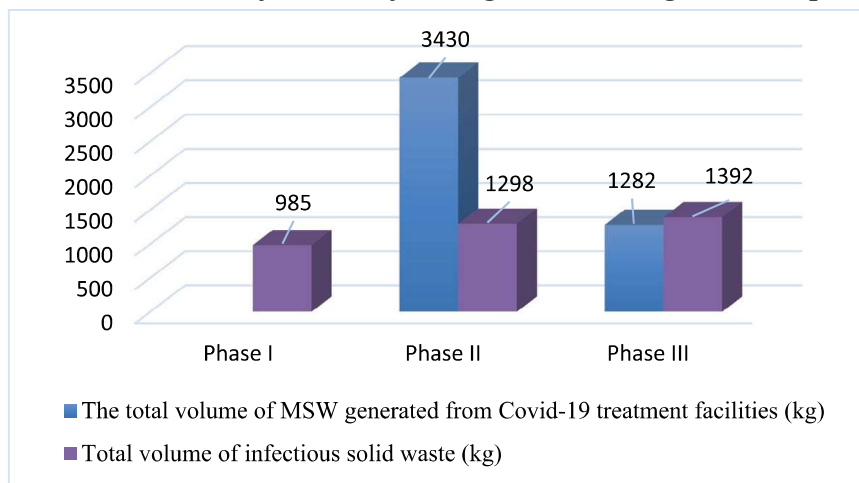
1 Vietnam Shoes Co., Ltd (Thanh Hoa city) [11]. After that, the disease spread to neighboring communes in Hoang Hoa district. Therefore, December 2021 is the month that Covid-19 treatment facilities of Hoang Hoa district general hospital generate the most medical solid waste. Although these facilities have gradually declined in the volume of medical solid waste month by month, there is not a big difference between months.

In phase III, 05 Covid-19 treatment facilities of Hoang Hoa district general

hospital were dissolved at the end of April 2022 [11], so there is no big difference between the volume of medical solid waste generated at these facilities in April 2022 and the previous months of phase II. Although the volume of medical solid waste arising from Covid-19 treatment area in May 2022 has collapsed by 1.4 times compared to April 2022, it is still relatively large compared to the remaining months in phase III. The beginning of May 2022 is the end of holiday, so the rate of infection and re-infection with Covid-19 is very high.



**Figure 3: Comparison of medical solid waste volume with the number of patients at the Covid-19 treatment facilities of Hoang Hoa district general hospital**



**Figure 4: Comparison of the total volume of medical solid waste generated from Covid-19 treatment facilities with the total volume of infectious solid waste (ISW) generated at Hoang Hoa district general hospital**

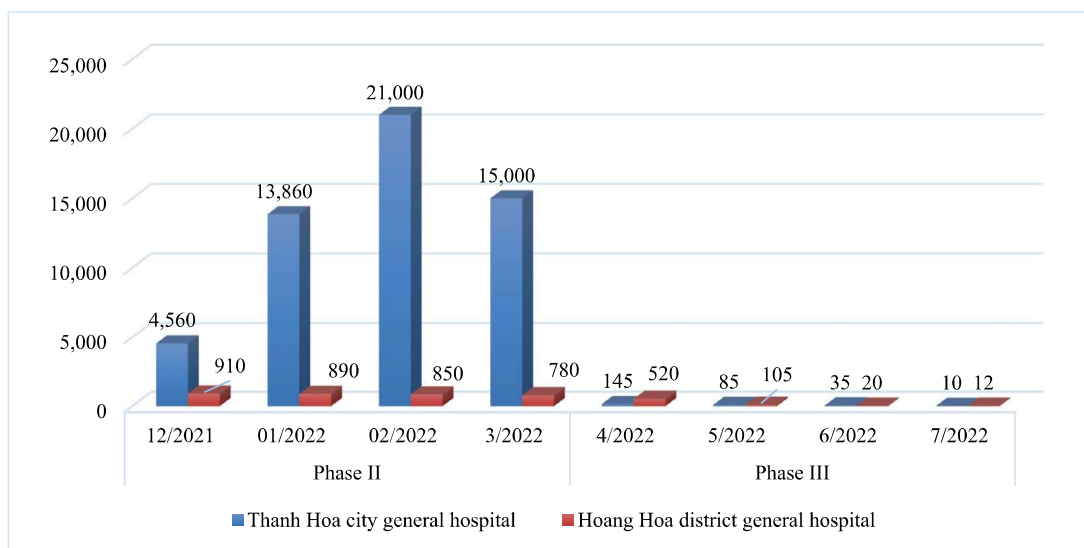
Source: Research result

In phase II, The total volume of medical solid waste generated from 05 Covid-19 treatment facilities of Hoang Hoa district general hospital is the largest, reaching 3430 kg. Hoang Hoa district general hospital is a cottage hospital with a scale of 300 hospital beds. In contrast, the total number of hospital beds at 05 Covid-19 treatment facilities is 1005 in phase II, which are used at 100 % of capacity. The disparity in number of hospital beds and patients leads to a significant disparity in the volume of medical solid waste. Phase II is when the Covid-19 pandemic broke out strongly, the number of patients increased, so the total volume of medical solid waste at

Covid-19 treatment facilities is 2.64 times higher than the total ISW volume in the same phase and 3.48 times higher than the total volume of ISW in the phase III.

In phase III, Hoang Hoa district general hospital returned to normal operation, the number of Covid-19 patients also decreased. However, due to the high risk of infection, Covid-19 treatment facilities use one-time items, such as medical gloves, medical masks, PPE,... Therefore, there is not much difference between the total volume of medical solid waste from Covid-19 area and the total volume of ISW arising from other areas of Hoang Hoa district general hospital.

**3.2.3. Evaluation of the current situation of medical solid waste generation in the Covid-19 treatment areas of 02 hospitals**



**Figure 5: Comparison of the volume of medical solid waste generated from Covid-19 treatment facilities between Thanh Hoa city general hospital and Hoang Hoa district general hospital**

Source: Research result

02 hospitals have similar developments in the generation of medical solid waste at Covid-19 treatment facilities. Phase II is the period when many holidays take place, especially the Lunar New Year, so people from other provinces and cities return to their hometown, with

complicated and dense moving schedules. Therefore, the Covid-19 treatment facilities of both hospitals increased the volume of medical solid waste generated in phase II and gradually decreased in phase III. However, there is still a difference between 02 hospitals. In phase



II, the volume of medical solid waste from Covid-19 facilities of Hoang Hoa district general hospital went down month by month and December 2021 is the month with the highest volume of generated medical solid waste. In contrast, the volume of medical solid waste generated at these facilities of Thanh Hoa city general hospital increased gradually in the first 03 months of phase II, then began to decline from March 2022. The volume of medical solid waste from Covid-19 treatment facilities of Thanh Hoa city general hospital is highest in February 2022. This gap is due to the difference in disease progression. In December 2021, Hoang Hoa district started an outbreak of disease. However, in February 2022, Thanh Hoa city just began to be severely affected by Covid-19 pandemic. In addition, Thanh Hoa city is the center of socio-economic development of Thanh Hoa province, attracting many laborers. Therefore, the time when people returned to Thanh Hoa city to work after Tet holiday was the time when pandemic broke out.

On the other hand, despite a larger number of facilities and hospital beds, the volume of medical solid waste generated from Covid-19 treatment facilities of Hoang Hoa district general hospital is still lower than Thanh Hoa city general hospital. Thanh Hoa city has a large population and area, the places

where the Covid-19 occurs are crowded areas, such as: Industrial parks, schools, factories,... In contrast, Hoang Hoa district has smaller population and area than Thanh Hoa city, where the Covid-19 pandemic occurs are the households in a certain area. Therefore, the number of patients recorded in each district or city is also different. This is the cause of the difference in the volume of medical solid waste generated from Covid-19 treatment facilities of 02 hospitals.

### ***3.3. Status of medical solid waste management in Covid-19 treatment facilities***

In phase I, both hospitals managed medical solid waste according to the provisions of Joint Circular No.58/2015/TTLT-BYT-BTNMT on Medical waste management. In phase II and III, when treating Covid-19 patients, 02 hospitals managed medical solid waste arising from Covid-19 treatment facilities according to “Guidelines for waste management and hygiene in the prevention and control of the Covid-19 pandemic” issued together with Decision No.3455/QD-BCDQG of the National Steering Committee for Covid-19 Prevention and Control.

#### ***3.3.1. Classification***

In phase I, both of 02 hospitals classified arising medical solid waste into 05 main groups, including:

***Table 2. Medical solid waste classification in at Thanh Hoa city general hospital and Hoang Hoa district general hospital***

<b>No</b>	<b>Type of waste</b>	<b>Classification</b>
1	Sharp infectious solid waste	Puncture resistant box, yellow, biohazard warning symbol
2	Non-sharp infectious solid waste	Plastic bin with plastic bag lining, yellow color
3	Non-infectious hazardous waste (HW)	- Black plastic bag - Plastic bin with plastic bag lining, black color, HW warning symbol
4	Domestic waste	Plastic waste container, lined with plastic bag, green color
5	Recycled waste	Plastic waste container, lined with plastic bag, white color



In phase I, 02 hospitals complied with regulations on medical solid waste classification. medical solid waste is classified into plastic containers and bags containing the specified color codes. At the gathering areas of garbage cans, there are instructions for sorting waste. The bins and bags are fully equipped, there is no shortage of trash cans and bags. The bins and bags also meet the standard, such as: puncture resistant, durable, warning symbol outside (for containers, bags containing infectious waste, hazardous waste,...). However, the instructions on waste classification in some departments at Hoang Hoa district general hospital have blurred or lost the information printed on the boards. On the other hand, at Thanh Hoa city general hospital, several sharp medical solid waste containers have been damaged, such as: Open the lid or blur the norm line.

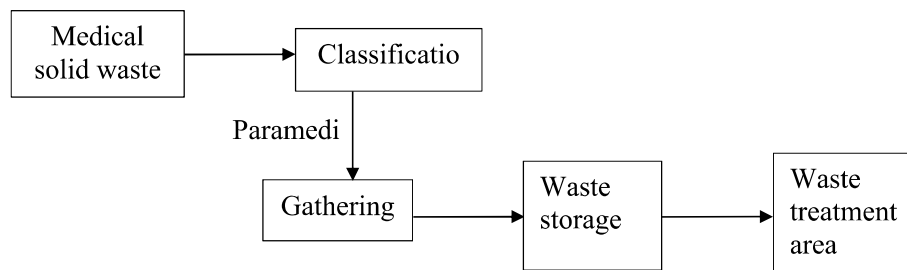
In phases II and III, due to the rapid spread of infectious diseases, all medical solid waste arising from the Covid-19 treatment facilities of the 02 hospitals was considered infectious waste and applied infectious waste management processes. Specifically, the generated medical solid

waste was stored in PE plastic bags or 30-liter, yellow trash cans. The outside of all bags and trash cans are labeled “WASTE CONTAINING SARS-CoV-2”.

In phase II, if the classification of medical solid waste arising from the Covid-19 treatment facilities is the same as the classification applied by 02 hospitals in phase I, the sanitation workers will have to come into direct contact with this waste. This does not ensure health safety as well as increases the risk of infection for sanitation workers. Therefore, it is completely reasonable to consider all medical solid waste generated in the Covid-19 treatment facilities as ISW and apply the equivalent management process. However, the storage of sharp solid waste with PE plastic bags like other types of medical solid waste is easy to tear the bag and drop waste out as well as possibly injuring the sanitation workers. They can get infected not only with Covid-19 but also many other infectious diseases.

### 3.3.2. Collection

In phase I, both hospitals have the following waste collection procedures:



**Figure 6: Waste collection process in phase I of Thanh Hoa city general hospital and Hoang Hoa district general hospital**

In phase I, medical solid waste, after being classified into waste containers and bags according to the specified colors, the paramedics are responsible for gathering waste on injection trucks,

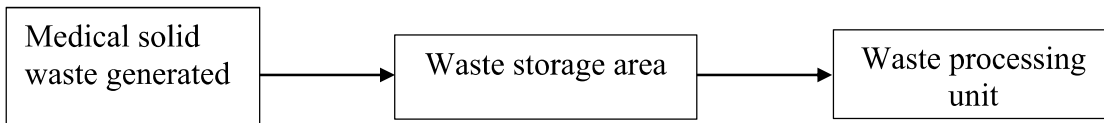
operating rooms and hospital rooms to the waste containers with corresponding color, placed at the gathering location as prescribed, with a minimum frequency of 01 time per day. The sanitation workers

will take the containers to the hospital's waste storage facility to wait for the waste to be disposed of. Although the collection model is similar, the method of waste collection at the two hospitals is still different. At Thanh Hoa city general hospital, medical solid waste is collected according to each department, the location of waste containers will be located at a fixed location in each department. At Hoang Hoa district general hospital conducts floor-to-floor collection, whereby the paramedics will collect the waste and collect it in waste containers that are fixed at the end of the corridor on each floor.

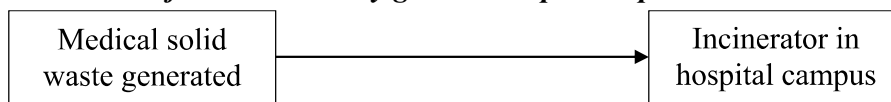
In phase II, both hospitals have had a change in the collection process. As mentioned in section 3.2.1, waste in each room is collected in PE plastic bags according to regulations. During the collection process, the sanitation

workers pushed the container to each room, collected the sealed waste bags and then transported them to the treatment area. During this process, each Covid-19 treatment facility of 02 hospitals maintains a minimum of 02 times per day of waste collection. However, when the number of patients increases and the amount of waste generated is large, the Covid-19 treatment facilities will actively increase the frequency of waste collection in 01 day to avoid the situation of waste being backlogged through the following days.

In phase III, in the Covid-19 treatment areas, 02 hospitals keep the same way of collecting waste as in phase II, meaning that the sanitation workers still push the container to each room to collect waste, then ship it to the next place in the process. However, due to the difference in waste treatment methods, the collection process between the 02 hospitals is different.



**Figure 7: The process of collecting medical solid waste from the Covid-19 treatment area of Thanh Hoa city general hospital in phase III**



**Figure 8: The process of collecting medical solid waste from the Covid-19 treatment area of Hoang Hoa district general hospital in phase III**

02 hospitals have followed the waste collection process in all 03 phases. In phase II, the Covid-19 treatment facilities of the 02 hospitals flexibly adjusted so that the generated waste was always treated on the same day. In addition, the Covid-19 treatment facilities of the 02 hospitals have well adhered to the principle of disinfection during and after the collection process. Specifically, the sanitation workers always disinfect the waste

bags before collecting and always clean the waste containers with Chloramine B solution after each collection shift. However, in phase III, Thanh Hoa city general hospital has reduced the frequency of collection to once a day, due to the relatively small number of patients that Thanh Hoa city general Hospital receives, leading to a large volume of waste arising not as much and continuously as phase II. In addition, in phase II and III, it is

unreasonable for the sanitation workers to push the waste container to each room for waste collection because it increases human exposure to potentially medical solid waste with a high risk of infection.

### *3.3.3. Transportation and storage*

#### *a. Medical solid waste transportation*

02 hospitals are divided into 02 waste transport routes within the hospital campus, including: Transport routes for infectious waste and hazardous waste; Transport routes for other types of waste. In phase I, the sanitation workers at the 02 hospitals transported waste according to the prescribed transport routes, not recording any spilled or leaked waste during the transportation process. Waste generated from the Covid-19 treatment area is considered infectious waste, in phase III, 02 hospitals will transport medical solid waste arising from the Covid-19 treatment area via dedicated transportation for infectious waste.

In phase II, due to the fact that the Covid-19 treatment facilities are established temporarily at the headquarters of agencies and organizations. Therefore, these facilities do not meet the basic conditions on medical solid waste management. All Covid-19 treatment facilities located outside the campus of the 02 hospitals do not have their own waste transportation routes. However, to overcome this, the sanitation workers have chosen the time of collection and transportation, when there are few people traveling, such as the end of the day or early morning, so that the work of waste collection and transportation can be more convenient and safer.

#### *b. Medical solid waste storage*

At Thanh Hoa city general hospital, the hospital's storage area is divided

into 02 separate parts. In which, a part is dedicated to storing infectious waste and hazardous waste. The remaining part is to store other types of waste. The waste storage house of Thanh Hoa city general hospital has an area of 25 m<sup>2</sup>, built in a self-contained manner, the door is locked (only opens when in use), has a warning sign,... The foundation of the storage area is built to ensure that it is not flooded, to prevent rainwater from overflowing from the outside [10]. However, the waste storage area of Thanh Hoa city general hospital is still not up to the standard due to the lack of equipment for fire protection systems. At Hoang Hoa district general hospital, the hospital's waste storage area is not divided into separate parts for waste types like Thanh Hoa city general hospital. All waste is stored together in a room and stored in color-coded plastic containers corresponding to each type of waste, with tight-fitting lids.

In phase II, due to limitations in facilities as well as the large amount of medical solid waste generated, the Covid-19 treatment facilities of both hospitals will not conduct waste storage but will treat the generated waste immediately each day. This is also the rule in treating medical solid waste related to the Covid-19 pandemic of Hoang Hoa district general hospital. In contrast, in phase III, Thanh Hoa city general hospital stores waste generated from the Covid-19 treatment area together with infectious waste and hazardous waste generated from other areas of the hospital at the hospital's storage room to wait for Song Cong Co., Ltd. to transport and treat. Thus, for medical solid waste related to Covid-19 diseases, Thanh Hoa city general hospital in phase III did not comply with the rule of Covid-19 waste, although the amount

of waste generated as well as the number of Covid-19 patients is relatively rare.

#### *3.3.4. Medical solid waste treatment*

The medical solid waste treatment in the Covid-19 treatment facilities of 02 hospitals in 03 phases has had certain changes, with many methods of medical solid waste treatment applied:

In phase I, 02 hospitals apply 02 main methods of treating medical solid waste, including: Cluster treatment and hire a treatment unit. Thanh Hoa province is divided into 09 waste treatment clusters, specializing in receiving and treating hazardous waste arising at district and provincial hospitals. In which, Thanh Hoa city general hospital belongs to cluster 1 - located at the Children Hospital of Thanh Hoa province, Hoang Hoa district general hospital belongs to cluster 2 - located at the Hau Loc district general hospital. Each cluster is equipped with a treatment system with steam sterilization technology combined with cutting [9, 10]. Specifically, the medical solid waste will be sterilized, crushed and cut into domestic waste and then treated as domestic waste. However, the solid waste treatment system in the clusters does not accept and handle sharp solids, hard objects and hazardous wastes of hospitals. The solid waste that is not received and treated at the cluster is transported and treated by Song Cong Co., Ltd (formerly Phu Ha Co., Ltd.).

In phase II, the Covid-19 treatment facilities of the 02 hospitals treated medical solid waste by manual burning method combined with burying on the campus of the treatment facilities [11, 12]. Specifically, at the Covid-19 treatment facility of Thanh Hoa city general hospital, the sanitation workers dug a large hole. Medical solid waste

after being collected is taken to the pit and burned with Diesel oil. After the waste is completely burned, the sanitation workers will proceed to cover it with sand and soil for burial. The incineration method is the preferred method, but the manual burning of waste at Covid-19 treatment facilities is ineffective, does not ensure that the waste is completely burned and pollutes the soil environment. The open burning of waste also negatively affects the air environment because of not controlling the quality of emissions. The fact that the burial pit is dug temporarily, the burying of waste is not meeting the standards of a sanitary landfill and not ensuring the safety for the sanitation workers. In addition, the unsanitary burial will put more pressure on the renovation and restoration after dissolving the Covid-19 treatment facility.

In phase III, Thanh Hoa city general hospital signed a contract with Song Cong Co., Ltd. to transport and treat all medical solid waste generated at the hospital, including medical solid waste arising from the Covid-19 treatment area, with a frequency of 3 days/time. Therefore, the medical solid waste arising from the Covid-19 treatment area will not be processed within the same day and must be stored together with the ISW and the hazardous waste of the hospital.

Medical solid waste generated in the Covid-19 treatment area of Hoang Hoa district general hospital in phase III is incinerated at the hospital's incinerator. The incinerator used at Hoang Hoa district general hospital is a 2 - chamber incinerator with a capacity of 150 kg/batch. This incinerator has been invested since 2009, with British technology A200 - inciner8 [12]. However, the hospital's incinerator has stopped working since

2016 due to overload and deterioration with the condition of the furnace button, broken, slow sensor, black smoke, costly and polluting the environment. To meet the needs of medical solid waste treatment from the Covid-19 treatment facilities, in March 2022, Hoang Hoa district general hospital upgraded, repaired and re-operated the incinerator in April 2022. The types of medical solid waste arising from other areas in phase III at Hoang Hoa district General Hospital will be transported and treated by Song Cong Co., Ltd.

### ***3.4. Proposing solutions to improve the quality of medical solid waste management for Covid-19 treatment areas***

02 hospitals need to equip tools for the sharp infectious solid waste collection in the Covid-19 treatment area, such as: gloves, tongs, bins, or containers for sharp infectious solid waste (with lids, puncture resistance, gauge lines, warning signs,...) to ensure the safety of sanitation workers as well as to eliminate the possibility of sharp waste damaging the bag, cause leakage, waste spillage.

02 hospitals need to adjust in the way they collect waste in the Covid-19 treatment areas. Specifically, sanitation workers collect waste bags from the rooms to the gathering area. Then, via the hospital's own transport, take the waste to the next point in the process.

02 hospitals need to focus on restoring and renovating waste landfills of waste collection facilities, to ensure the safety of people when those areas return to normal operation. In addition, Thanh Hoa city general hospital also needs to adjust the frequency of waste collection with Song Cong Co., Ltd, so that medical

solid waste in Covid-19 treatment areas is treated on the same day. Thanh Hoa city general hospital also needs to consider remodeling and re-operating the hospital's incinerator, so that it can be more proactive in handling solid waste related to the Covid-19 epidemic.

In addition, hospitals also need to upgrade, repair and supplement the missing aspects at the hospital's waste storage house, such as: Fire protection system, solid waste subdivisions in the waste storage areas. Moreover, 02 hospitals also need to pay attention to human resource issues to ensure both quantity and quality for the hospital's sanitation workers. Specifically, the hospital needs to ensure safe and hygienic conditions for employees participating in the collection, transportation and treatment of medical solid waste from the Covid-19 treatment area, such as: Fully equipped with costumes and equipment protected; Ensure regular health care regime; Ensure vaccination regime against Covid-19; Conduct a quick test for staff before each shift,... Sanitation workers working in the hospital's Covid-19 treatment area need to be trained to be aware of risks of ISW and hazard waste as well as the procedures to be followed in hospital to prevent and minimize the possibility of exposure and infection.

## **4. Conclusion**

In general, Thanh Hoa city general hospital and Hoang Hoa district general hospital have complied and flexibly applied regulations on management of medical solid waste. All medical solid waste in the Covid-19 treatment areas of the 02 hospitals are not classified.

02 hospitals considered all waste as infectious waste and applied the same

management process. In 02 hospitals, sharp solid waste is still collected with other types of waste, which easily punctures waste bags and does not ensure the safety of staff during waste collection, transportation and treatment.

02 hospitals carried out manual waste collection at each room in the Covid-19 treatment facilities, with a frequency from 01 to 02 times/day, depending on about each phase. Waste from Covid-19 treatment activities at 02 hospitals is prioritized for collection on the same day. The collection of Covid-19 waste of the two hospitals also paid special attention to hygiene and disinfection.

Most of the waste in the Covid-19 treatment areas of the two hospitals is prioritized for treatment within the same day. Both hospitals have changed the medical solid waste treatment methods in Covid-19 treatment areas. However, in phase II, 02 hospitals have not yet complied with regulations on Covid-19 waste treatment when burning open-air and burying non-standard waste, causing many negative impacts on the environment. In phase III, at Thanh Hoa city general hospital, medical solid waste arising from the Covid-19 treatment area is not treated immediately but must be stored for days to wait for Song Cong Co., Ltd. to collect with the other types of waste.

Therefore, it is proposed that 02 hospitals need to adjust and invest in a system of collecting, transporting and treating medical solid waste generated in Covid-19 treatment areas in accordance with the provisions of the issued legal documents. It is also recommended to sharp waste and other types of waste in the Covid-19 treatment area to ensure the safety and efficiency of the waste

collection and treatment process.

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