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the People of Japan



UNDP TURKEY

UNDP ISTANBUL INTERNATIONAL CENTER FOR PRIVATE SECTOR IN DEVELOPMENT

# COVID 19 Response and Recovery Medical Waste Ecosystem in Turkey During COVID 19





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UNITED NATIONS DEVELOPMENT PROGRAMME

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ESM	- Environmentally sound management
IICPSD	- Istanbul International Center for Private Sector in Development
MoEU	- Ministry of Environment and Urbanization
PPE	- Personal protective equipment
PPP	- Public Private Partnership
R&D	- Research and development
SDGs	- Sustainable Development Goals
UNDP	- United Nations Development Programme
UNEP	- United Nations Environment Programme
WHO	- World Health Organization

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2020 marked the beginning of a Decade of Action towards the Sustainable Development Goals (SDGs). But with the COVID-19 pandemic, the global context for development has fundamentally changed. The world faces the greatest socio-economic shock in a generation, coming at a time of acute inequality, ecological fragility, and growing distrust within and amongst societies. This pandemic should not just be labelled as a health crisis. Tackling COVID-19 is also a humanitarian and development crisis that is threatening to leave deep social and economic scars for years to come, particularly in countries already weighed down by fragility, poverty and conflict. The solidarity that brought the global community together to create the Global Goals is needed more than ever. From building strong institutions, to creating jobs and ensuring education and healthcare for all, the SDGs and the pledge to leave no one behind work best when tackled in an integrated manner. This is how the world must work together in order to defeat COVID-19!

Although the COVID-19 pandemic and its effects caused increasing environmental problem consequences related to the extra generation of medical waste and single-use plastics, such as personal protective equipment (PPE), and packaging plastics<sup>2</sup>, the pandemic also offers an opportunity to develop recovery plans that will reverse current trends and shift our patterns of life towards a more sustainable course. A successful transition will mean improvements in resource efficiency, consideration of the entire life cycle of economic activities, and active engagement in multilateral environmental agreements. The management of chemicals and wastes is a significant part of the UNDP's efforts to accomplish sustainable, comprehensive and resilient human development towards the Sustainable Development Goals (SDGs). The UNDP helps countries to support and improve the holistic management of chemicals and waste at national, regional and global levels by helping countries access financial and technical resources, and provides technical assistance and implementation guidance. The UNDP tackles unsustainable consumption and production patterns, including poor design and material choices, which lead to resource depletion, waste generation and pollution. As the COVID-19 pandemic is threatening to overwhelm health services and harm vulnerable economies, the world will be drowning in medical waste and the repercussions of this glut will have a profound impact on sustainable medical waste management practices for years to come.

Within this scope, UNDP Turkey and the Istanbul International Center for Private Sector in Development (IICPSD) developed a survey with an aim to assess the needs and gaps of the medical waste ecosystem, and to identify the significant challenges in the medical waste ecosystem during COVID-19. The survey was conducted to responsible parties in the ecosystem, particularly in health care facilities and medical waste sterilization companies. The detailed findings were followed by a full methodology to reveal the challenges as per the responses to the survey of company focal points.

This report provides a background of medical waste ecosystem during COVID-19 at a global scale as well as providing a snapshot of Turkey in light of the responses to the survey. Considering the intense workload of the parties due to the heavy load brought by the pandemic to the health system; the proportion of responses to the questionnaire from hospitals were very low. Yet, the questions of the survey were quite effective in assessing the country's medical waste ecosystem from the provided responses of the medical waste sterilization companies.

In light of the findings, Turkey has an established Legislation for the control and management of medical waste. Medical waste management in Turkey subjects to regulation Medical Waste Control Legislation (29959)<sup>3</sup>, in which the regulations and implementation of the legislation is under the authority of Urban and Environment Ministry. The medical waste and management procedure is clearly defined under the regulation as well as the responsible parties such as authorities (ministry, local authorities, municipalities, health care institutions, private sector). During the COVID-19 outbreak, the responsible parties continue to follow the current regulations. The ecosystem has sufficient installed capacity and technology to manage medical waste. Although the medical waste sterilization companies faced several challenges during the peak period; they managed to repurpose and restructure their strategies, and could immediately responded to the increasing demand. The bottlenecks, risks and measures undertaken to overcome these challenges were presented in the Report.

<sup>1</sup> UN SDG Report, 2020

<sup>2</sup> Teymourian, T., Teymourian, T., Kowsari, E. et al. Challenges, Strategies, and Recommendations for the Huge Surge in Plastic and Medical Waste during the Global COVID-19 Pandemic with Circular Economy Approach. Mater Circ Econ 3, 6 (2021).

<sup>3</sup> <https://www.resmigazete.gov.tr/eskiler/2017/01/20170125-2.htm>

## I. Medical Waste & Sustainable Development Goals (SDGs)<sup>4</sup>

The Sustainable Development Goals (SDGs)<sup>5</sup> are a collection of 17 global goals set by the United Nations, with the aim of transforming the world by 2030 through the fight against extreme poverty, inequality, injustice and climate change and in the search for a more prosperous, equitable, and sustainable world. They call for action by all countries, rich and poor, to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

To achieve a sustainable world, the SDGs also explicitly include waste management. Healthcare waste management is a key utility service that can be directly linked to several of the 17 Sustainable Development Goals (SDGs). For instance, while Goal 1 refers to jobs in waste collection and recycling directly, bioenergy opportunities from organic waste are included by Goal 7. On part of technology, Goal 9 states that recycling innovation is growing and scalable. In addition to this, Goal 14 aims towards less plastic pollution in the sea and oceans.<sup>6</sup> Success in healthcare waste management especially will speed progress towards meeting UN Sustainable Development Goals, particularly: Good health and wellbeing (SDG3), clean water and sanitation (SDG6), decent work and economic growth (SDG8), and responsible consumption and production (SDG12).<sup>7</sup>

Success in healthcare waste management will speed progress towards meeting several of the UN Sustainable Development Goals	
 <p><b>SDG 3</b> Good health is an essential element of sustainable development. Despite progress in life expectancy, maternal and child health, HIV and other areas, many diseases and persistent and emerging health issues remain.</p> <p>Healthcare waste management is one area that has been persistently under-recognized and under-resourced, with enormous knock-on effects for workers, patients and the community. Solving this problem would remove direct and indirect threats to the health of over half of the world's population.</p>	 <p><b>SDG 6</b> aims to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, and further improving wastewater treatment and increasing recycling and reuse globally.</p>
 <p><b>SDG 12</b> includes targets on reducing pollution and health impacts through environmentally sound management (ESM) of all waste throughout the product life cycle, promoting waste prevention, reduction, and recycling and reuse. Sustainable procurement is also required: almost all hospital waste has come in the front door as a product. Healthcare needs to leverage its buying power to ensure that the materials it purchases generate as little waste as possible that is toxic, non-repairable, non-recyclable or simply unnecessary. Advocating for the replacement of these products with safer alternatives, the healthcare system can help kick-start the global circular economy.</p>	 <p><b>SDG 13</b> Minimizing waste, segregating at source, avoiding incineration, and recycling all conserve resources and energy. Research conducted by Health Care Without Harm<sup>8</sup> proved that autoclaving has waste with CO2 emissions at least fifteen times lower than waste incineration. Organic wastes produce methane gas as they degrade, but if this is done in a controlled manner in a biodigester, the methane can be captured for use as a fuel. Because methane has a stronger greenhouse effect than carbon dioxide, burning it reduces the CO2 emissions of the waste. These techniques all help mitigate climate change. Sustainable healthcare waste management technologies such as bio digestion and autoclaving can also play a role in making healthcare systems more resilient to disasters.</p>

## II. World Health Organization (WHO) Directives on Medical Waste<sup>9</sup>

**General definition and classification:** The term health-care waste includes all the waste generated within health-care facilities, research centers and laboratories related to medical procedures. In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g., home dialysis, self-administration of insulin and recuperative care).

Box 1: WHO Categorization of Medical Waste

Waste category	Descriptions and examples
Sharps waste	Used or unused sharps (e.g., hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass).
Infectious waste	Waste suspected to contain pathogens and that pose a risk of disease transmission (see section 2.1.2). For example, waste contaminated with blood and other body fluids; laboratory cultures and microbiological stocks; waste including excreta and other materials that have been in contact with patients infected with highly infectious diseases in isolation wards.
Pathological waste	Human tissues, organs or fluids; body parts; fetuses; unused blood products.
Pharmaceutical waste, cytotoxic waste	Pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals. Cytotoxic waste containing substances with genotoxic properties (e.g., waste containing cytostatic drugs – often used in cancer therapy; genotoxic chemicals).
Chemical waste	Waste containing chemical substances (e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents; waste with high content of heavy metals, e.g., batteries; broken thermometers and blood-pressure gauges).
Radioactive waste	Waste containing radioactive substances (e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources).
Non-hazardous or general health-care waste	Waste that does not pose any particular biological, chemical, radioactive or physical hazards.

<sup>4</sup> <https://noharm-global.org/issues/global/health-care-waste-management-and-sustainable-development-goals>

<sup>5</sup> Take Action for the Sustainable Development Goals – United Nations Sustainable Development

<sup>6</sup> <https://wasteaid.org/wp-content/uploads/2016/05/swm-sus-goals-without-zlcomms.png>

<sup>7</sup> Health Care Waste Management and Sustainable Development Goals in Malaysia, 2019

<sup>8</sup> <https://noharm-global.org/issues/global/what-hcwh-doing-waste>

<sup>9</sup> World Health Organisation, Safe management of wastes from health-care activities. Second edition

**Medical Waste Sources:** Different types of health-care facilities can be viewed as major or minor sources of health-care waste, according to the quantities produced. The major and the minor sources are listed in Box 2 and Box 3 respectively.

**Box 2: Major Sources of Health Care Waste Management**

**Hospitals**

- State hospitals
- Private hospitals
- City hospitals
- Hybrid hospitals (State-Owned and university hospitals)

**Other health-care facilities**

- Emergency medical care services
- Health-care centers and dispensaries
- Obstetric and maternity clinics
- Outpatient clinics
- Dialysis centers
- Long-term health-care establishments and hospices
- Transfusion centers
- Military medical services
- Prison hospitals or clinics

**Related laboratories and research centers**

- Medical and biomedical laboratories
- Biotechnology laboratories and institutions
- Medical research centers

**Mortuary and autopsy centers**

- Animal research and testing
- Blood banks and blood collection services
- Nursing homes for the elderly

**Box 3: Minor sources of health-care waste**

**Small health-care establishments**

- First-aid posts and sick bays
- Physicians' offices
- Dental clinics
- Acupuncturists
- Chiropractors

**Specialized health-care establishments and institutions with low waste generation**

- Convalescent nursing homes
- Psychiatric hospitals
- Disabled persons' institutions

**Activities involving intravenous or subcutaneous interventions**

- Cosmetic ear-piercing and tattoo parlors
- Illicit drug users and needle exchanges

- Funeral services
- Ambulance services
- Home treatment

### III. The State of Medical Waste During COVID-19 – Global Perspective

Medical waste includes all the waste generated from healthcare facilities, research centers and laboratories related to medical procedures. In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g., home dialysis, self-administration of insulin, recuperative care). Medical waste also includes pharmaceutical waste where expired, unused, spilled, and contaminated pharmaceutical products, prescribed and proprietary drugs, vaccines, and sera that are no longer required, and, due to their chemical or biological nature, need to be disposed of carefully. The category also includes discarded items heavily contaminated during the handling of pharmaceuticals, such as bottles, vials and boxes containing pharmaceutical residues, gloves, masks and connecting tubes.<sup>10</sup>

As the COVID-19 pandemic is threatening to overwhelm health services and harm vulnerable economies, the world will be drowning in medical waste and the repercussions of this glut will have a profound impact on sustainable medical waste management practices for years to come.

In usual situations, it is mandatory in all countries that medical waste and other hazardous waste must be source separated at source to avoid contamination, toxic exposure or injury. In China, since the previous SARs outbreak, many cities introduced centralized collection systems for medical wastes with appropriate segregation; temporary storage prior to being sent for treatment/disposal including proper design of equipment and vehicles.

Multilateral Environmental Agreements, Treaties and Conventions such as Basel Convention, Stockholm Convention, Rotterdam Convention, Montreal Protocol, and London Convention asks for stopping illegal dumping and trade of hazardous wastes. To implement these treaties, a national inventory of COVID-19 wastes generated, and the identification of suitable national waste management technologies are needed.

Over 3 billion people worldwide lack access to controlled waste disposal facilities. Household wastes from individuals undergoing quarantine and/or treatment should also be controlled and sent to healthcare facilities for safe disposal to prevent risk of cross infection. Hospitals and clinics should avoid the dumping or open burning of medical waste and should not add medical waste to municipal waste for disposal.

Some hospitals may have inefficient treatment or disposal systems which pose the risk of a negative impact on public health, and environment through possible releases of harmful chemicals (dioxins and furans), release of hazardous liquid waste and chemicals into waterbodies and soil. The expected trend of medical waste flow along with the pandemic crisis showed that medical waste generation increased sharply, reaching up to a 370% increase in some places such as the Hubei Province in China.<sup>11</sup> In Wuhan, medical waste rose from a normal level of 40 tons per day to a peak of approximately 240 tons per day, reaching a maximum capacity of 49 tons per day for incineration.<sup>12</sup> In Lebanon, which is one of the global south countries, the estimated average of COVID-19-related infectious healthcare waste per month is 39,035 kg or 1.3 tons per day, which constitutes 5–20% of total infectious healthcare waste.<sup>13</sup> According to the report by the United Nations Environment Programme, the increase in healthcare waste from COVID-19-associated healthcare facilities was reported to be 3.4 kg per person per day worldwide, and Global South Countries produced approximately 2.5 kg per bed per day of COVID-19- related healthcare waste.<sup>14</sup>

Furthermore, medical waste management companies need to be ready to assist cities and countries worldwide as they seek to manage the volumes of infectious material.<sup>15</sup> In Wuhan, officials did not just need to build new hospitals for the influx of patients; they had to construct a new medical waste plant and deploy 46 mobile waste treatment facilities too. Hospitals there generated six times as much medical waste at the peak of the outbreak as they did before the crisis began. The daily output of medical waste reached 240 metric tons, or about the weight of an adult blue whale.<sup>16</sup> Concerning the global market for medical waste management, there will be a strong demand in the coming months and years for additional facility capacity and for advanced solutions that deliver improved efficiency.<sup>17</sup>

<sup>10</sup> World Health Organization, 2014, Safe Management of Wastes from Health-care Activities, 2nd ed.

<sup>11</sup> Klemeš et al. (2020)

<sup>12</sup> <https://www.adb.org/sites/default/files/publication/578771/managing-medical-waste-covid19.pdf>

<sup>13</sup> Impact of COVID-19 pandemic on medical waste management in Lebanon (2021) <https://journals.sagepub.com/doi/full/10.1177/0734242X211003970>

<sup>14</sup> UNEP (2020)

<sup>15</sup> <https://ww2.frost.com/frost-perspectives/managing-the-growing-threat-of-covid-19-generated-medical-waste/>

<sup>16</sup> <https://www.theverge.com/2020/3/26/21194647/the-covid-19-pandemic-is-generating-tons-of-medical-waste>

<sup>17</sup> <https://ww2.frost.com/frost-perspectives/managing-the-growing-threat-of-covid-19-generated-medical-waste/>

All health-care waste produced during patient care, including those with confirmed COVID-19 infection, is treated to be infectious (infectious, sharps and pathological waste) and therefore should be collected safely in clearly marked lined containers and sharp safe boxes. This waste should be treated, preferably on-site, and then safely disposed of. If waste is moved off-site, it is critical to understand where and how it will be treated and disposed of. Waste generated in waiting areas of health-care facilities can be classified as non-hazardous, and should be disposed of in strong black bags and closed completely before collection and disposal by municipal waste services.

All those who handle health-care waste should wear appropriate PPE (boots, long-sleeved gown, heavy-duty gloves, mask, and goggles or a face shield) and perform hand hygiene after removing it. The volume of infectious waste during the COVID-19 outbreak increased, especially through the use of PPE. Therefore, it is important to increase the capacity to handle and treat this health-care waste. Additional waste treatment capacity, preferably through alternative treatment technologies, such as autoclaving or high temperature incinerators, may need to be procured and systems may need to be put in place to ensure sustained operation.<sup>18</sup>

## IV. Medical Waste Ecosystem in Turkey During COVID-19

### 1. Situation During COVID-19

Turkey is part of the ongoing worldwide pandemic of COVID-19, likewise the rest of the globe. The first case in the country was detected on 11 March 2020, and by 1 April it was confirmed that COVID-19 had spread all over Turkey.<sup>19</sup> Turkey has begun taking measures promptly through effective cooperation with all concerned public and private institutions to prevent the outbreak from entering and spreading within the country.

As an immediate action to the crisis, the Ministry of Health established a Scientific Committee which is composed of scientists and medical doctors, and the committee is directly reporting to Minister and is at the center of decision-making/providing advice for health-related issues.

One sub team of the Scientific Committee is working on research and development (R&D) to develop treatment alternatives that could contribute to preventing or treating the disease, in order to contain the outbreak. Ensuring the provision of appropriate medical equipment and tools at national and regional level, and increasing the capacity of currently active 73 diagnostic laboratories (test kits, diagnostic tools) is currently prioritized by the Ministry of Health. One of the most effective assets in fighting against the outbreak Turkey has at its disposal is a large number of hospitals and intensive care units per person, and thus causing an extensive use of medical equipment as a consequence; the disposal of materials has risen as sensitivity to the disease has climbed. Authorities have mandated more careful and frequent collection of these wastes and their disposals.

As a result of the global outbreak of the (COVID-19) pandemic, the "Notice on Covid-19 Precautions for the Management of Personal Hygiene Material Wastes such as Disposable Masks and Gloves" was published by the Ministry of Environment and Urbanization on 7 April 2020 as a response. Aspects mentioned within the scope of this notice include:

Masks, gloves and other material wastes generated in the buildings and campuses of institutions, organizations and businesses, are to be collected and disposed of separately in containers placed at the communal areas of buildings, including the main entrance and exit. The containers provided for the acquirement of the waste should be grey coloured or grey labelled; similar to "other waste" containers. Containers should display texts and/or visuals to depict that only mask, gloves and other personal hygiene material wastes will be accumulated. After three-quarters of the waste bags are filled, the bags are to be tightly sealed and placed into a second bag, and the accumulated waste is to be kept in a temporary storage area for at least 72 hours, and later delivered to a municipality as "domestic waste".

- Personal hygiene material waste used in homes and workplaces such as masks and gloves should be collected in small amounts in tear-resistant plastic waste bags, secured tightly and placed in a second bag for at least 72 hours, and retained in an area that is not in close proximity with human contact (room or balcony). It must be delivered to a municipality as "domestic waste".

### 2. Legal Framework

#### 2.1. The Regulation<sup>20</sup>

The medical waste management legislation is under the administration of Ministry of Environment and Urban. According to the revised Regulation No:(29959)<sup>21</sup>.

The Regulation covers the principles regarding the medical wastes generated as a result of the activities of health institutions and the separate collection of these wastes in the places where they are produced, their transportation within the health institution, their temporary storage, transportation to the medical waste processing facility and their disposal.

#### 2.2. Responsible Parties<sup>22</sup>

Under the Regulation the duties and authorities are defined as follows:

- **Ministry of Environment and Urban:** To determine the programs and policies regarding the environmentally compatible management of medical wastes, to ensure cooperation and coordination for the implementation of this Regulation and to take the necessary administrative measures.

<sup>18</sup> Water, sanitation, hygiene, and waste management for the COVID-19 virus, 23 April 2020, WHO

<sup>19</sup> Euronews. 23 March 2020. Retrieved 24 March 2020.

<sup>20</sup> <https://www.resmigazete.gov.tr/eskiler/2017/01/20170125-2.htm>

<sup>21</sup> <https://www.resmigazete.gov.tr/eskiler/2017/01/20170125-2.htm>

<sup>22</sup> <https://www.resmigazete.gov.tr/eskiler/2017/01/20170125-2.htm> (the original version of the Regulation on the Official Gazette of the Republic of Turkey)

The responsibilities of the ministry is not limited to aforementioned points; they are also responsible to control and execute periodic inspections of all activities covering the management of medical wastes from their formation to their disposal, and also to ensure national and international coordination in the implementation of systems and technologies for the environmentally compatible management of medical wastes, and further grant environmental licenses to medical waste processing facilities.

- **Provincial Directorates of Environment and Urbanization** are defined to be responsible to control and periodically audit all activities covering the management of medical wastes from production to disposal. They impose sanctions in case of violation of the relevant legislation, issuing transportation licenses to individuals, institutions or organizations that will transport medical waste and their vehicles, inspecting their activities and revoking the license when necessary, examining, evaluating and implementing the medical waste management plans submitted by the municipalities, monitoring and inspecting the activities of medical waste processing facilities with environmental licenses, obtaining and evaluating information on the amount of medical waste generated, collected and disposed of within the borders of the province, and sending it to the Ministry in the form of a report to evaluate the municipality's requests for sending the medical wastes generated in the province to a medical waste processing facility outside the province, or accept the medical wastes generated outside the province to a processing facility in the region within the framework of the subparagraph.

- **Municipalities:** prepare the medical waste management plan, present it to the provincial provincial directorate of environment and urban, implement and ensure that the public is informed on the procedure. Additionally, retrieving medical wastes from temporary storage areas/containers, and transporting/having them transferred to the medical waste processing facility is their responsibility. Furthermore, local authorities are to provide sterilization and/or to ensure disposal of medical waste, to establish and operate a medical waste treatment facility for this purpose. But, at the same time, they may allow the private sector to execute these duties. Municipalities obtain/permit the acquisition of an environmental license for medical waste treatment facilities, and a transportation license for the transport of medical wastes. Besides, they inform the provincial directorate in case of insufficient work or malfunctioning. They periodically train/permit training for personnel in charge of medical waste management. Moreover, they provide and ensure the use of special clothing and protective equipment of the personnel in charge of the management of medical wastes. Furthermore, they ensure the immunization of the staff responsible for the management of medical wastes, as they undergo a health check and other preventive measures at least once every six months. Local authorities record the amount of medical waste collected, transported, sterilized, and disposed of from the health institution. Finally, they register the medical waste processing facility in online programs, and prepare mass-balance information containing the wastes/products generated as a result of the medical waste processing activity to create a notification through the online program.

- **Health Institutions:** Establishing a system that will minimize waste at its source, making a protocol with the relevant municipality for the collection, transportation and disposal of medical wastes, preparing and implementing the medical waste management plan which includes the separate collection of medical wastes, their transportation and temporary storage within the health institution, and the measures to be taken in case of an accident, collecting medical, dangerous, non-hazardous, packaging, municipal and other wastes separately at their source without mixing them with each other, collecting pathological wastes treated with any chemical separately from other medical wastes, using bags and containers, the technical features of which are specified in this The Medical Waste Control Regulation, while collecting medical wastes.

### 3. Medical Waste Management

Under the Regulation, it is forbidden to give medical wastes directly or indirectly to the receiving environment in a way that harms the environment and human health. It is also essential that medical wastes are not mixed and separated according to categories such as hazardous, non-hazardous, municipal or packaging wastes. The Medical waste procedure should be followed to collect, temporarily store, transport and dispose of medical wastes separately from other wastes at the source. Parties involved in the collection, transportation, temporary storage and disposal of medical waste are jointly and severally liable for damages caused by environmental pollution and deterioration. Individuals, institutions/organizations responsible for the management of medical wastes are obliged to take the required measures to reduce the harmful effects of these wastes on the environment and human health. Health institutions are obliged to meet the necessary expenses for the collection, transportation, sterilization and disposal of their wastes.



#### Step 1 Collection

Medical wastes are accumulated separately by health personnel without mixing with other wastes at the source. Collection equipment is kept in accordance with the nature of the waste at the closest point to the source of the waste. Medical wastes must be kept separately from the municipal, packaging, hazardous and other types of waste. The packaging; red colored plastic bags with black stamp "ATTENTION! MEDICAL WASTE" on both sides with "International Biohazard" emblem. The package should be resistant to tearing, puncture, explosion and transportation, which is produced from medium-density polyethylene raw material, impermeable, with double bottom seam and without bellows, with a double layer thickness of 100 microns, and a lifting capacity of at least 10 kilograms; large enough to be seen.

The bags are filled to a maximum of ¾, and their purse string are tightly tied. These bags are banned to be recovered or reused by no manner of means. The contents of the medical waste bags are not allowed to be compressed, removed from the medical waste bags, emptied and transferred to another container in no circumstances. Pathological wastes, apart from other medical wastes, is collected in red colored plastic containers in black stating: "ATTENTION! PATHOLOGICAL MEDICAL WASTE KIT", with a black "International Biohazard" emblem which are puncture, break and explosion proof, waterproof and leakproof.

Waste with sharp and penetrating properties is collected in boxes or containers, made of plastic or laminated cardboard with the same characteristics, which includes a black "International Biohazard" emblem and stamp stating "ATTENTION! SHARP AND PIERCING MEDICAL WASTE KIT" on it. Liquid medical wastes created by condensation with suitable absorbent materials are also placed in medical waste bags. Medical waste bags are kept in a medical waste container or bucket during storage process. Medical waste container or bucket must be made of orange colored plastic material with a black "International Biohazard" emblem and stamp stating "ATTENTION! MEDICAL WASTE", which is puncture, tear, shatter, explosion, waterproof and leakproof.



#### Step 2 Transportation

Medical waste bags are made of stainless metal, plastic or similar material and used by trained personnel in the health institution. The bags do not have sharp edges that may cause damage or puncture during loading and unloading. The bags are designed to be easy to load, unload, clean and disinfect, and are reserved for this use only.

Bags are collected and transported with a lidded container/container/bucket. The container/container/bucket used for the transportation of medical wastes within the health institution will be orange in color, with the black "International Biohazard" emblem attached to them, and a black stamp stating "ATTENTION! MEDICAL WASTE".

Medical waste bags are tightly tied and transported with a lidded container/container/bucket without being compressed. Waste bags and pathological waste collection containers should never be carried by hand. During the collection and transportation process, any contact with skin is avoided. Waste chimneys and walking lanes cannot be used during the transport process. Pathological waste collection containers are transferred by wheeled medical waste transport vehicles. Medical wastes and other wastes cannot be loaded and transported on the same vehicle. Medical waste containers/buckets are cleaned and regularly disinfected every day. In case of any bag tearing, bursting or spilling, the waste is safely emptied into a new bag and the container/container/bucket is immediately disinfected.

Personnel assigned to collect medical wastes within the health institution and transport them to the medical waste temporary storage, are obliged to wear special orange clothes and use protective equipment during transportation.

The medical waste should be collected within the health institution. The routes to be followed by the waste transportation vehicles/waste carrying personnel are planned to be as far as possible from locations where patients are treated and other clean areas, including areas with heavy human and patient traffic.



### Step 3. Temporary Storage

Medical wastes can be kept in the medical waste temporary storage or container for no more than 48 hours before being transported to the medical waste processing plant. The waiting period can be extended up to one week, provided that the temperature in the medical waste temporary storage is +4 °C and the capacity is appropriate. In health institutions that produce up to 1 kilogram of medical waste per day, medical wastes can be kept in the lidded container/container/bucket for no more than 48 hours.

## Management of Medical Wastes in the Waste Processing Plant

### Step 1. Transportation of medical waste to processing facilities

It is imperative that medical wastes are transported safely to the medical waste sterilization facility directly without halting, and further without spreading and causing any leakage. After unloading the bags, the vehicles are cleaned and disinfected. In the event that the bags with medical waste burst or spread for any other reason, it is vital that the surroundings are cleaned and disinfected immediately. In addition to this, the vehicles are banned to drive for other purposes, and further for the transportation of any other wastes that are not medical. Medical waste bags can be loaded directly to the medical waste transport vehicle as long as they are well suited in plastic or metal containers/bucket containers with lids loaded into the waste transport vehicle. Medical wastes are delivered by only the licensed transport vehicle.

Medical waste transport vehicles have orange outer surfaces and should have the black "International Biohazard" emblem that can be seen on the right, left and rear surfaces, and the black stamp indicating "ATTENTION! MEDICAL WASTE".

### Step 2. Temporary storage of medical wastes in waste treatment plants

In order to determine whether there is radioactive material in medical wastes or not, the medical waste transport vehicle is accepted to the plant after passing through the radiation panel at the entrance. If there is already a radiation panel shared with other facilities in the area, there is no need to install another radiation panel to process medical waste.

In the sterilization facility there should be a medical waste temporary storage area which is cooled to +4 °C, where the wastes can be safely stored temporarily without harming the environment and human health at the medical waste sterilization plants. The temporary storage period of medical wastes cannot be longer than one week. However, this period is at most six months for pathological wastes treated with any chemical.

### Step 3. Sterilization

During the sterilization, it is important that the entire process is documented to be compliant with national and/or internationally accepted standards. It is important to remove volatile and semi-volatile organic substances and chemicals, especially mercury, genotoxic/cytotoxic agents, radiological wastes and pressure vessels in the wastes to be sterilized.

It is mandatory to have a waste shredding mechanism in sterilization plants. Before sterilization, gases originating from the vacuuming process cannot be released to the atmosphere without passing through a HEPA filter or a similar system. Sterilization processes must be recorded.

### Step 4. Disposal

#### Regular storage and disposal of medical waste

Medical wastes can be classified as harmless after being sterilized and can be disposed in the second-class landfills defined in the regulation which is "Regulation on Landfilling of Wastes"; published in the Official Gazette dated 26/3/2010 and numbered 27533.

#### Disposal of medical waste by incineration

Medical wastes that need to be incinerated should not contain high levels of mercury and cadmium, radiological wastes containing silver salts, ampoules containing heavy metals and pressure vessels. If large amounts of genotoxic waste are present in the medical wastes to be incinerated, the temperature must be at least 1100 °C.

Medical wastes can be incinerated in incineration or co-incineration facilities only if permitted by the Ministry of Environment and Urban ; provided that the necessary precautions are undertaken and it is not a continuous act, under the Regulation on Incineration of Wastes.

## V. Medical Waste Management in Turkey During COVID-19

As COVID-19 imposes ramifications on healthcare facilities across the globe, the managing waste from health care facilities gets more crucial in responding to this unprecedented health emergency.

Since the rate and rate of spread of the disease were very high in this process, all actors in the medical waste ecosystem played a critical role during the pandemic. Due to the density in hospitals, many procedures such as separation at the source and frequency order in the transportation process were experienced more intensely in this critical period. Considering all these challenges; medical waste sterilization companies played a very important role in waste management.

All healthcare waste generated during the care of patients, including individuals with confirmed COVID-19 infections, must be safely collected in clearly marked, insulated containers and sharp medical waste bins, as they are treated as infectious waste (infectious, sharp, and pathological waste).

## VI. Challenges During COVID-19

### Step 1 Collection

- Weak supervision and monitoring of the collection process by health care facilities due to intense workload
- Lack of the segregation of the characterized medical waste defined under the Regulations
- As all the equipment used by the infected individuals had been considered as medical waste such as beds pillows etc., the storage bags were overloaded
- Inadequate labeling on packages
- Sharp needles and similar tools had not been packed separately by the facility



### Step 2 Transport

The challenges faced for transportation was mostly due to the increase in the demand from the health care facilities. As the Novel COVID-19 virus is highly infectious; the facilities requested immediate transport of the collected wastes, so the companies had to increase their capacity to respond to demand. The challenges can be listed as:

- Increase in frequency of load/unload process (during the peak period companies had to transport the waste to storage areas more than 5 times a day)
- Increase in the cleaning and disinfection of the vehicles, and thus increased the demand for disinfectant chemicals and materials

### Step 3 Storage

During the COVID-19 outbreak; the collected wastes are immediately sent to the sterilization facilities. So, neither health care facilities nor the responsible companies stored the waste.



During COVID-19, some hospitals have been designated as Pandemic Hospitals. As the Government of Turkey imposed long weekend curfews and warned the citizens to delay their routine health care checks if not urgent; the health care facilities produce less amount of waste than during regular times. So, the amount of medical waste produced during COVID-19 did not rise dramatically. Almost all of the participants in the survey responded to questions involving issues of capacity to not be an issue.

### Step 4 Sterilization

Sterilization companies in Turkey are using the latest technologies for medical waste management. Heating in an Autoclave is the most widely used and dependable method for sterilization. The basic principle of steam sterilization is to expose each item to direct steam contact at the required temperature and pressure for the specified time. Steam sterilization has many advantages, as it is a simple, rapid, effective, safe, environment-friendly and low-cost sterilization method. By means of managing the sterilization step; Medical Waste Management ecosystem in Turkey have the sufficient technical capacity.



During the COVID-19 outbreak, as collection points have packaged all the materials used by the infected persons, some technical problems occurred. In particular, nearly half of the shredding machines used by companies malfunctioned due to issues with the blades.

## VII. Measures

As medical waste management played a crucial part of the COVID-19 response in Turkey, companies had taken some measures to ensure the continuity of the business, and further protect the health and safety of their employees.

### Business Continuity Measures

- Updated their disaster/risk response scenarios and plans
- Established emergency measures and organizational instructions in order to ensure continuity of operations according to the level of risk
- Prepare for a need for an immediate close down if cases of infection occur
- Procured additional personnel and equipment such as transport vehicles

### Employee Oriented Measure

- Employees whose assignments are available for telecommuting have been allowed to work from home
- Extra measures taken for workplace hygiene
- Regularly monitoring the health of employees
- Decrease risk exposure by splitting technical teams into small groups
- Organized trainings for employees on COVID-19 percussions
- Displaying flyers of measures to be taken for self-protection at the workplace
- Procured additional Personal Protection Equipment for employees

## VIII. Conclusion and Further Recommendations

The survey was conducted to responsible parties in the ecosystem; particularly health care facilities and medical waste sterilization companies. The detailed findings were followed by a full methodology to reveal the challenges as per the responses to the survey of company focal points.

This report provides a snapshot of Turkey's medical waste ecosystem during COVID-19 in light of the responses to the survey. Considering the heavy workload of the parties due to the heavy load brought by the pandemic to the health system; The proportion of responses to the questionnaire from hospitals were very low. Yet, the questions of the survey were quite effective in assessing the country's medical waste ecosystem from the provided responses of the medical waste sterilization companies.

The findings upon the responses from the companies reveal:

- Turkey has effective Legislations in line with International Standards
- Companies have the latest technology to manage the sterilization
- Companies have enough installed capacity to meet the demand
- Companies have Health and Safety Standards and easily adapted to new measures by organizing additional trainings on COVID-19
- Companies faced challenges in PPE provision during the initial stages of the outbreak; after the Government of Turkey coordinated the local PPE production and dissemination; the companies were able to find the necessary PPEs
- As per the responses, the companies indicated the effect of COVID-19 will affect their business strategy till the end of 2022

COVID-19 placed ramifications in the economy; the company's biggest challenge was the financial constraints. The companies responsible for sterilization are Small-Medium Enterprises. As the UN's global framework provides a strategy for the urgent socio-economic response based on five critical pillars: Protecting health services and systems; social protection and basic services; protecting jobs and small and medium sized enterprises, and the most vulnerable productive actors; macroeconomic response and multilateral collaboration; social cohesion and community resilience, the companies should be considered as one of the vulnerable responsive parties for a comprehensive COVID-19 response.

## ANNEX

### 1. Participants – Licensed Medical Waste Sterilization Companies

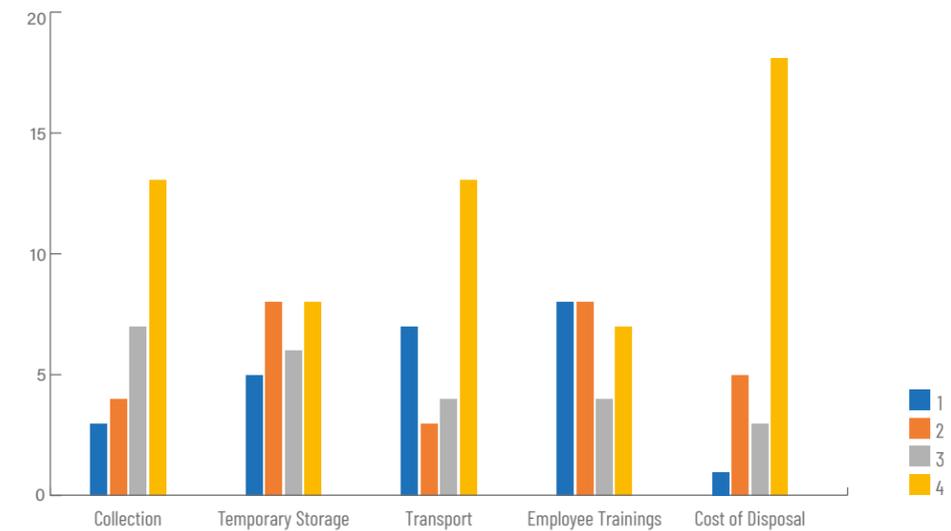
City	Company Name	Business Model	Technology for Sterilization
Eskişehir	ARY İnşaat	Public Private Partnership	Convertiser
Aksaray	Athisa	Public Private Partnership	Heat Sterilization
Osmaniye	Atlas İnşaat	Public Private Partnership	Pre-Shedding Pressure Heat
Burdur	Atlas Katı Atık	Public Private Partnership	Autoclaving
Elazığ	Atlas Katı Atık	Public Private Partnership	Autoclaving
Konya	Biberçi İnşaat	Public Private Partnership	Heat Sterilization
Bolu	Atlas İnşaat	Public Private Partnership	Pre-Shedding
İstanbul	İstaç	Municipal Enterprise	Heat Sterilization
Diyarbakır	Diçev	Public Private Partnership	Heat Sterilization
Siirt	Dicle Life	Public Private Partnership	D9
Muş	ECT	Public Private Partnership	Heat Sterilization
Karabük	ECT	Public Private Partnership	Heat Sterilization
Bingöl	ECT	Public Private Partnership	Heat Sterilization
Edirne	Atlas Katı Atık	Public Private Partnership	Autoclaving
Samsun	EMS	Public Private Partnership	Heat Sterilization
Hatay	Envitec	Public Private Partnership	Heat Sterilization
Gaziantep	Gazibel	Municipal Enterprise	Autoclaving
Mersin	IN-TE	Public Private Partnership	Heat Sterilization
Tokat	IN-TE	Public Private Partnership	Heat Sterilization
Afyonkarahisar	Miroğlu Çevre	Public Private Partnership	Heat Sterilization
Manisa	Miroğlu Çevre	Public Private Partnership	Heat Sterilization
Menemen	Miroğlu Çevre	Public Private Partnership	Heat Sterilization
Kocaeli	SAS Group	Public Private Partnership	Heat Sterilization
Balıkesir	Vertisa	Public Private Partnership	Hydrogen Peroxide
Karaman	Vertisa	Public Private Partnership	Autoclaving
Kilis	Vertisa	Public Private Partnership	Autoclaving
Ordu	Vertisa	Public Private Partnership	Autoclaving

### 2. Survey Responses

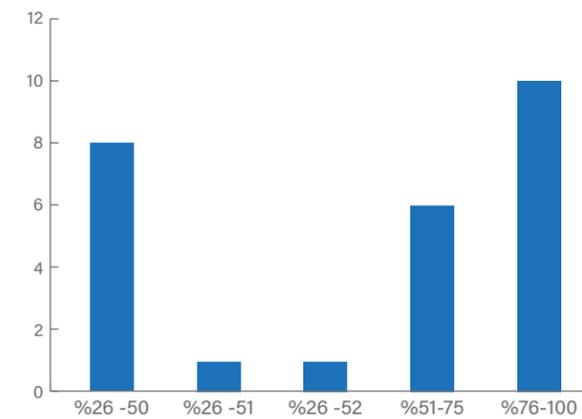
In the surveys conducted, participants were asked to evaluate the difficulties faced in the medical waste sterilization process during the COVID-19 outbreak on a scale of 1 to 4; with 1 being the lowest and 4 being the highest. The graph related to the answers received is shown below. Companies predominately experienced the most difficulty in the aspect of costs.

#### COVID-19 effect on business continuity (Scale: 1 Low- 4 High)

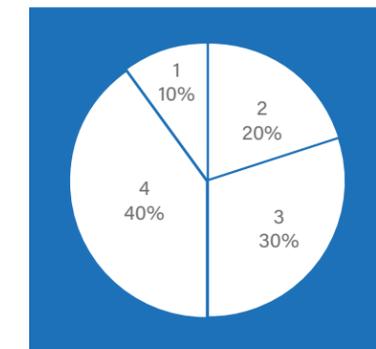
##### COVID 19 Effect



##### Utilized Capacity



##### Overall Effect of COVID-19 (Scale: 1-Low- 4 High)





**United Nations Development Programme (UNDP) in Turkey**  
Yıldız Kule, Yukarı Dikmen Mahallesi, Turan Güneş Bulvarı,  
No:106, 06550, Çankaya, Ankara / Turkey

For more information: [www.undp.org](http://www.undp.org) | [www.iicpsd.org](http://www.iicpsd.org)

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