1. Introduction

As of early May 2020, there are more than 3.5 million infected cases and 247 thousand dead of COVID-19 in the world. The world has spared no effort to contain COVID-19 since its initial emergence from the epicenter since last December in 2019. At the early stage of the outbreak, the Republic of Korea (hereafter ROK) was one of the countries whose number of infected cases ranked as the top five, and the virus started quickly spreading at the local and community level. However, since March 2020, there has been a significant decrease in cases nationwide. The ROK’s response to COVID-19 has received many compliments and been highlighted as a positive response model to follow. There are many aspects of the response measures, but this policy brief focuses on ROK’s management of clinical waste to prevent spreading COVID-19. It is estimated that each patient disposes of 10kg of clinical waste per day in ROK. The government of the ROK has been handling those wastes adequately, even with a sharp increase in waste over a short period of time. The purpose of this policy brief is to contribute knowledge tools and ideas on implementing relevant clinical/medical waste management measures for the globe in fighting efficiently against COVID-19.

The safe waste treatment for COVID-19

Lessons from the Republic of Korea
2. Rapid and Flexible Response to the Situation

The Korean government has been implementing as well as introducing newly strengthened measures of managing medical waste from hospitals, treatment facilities, and self-quarantined population in their homes, adapting to the rapidly changed situation.

At the early-stage, since the first infected case was confirmed on Jan 20 in ROK, the Ministry of Environment of ROK announced the first version of “The extraordinary measures for safe waste management against COVID-19” on Jan 28. In order to make sure public safety, this newly developed policy included stricter regulation compared to the “Wastes Control Act.”
Table 1. Comparison between the existing Act and the extraordinary measure in treating waste

<table>
<thead>
<tr>
<th>Wastes from the infected</th>
<th>Existing Act</th>
<th>Extraordinary measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ They can be stored for <strong>7 days</strong></td>
<td>▪ They are allowed to store only for <strong>24 hours</strong></td>
<td></td>
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<tr>
<td>▪ They should be delivered and incinerated within <strong>2 days</strong></td>
<td>▪ They should be delivered and burned on <strong>the same day</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Waste from the self-quarantined</th>
<th>Existing Act</th>
<th>Extraordinary measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Food waste and recycling one should be dumped <strong>separately</strong></td>
<td>▪ All trash must be dumped together, sanitized and double-packed with the sanitizer and the dedicated plastic bag which the government distributes</td>
<td></td>
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<tr>
<td>▪ Municipal waste should be thrown out in the standard plastic garbage bag by <strong>waste producers</strong></td>
<td>▪ <strong>Local government officials</strong> visit to collect wastes</td>
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</tbody>
</table>

[source: Ministry of Environment of ROK]

**When the infectious disease alert level in ROK was raised to Red(level 4) on Feb 23,** Korea’s hospital system was overwhelmed and struggled in handling the influx of infected cases within its health system. Hence, some patients were in self-quarantine in their homes while waiting for being hospitalized. Although wastes from households are usually “general municipal waste,” according to the “Wastes Control Act,” wastes thrown by households of infected patients were treated as “medical waste” with stricter regulation. The dedicated bags and containers for “medical waste” were distributed, and wastes were collected through local public healthcare centers. Also, the government eased regulations as the waste that should be treated in waste disposal facilities had increased because of COVID-19. For example, the local waste disposal facilities were strongly encouraged to prioritize in treating possibly contaminated medical wastes disposed of by households with self-isolating community members. Treatment of the general municipal wastes, in the meantime, was given an extra timeline to be stored to enable clinical wastes to be treated with priority.

**As ROK started to see deeper local community level contamination,** the government categorized patients into four groups from Mar 1, according to their condition, to avoid a shortage of hospital beds. Only the sickest and elderly were sent to hospitals, and patients with mild symptoms stayed designated residential treatment centers based in nonmedical state-run
facilities. All wastes generated at the centers were treated as “medical waste.” The Ministry of Environment announced the “Guideline for waste treatment in residential treatment centers” and updated the “Extraordinary Measures.” Also, the government established the emergency response system, which utilized the private company in collecting waste thrown from patients in home-quarantine, to help local officials who were supposed to collect those waste, alleviating the working burden. The government also distributed 84,000 sets of protective clothing and masks to workers of medical waste disposal facilities for their safety. Also, the regulations were mitigated to produce the dedicated containers of “medical waste” smoothly, leading to making more than 23,000 containers, which used to be 18,500 before COVID-19.

After the inspection of inbound passengers has been strengthened from April, all wastes from the temporary inspection and staying facilities were treated strictly as “medical waste.” Since the COVID outbreak has spread in ROK, the government has been continuously monitoring the amount of generated and treated medical waste from each facility on a daily basis. As of the end of April, more than 1,960 tons of medical waste has been generated from 91 designated hospitals, 8 residential treatment centers, 24 temporary staying facilities for inbound passengers, and households in self-quarantine. The government has been incinerating all of the medical wastes safely without encountering any major problems. The amount of medical waste has decreased as the cases of COVID-19 have steadily slowed down.

Figure 2. The medical wastes generated per day (ton)

[source: Ministry of Environment of ROK]
Also, the government has provided persons in self-quarantine with more than 230 thousand packages of disinfectants and the dedicated plastic bags.

![Picture 1. Dedicated plastic bag(left) and synthetic resin containers(right) for medical waste](source: Ministry of Environment of ROK)

3. Different management tools to each target

The government has applied different management tools to each target depending on their severity and risk to spread the virus for effective and rapid disposal.

3.1. Wastes of the confirmed cases in hospitals and testing centers of COVID-19

The wastes generated from the infected patients are the “separated medical waste,” which must be controlled with the strictest measure. They are double-packed with dedicated plastic bags and containers followed by sterilization with a disinfectant directly and promptly at the disposal site. Those wastes must be removed from the places on the same day to minimize the storage period at hospitals and centers. Also, they should be kept refrigerated and disinfected continuously. Only authorized persons can have access to the waste storage area. The wastes are directly transported to an incinerator of medical wastes without being kept in a temporary storage area. Then, they are burned with containers as a whole, soon after they are moved to the facility.

3.2. Wastes generated at households during self-quarantine

For disposal of wastes generated at households during self-quarantine, the government has provided dedicated plastic bags and disinfectants to self-quarantined people for free. Those wastes are categorized into three groups depending on whether self-quarantined people are infected or asymptomatic before getting the test result.
In the first place, **in the case of asymptomatic people in self-quarantine**, it is not allowed to dispose of waste outside of homes before it is confirmed that their COVID-19 test is negative. Exceptionally, only when there are issues like odor and sanitation, self-quarantined people can ask local public healthcare centers to remove wastes, which was put in the dedicated plastic bag into the standard garbage bag. Then, local officials transport them to the incinerator and treat them like other municipal wastes.

The second is **wastes generated at places of people who turn out positive in the COVID-19 test during self-quarantine**. The wastes must be double-packed with the dedicated plastic bag and the standard garbage bag after being disinfected. After wastes are moved to the local public healthcare center, workers of the medical waste treatment facility transport the wastes by putting them into the dedicated synthetic resin container. Then, the wastes go through the burning process in the incinerator on the same day.

Lastly, there are **wastes generated from houses of infected patients who are waiting to be hospitalized**. The wastes must also be double-packed, but with the synthetic resin container instead of the standard garbage bag, and be stored at home before the patient is hospitalized. When the patient is transported to hospitals, wastes are also treated the same as the second case, that is, being moved to the local public healthcare center, taken to the incinerator by workers of the medical waste treatment facility, and burnt on the same day. In the case where there is an overflowing number of infected patient’s wastes to be collected, overwhelming the usual local response system, the local environmental agencies organize the emergency response system to treat those wastes on behalf of the healthcare center.

**Annex 1** shows the waste treatment guideline for self-quarantined people before and after the confirmed with COVID-19.

(source: Maeil News)
3.3. Waste generated at residential treatment centers

Since the infected case had increased from March, patients with mild symptoms or inbound people for quarantine started staying at the designated residential treatment centers based in nonmedical state-run facilities.

All wastes from the infected patients, including food waste, are treated as the “separated medical waste.” Patients must dispose of their waste just in front of their rooms with the dedicated bag and container after sanitizing by themselves. Then, workers visit each door every day to collect garbage and keep it at the designated storage area of the centers after disinfecting it again. Workers from the collecting and delivering facilities transport the wastes of the storage area to the treatment facility to make sure it gets incinerated within the same day of collection.

The garbage generated from workers in centers, not from patients, is also treated as the “medical waste” as a precaution, even though those wastes would otherwise be regarded as “general municipal waste” under the “Waste Control Act.” Those wastes are treated as same as patients’ wastes, but by using the dedicated paper bag instead of the resin containers. The local environmental agencies designate the collection and delivery facilities and monitor the quantity of generated and treated wastes every day to check if wastes are handled timely and adequately.

3.4. Waste of places where the infected people have visited and public areas

All places where the infected people have visited must be disinfected, and people are not allowed to be entered, according to the guideline of the Korean Center for Disease Control(KCDC). Wastes generated during disinfection, including masks and protective clothing, are treated as “medical waste.” Also, the public areas are disinfected regularly to minimize possible virus contamination. The garbage generated during the disinfection of those places is
Those double-packed with the standard garbage bag and sterilized. Then they are burnt in the municipal incinerator facility. As one of the measures against COVID-19, the regulation prohibiting the use of single-use plastic containers in café and restaurants were eased if the local government deems it’s necessary.

3.5. Efforts to secure the safety of workers of waste treatment facilities

It is mandatory for medical waste inspectors and workers of COVID-19 wastes collection, delivery, and treatment facilities to use the personal protective equipment, including an own disinfectant, a mask, protective glasses, protective gloves, and a single-use gown for preventing infection and spread of the virus.

Medical wastes of an ambulance that transports the patients are also treated adequately by the local government. Vehicles for delivering medical waste are regularly sterilized for the safety of drivers and workers. Every hospital and waste treatment facility are inspected continuously by local governments and local environmental agencies to confirm if it is treating its medical waste as the guideline and regulation.

4. Conclusion

The world has been struggling to contain the COVID-19 by applying a wide range of social responses with varying degrees of success. The safe and stable clinical waste treatment might have been fallen through the crack as a critical factor for effective national containment response. However, as shown in ROK’s successful containment efforts, adequate management of medical waste is essential for combating the COVID-19. Even though the quantity of medical waste increased since the COVID-19 virus started to spread into the community in ROK, the government has been handling them with the advanced and systematic measures. While the ROK’s action for treating waste of the COVID-19 is not the single answer for member States in Asia and the Pacific, the following can be considered and highlighted as some lessons learned from the ROK’s response to risky medical waste of the COVID-19.

First, the government’s prompt and flexible response to a rapidly changing situation

The extraordinary measures for medical wastes of the COVID-19 had been announced as part of the comprehensive guideline for waste treatment soon after the first infected case of confirmed in ROK. With this measure, every stakeholder could take their role thanks to well-outlined directional measures. Also, some regulations were strengthened while others were alleviated despite the existing Act, “Waste Control Act,” to minimize the risk of spreading the virus. The government implemented relevant measures in advance to avoid a complicated situation, like a shortage of dedicated containers and protective clothing for workers treating medical waste. Those preventive and advance measures were effective for the government to manage wastes of COVID-19 without any severe safety issues.
Second, the government’s continuous monitoring and close inspection of the treatment trend

The total quantity of COVID-19 waste from every designated hospital, residential treatment facility, and self-quarantined people were reported every day, and it was assessed whether they could be treated within the operating capacity of medical waste treatment facilities. The government encouraged the treatment facilities to treat COVID-19 wastes with the highest priority over other general wastes, based on the monitoring result. Local environment agencies also closely inspected hospitals and waste treatment facilities every week to examine if they were following the guideline to prevent spreading the virus into the community.

Finally, systematic and prioritized cooperation measures between national agencies

From the early stage of the outbreak, related institutions have taken a particular role in treating COVID-19 waste under the control of the Ministry of Environment and local governments. Cooperation functioned in an effective manner to respond to the emergency, as the local public healthcare centers faced unprecedented scales of challenges with managing the increasing COVID-19 wastes as the number of the self-quarantined people surged.

While the globe is fighting against COVID-19, the ROK’s effort and experiences to treat medical wastes of COVID-19 so far can offer valuable ideas and recommendations to other member States in addressing waste treatment due to COVID-19.

*Figure 3. Cooperation system for treatment of COVID-19 wastes*
Reference


2. Ministry of Environment(Mar 2 2020). The extraordinary measures for safe waste management against COVID-19(the 3rd version). Retrieved from http://me.go.kr/home/web/board/read.do?pagerOffset=0&maxPageItems=10&maxIndexPages=10&searchKey=createName&searchValue=%EA%B9%80%EC%9C%A0%EA%B2%BD&menuId=286&orgCd=&boardId=1338400&boardMasterId=1&boardCategoryId=&decorator=


Annex 1. Public announcement posters on COVID-19

(source: Ministry of Environment of ROK)

Safe waste treatment guideline for self-quarantined people before confirmed with COVID-19

1. Use specific medical waste bags
2. Spray a disinfectant both inside and surface of the waste bags
3. Do not fill over 75% of a waste bag
4. Do not dispose of the wastes without notice. Store them at home
5. Call your local public health care center for disposal
6. Put the filled medical waste bag into a standard garbage bag before disposal

Q. If you develop COVID-19 suspected symptoms while in self-quarantine,

1. Make sure to notice your symptoms to your local public healthcare center or the local government office while following the above guideline.
2. Your local government will take your wastes free of charge and treat them in a safe way.
Safe waste treatment guideline for self-quarantined people after confirmed with COVID-19

1. Use specific medical waste bags

2. Spray a disinfectant both inside and surface of the waste bags

3. Do not fill over 75% of a waste bag

4. Store the waste bags in a specific synthetic resin container

5. The wastes will be treated after you are transported to a residential treatment center or a hospital

Tips:
- Put household wastes including food wastes into specific medical waste bags.
- If you are not yet provided with specific medical waste bags, use standard garbage bags instead.
- Every time you put wastes in a waste bag, spray a disinfectant both inside and surface of the bag.
- Spray a disinfectant on the surface of the medical waste bags at least once a day.
- Do not fill over 75% of the waste bag for sealing. Seal when a waste bag is 75% filled.
- After sealing a filled medical waste bag, put it into a specific synthetic resin container.
- When you are transported to a residential treatment center or a hospital, notify your local public healthcare center or local government office of the wastes stored in the specific containers. They will be collected and treated for free of charge.
- If you want to dispose of the wastes before you are transported, ask your local healthcare center or the local government office.

Caution! In using the specific synthetic resin containers.

Once closed by the lid, the specific synthetic resin container becomes locked and cannot be opened. Be careful not to close a container with the lid until its disposal.