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ON THE TOPIC

# REGULATION OF BIOMEDICAL WASTE DISPOSAL WITH SPECIAL REFERENCE TO THE COVID- 19 SCENARIO


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# CERTIFICATE

This is to certify that Ms. **ANJALI DEVI. P** Reg. No: LM0320014 has submitted her dissertation titled "**REGULATION OF BIOMEDICAL WASTE DISPOSAL WITH SPECIAL REFERENCE TO THE COVID- 19 SCENARIO**" in partial fulfillment of the requirement for the award of Degree of Masters of Laws in Public Health Law to the National University of Advanced Legal Studies, Kochi under my guidance and supervision. It is also affirmed that the dissertation submitted by her is original, bona fide and genuine.

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# DECLARATION

I declare that this dissertation titled "**Regulation of Biomedical Waste Disposal with special reference to the Covid- 19 Scenario**" is researched and submitted by me to the National University of Advanced Legal Studies, Kochi in partial fulfillment of the requirement for the award of Degree of Master of Laws in Public Health Law, under the guidance and supervision of Mr. **Abhayachandran K**, Assistant Professor, NUALS, Kochi. It is an original, bona fide and legitimate work pursued for an academic interest. This work or any type thereof has not been submitted by me or anyone else for the award of another degree of either this University or any other University.

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**ANJALI DEVI P**

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AIR | All India Reporter |
| AMR | Anti Microbial Resistance |
| ASSOCHAM | Associated Chambers of Commerce and Industry of India |
| BMWM R | Biomedical Waste Management Rules, 2016 |
| CBWTFs | Common Biomedical Waste Treatment Facilities |
| CEMS | Continuous Emission Monitoring System |
| CFLTCs | Covid First-Line Treatment Centers |
| CLJ | Corporate Law Journal |
| CLT | Cuttack Law Times |
| CPCB | Central Pollution Control Board |
| EPCA | Environment Pollution (Prevention & Control) Authority |
| HCFs | Health-Care Facilities |
| HIV | Human Immunodeficiency Virus |
| ILR | Indian Law Reporter |
| IMAGE | Indian Medical Association Goes Eco-friendly |
| IPC | Infection Prevention and Control |
| MANU | Manupatra |
| MERS-CoV | Middle East Respiratory Syndrome- related Corona Virus |
| MLJ | Madras Law Journal |
| MoEFCC | Ministry of Environment, Forests and Climate Change |
| MoHFW | Ministry of Health and Family Welfare |
| NGT | National Green Tribunal |
| OCEMS | Online Continuous Emission Monitoring System |
| PCC | Pollution Control Committees |
| POP | Persistent Organic Pollutants |
| PPE | Personal Protective Equipment |
| S. | Section |
| SARS CoV | Severe Acute Respiratory Syndrome- related Corona Virus |
| SCC | Supreme Court Cases |
| SPCB | State Pollution Control Board |
| U.N.T.S | United Nations Treaty series |

| | |
|---|---|
| UDHR | Universal Declaration of Human Rights |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNICEF | United Nations Children's Fund |
| U.S E.P.A. | United States Environmental Protection Agency |
| UOI | Union of India |
| WHO | World Health Organisation |

## LIST OF CASES

| | | |
|---|---|---|
| 1. | *B.L Wadehra v. Union of India* | (1996) 2 SCC 594. |
| 2. | *C.S. Prakash & Ors. v. The HUDA & Ors*. | (2001) ILR 2 AP 323 |
| 3. | *Environment Monitoring Forum & Anr. v. Union of India & Ors.* | MANU/KE/0894/2003 |
| 4. | *G. J. Multiclave (India) Pvt. Ltd. v. The State of Telangana* | W.P. No. 19727 of 2016 |
| 5. | *Haat Supreme Wastech Pvt. Ltd v. State of Haryana & Ors*. | MANU/GT/0089/2015 |
| 6. | *In re: Scientific Disposal of Bio-Medical Waste arising out of Covid-19 treatment* | O.A. No. 72 of 2020 |
| 7. | *Indian Council for Enviro Legal Action v. Union of India* | (2011) 8 SCC 161 |
| 8. | *Kasala Malla Reddy & Ors. v. State of Andhra Pradesh & Ors*. | (2017) S.C.C. OnLine NGT 1914 |
| 9. | *M. C. Mehta v. Union of India* | (2004) 12 SCC 118. |
| 10. | *M.C Mehta v. Union of India* | WP(C) No. 13029/1985 |
| 11. | *Mahesh Dubey v. Chattisgarh Environment Conservation Board & Ors*. | MANU/GT/0140/2016 |
| 12. | *Maitree Sansad v. The state of Orissa and Ors*. | (2007) 103 CLT 191. |
| 13. | *Meera Shukla v. Municipal Corporation Gorakhpur & Ors*. | (2019) S.C.C. OnLine NGT 866. |
| 14. | *Occupational Health & Safety Association v. Union of India* | A.I.R. 2014 SC 1469 |
| 15. | *Virendra Gaur & Ors. v. State of Haryana* | 1995 (2) SCC 577 |

# TABLE OF CONTENTS

# CHAPTER: 1

## INTRODUCTION

**"The benefits of biomedical progress are clear, obvious, and powerful; but the hazards are much less well appreciated".**

- Leon Kass [American Physician & Scientist]

Waste is the useless by-product of human activities.[1]Article 5 of the Basel Convention defines 'waste' as "substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law."[2]

Almost all human activities generate waste.[3] Every household, organization, and human activity generates some waste. On the basis of the source from which waste is generated, they are classified into municipal solid waste, agricultural waste, medical waste, radioactive waste, hazardous waste, industrial non-hazardous waste, fuel combustion waste, sewage sludge, etc.[4] As per the Basel Convention, there are mainly two types of wastes- hazardous and non-hazardous.

Hazardous wastes are those which potentially cause harm or have harmful effects on the environment and human health[5] and therefore are handled and treated separately. Medical waste is one such category of waste regulated by the Basel Convention. It usually originates from the healthcare systems and comprises of pharmaceutical products, medical equipment, medicines, bodily fluids, and other radioactive or toxic wastes, including harmful microorganisms.

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[1] Amasuomo & Baird, *The Concept of Waste and Waste Management*, 6(4) J. MGMT. & SUSTAINABILITY 88, (2016).

[2] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx (last visited Feb: 27, 2021)

[3] Brunner P.H & Rechberger H., Waste to energy- a key element for sustainable waste management, 35(4) WASTE MANAG. 1, (2015).

[4] United States Environmental Protection Agency, Report on the Environment, https://www.epa.gov/report-environment/wastes (last visited Feb. 28, 2021)

[5] KUMMER K., INTERNATIONAL MANAGEMENT OF HAZARDOUS WASTES: THE BASEL CONVENTION AND RELATED LEGAL RULES 3, (Oxford University Press, 2000).

The progress of any nation could be defined in terms of the quality of its healthcare sector. There has been a tremendous advancement in this sector over the past few years[6]. Novel and innovative techniques offering better healthcare facilities sprang up in every nook and corner of the world. It was seen as a boon for humanity with increased life expectancy rates and prompt delivery of healthcare services. However, it always had a dark side as well,[7] which was often neglected. That is, the hazardous and infectious biomedical wastes generated from these healthcare systems, which would, in turn, pose a severe threat to human health if not managed properly.

Biomedical waste:

The wastes generated by health care activities are brought under an umbrella term – 'biomedical wastes' covering a wide range of materials, starting with syringes, needles, to the soiled dressings, body parts, diagnostic samples, blood, chemicals, medical devices, and radioactive materials[8]. It includes the wastes generated from clinical establishments, research centers, laboratories, blood banks, autopsy centers, animal research and testing laboratories, and other nursing homes[9]. The world health Organisation had released its latest guidelines on Safe Management of Wastes from Healthcare Facilities in 2018.

It has become a significant concern not just for human health but also for the environment. In India, as per the recent study conducted by the Associated Chambers of Commerce and Industry of India [ASSOCHAM], more than 500 tonnes of biomedical wastes are generated per day.

The term "bio-medical waste" means any waste generated during the diagnosis, treatment, or immunization of human beings or animals or research activities pertaining to or in the production or testing of biological or in health camps[10]. The essential components of biomedical waste consist of human anatomical waste, microbiology and biotechnology waste, waste sharps, discarded medicines and drugs, solid waste and liquid waste generated from infected areas, incineration ash, chemical wastes, etc.

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[6] Patan. S & Mathur P, *Assessment of biomedical Waste Management*, 5(1) INT. J. RES. PHARM. SCI. 1, 6 (2015).
[7] Jariwala C.M., *The Biomedical Waste: Direction of Law and Justice*, 41(3) JOURNAL OF INDIAN LAW INSTITUTE 368, (1999).
[8] World Health Organisation, Health-Care Waste, https://www.who.int/news-room/fact-sheets/detail/health-care-waste (last visited Feb. 28, 2021)
[9] *Id.*
[10] The Bio-Medical Waste Management Rules, 2016, S. 3(f).

The Bio-Medical Waste Management Rules regulate biomedical waste disposal in India, 2016, framed under the Environment (Protection) Act of 1986. It deals with the collection, segregation, and removal of biomedical wastes. Furthermore, the Central and State Pollution Control Boards (CPCB & SPCB) were entrusted with monitoring and implementing these rules. However, the proper enforcement of the regulations is still concerned with the rampant mismanagement and illegal dumping of biomedical wastes.

Strict compliance with the stipulations of the rules was not ensured and that, the biomedical wastes were dumped along with the general wastes in the municipal dumping sites. The National Green Tribunal and the Central and State Pollution Control Boards have addressed these issues on many occasions. *B.L Wadehra v. Union of India*[11] is the first instance where the mismanagement in the handling of Bio-Medical wastes came to the apex court's attention as a gross violation of the rights guaranteed under Article 21, 48 A and 51A(g) of the Constitution. The court, in this case, issued adequate guidelines for the proper handling, disposal, and treatment of these wastes. The National Green Tribunal had also in a number of cases, such as *Meera Shukla v. Municipal Corporation, Gorakhpur & Ors., K.M Reddy v. State of Andhra Pradesh & Ors., Mahesh Dubey v. Chhattisgarh Environment Conservation Board*[12] , etc., had addressed the issue of unscientific disposal of biomedical wastes. Besides this, a lack of sufficient funds was cited as an excuse for the non-implementation of these rules. Many hospitals were not willing to invest in the high costs associated with phasing out chlorinated plastic bags, blood bags, gloves, containers, or even in setting up incinerators for the proper disposal of biomedical wastes[13].

Moreover, with the outbreak of Covid 19, there has been a drastic increase in India's amount of biomedical wastes. Huge piles of PPE kits, their misuse, and the indiscriminate disposal of gloves and masks worsened the situation. As per the Central Pollution Control Board reports, India had generated over 33000 tons of Covid 19 related medical wastes in addition to the

[11](1996) 2 SCC 594.
[12] 2016 SCC OnLine NGT 3724
[13] Datta P, et al., *Biomedical waste management in India: Critical appraisal*, 10(1) J. LAB. PHYSICIANS 1, 6, (2018).

existing 710 metric tons of biomedical wastes per day[14]. It, in turn, posed a unique challenge to the current situation.

As per the existing rules are concerned, there is no provision regarding adequate covid waste management. There also exist gaps in the proper compliance of the biomedical waste management rules. Significantly, the unscientific disposal of Covid wastes, improper segregation of the garbage, mixing it up with the municipal solid wastes, etc., are specific unaddressed issues in the existing Rules[15]. Besides this are the issues concerning the rights of waste handlers. Improper management of these wastes potentially exposes the waste handlers and health care workers to serious health risks. Their safety, considering the contagious nature of the disease, is an alarming issue. Further, the existing biomedical waste treatment facilities are also inadequate to meet this Covid19 scenario. Therefore, an adequate regulatory mechanism with a high implementation rate is inevitable to overcome the challenges of biomedical waste disposal in India.

This dissertation seeks to examine the existing rules regarding biomedical wastes and the need to implement more stringent regulations to curb the indiscriminate disposal of biomedical wastes in the wake of the Covid 19 pandemic.

## RESEARCH QUESTIONS

1. What are the existing legal frameworks regarding biomedical waste disposal in India?
2. Whether the existing laws are sufficient to curb the indiscriminate disposal of biomedical wastes?
3. Whether the existing legislation is viable to tackle the Covid 19 related waste disposals?

[14] Central Pollution Control Board, Generation of COVID 19 related biomedical waste in States /UTs, Status Report, June 2020, https://cpcb.nic.in/covid-waste-management/ (last accessed Feb. 27, 2021)

[15] *In re: Scientific Disposal of Bio-Medical Waste arising out of Covid-19 treatment*, O.A. NO. 72 of 2020, Apr. 23, 2020 (NGT), 2.

## OBJECTIVES OF THE STUDY

The objective of the research is as follows:

1. To examine the existing legislative measures regarding biomedical waste disposal in India.
2. To analyze and evaluate the efficacy of the existing legislative provisions in the light of WHO's guidelines.
3. To examine whether the existing legal framework is sufficient to combat the Covid-19 related waste disposal.
4. To suggest an adequate legal framework for combating the drastically increasing biomedical waste disposal in India.

## HYPOTHESIS OF THE STUDY

The research and other ancillary works on the dissertation are initiated based on the hypothesis that the existing legal framework is insufficient to combat India's drastically increasing biomedical waste disposal, especially in the wake of Covid-19.

## METHODOLOGY OF THE STUDY

The method used in the dissertation is a doctrinal research methodology based on primary data sources such as rules, guidelines, notifications, reports, etc., and secondary sources such as books, journals, online sources, and newspaper articles.

## CHAPTERIZATION

The second chapter, 'The Concept of Biomedical waste and its impact on Human Health', looks into the common and legal understanding of the concept of biomedical wastes and the threat it poses to human health and the environment.

The Third Chapter, 'The Regulatory Framework on Biomedical Waste Disposal,' examines the legislation regulating biomedical waste disposals. The chapter also looks into the Basel Convention and its influence on the existing rules.

The Fourth Chapter, ‘The System of Bio-Medical Waste Management in India – An Analysis,' analyses the efficiency of the existing laws regarding the management of biomedical wastes in India and the concerns regarding its enforcement.

The Fifth Chapter, ‘The Covid-19 Waste Disposal and the Competency of the Existing Regulations- an Analysis', seeks to examine whether the existing legislation is compatible with tackling the Covid 19 related wastes.

The sixth and final chapter, ‘Recommendations/ Suggestions,' provides the study's conclusion and seeks to lay down specific recommendations to fix the current state of affairs.

**CHAPTER: 2**

# THE CONCEPT OF BIOMEDICAL WASTE AND ITS IMPACT ON HUMAN HEALTH AND THE ENVIRONMENT

***"Healthcare activities protect and restore health and save lives; but what about the waste and by-products they generate?"*** **- WHO, Feb. 2018[16]**

## 2.1. INTRODUCTION

During the past century (1900- 2000), the global production of waste has increased ten times and is expected to grow twice over by 2025, meaning that the waste "is being generated faster than other environmental pollutants, including greenhouse gases."[17] The reason for this abrupt growth could be a combination of factors like an increase in wealth, population expansion, urbanization, increased usage of plastics, etc. Biomedical waste is one such class of waste that healthcare activities generate.

Biomedical waste has become a global challenge in healthcare, raising various humanitarian concerns. Medical care is essential for protecting, saving, and sustaining life, but at the same time, it generates medical wastes as the by-product of healthcare, depicting the accurate picture of the healthcare system. Biomedical wastes emerged as a separate waste category during the 1980s when it was first found along the shores of the East Coast and the Great Lakes states of USA[18].

Although generated in small amounts, hospital wastes are special kinds of wastes carrying a high potential for infection or injury. These medical wastes have a high potential to

[16] World Health Organization, Health Care Waste, (2018), https://www.who.int/newsroom/fact-sheets/detail/health-care-waste (last visited: June 23, 2021)

[17] Hoornweg, Daniel, et al., *Chris, Environment: Waste production must peak this century*, 502 NATURE 615, (2013).

[18] 2 TIM DELANEY & TIM MADIGAN, BEYOND SUSTAINABILITY: A THRIVING ENVIRONMENT 134, (McFarland & Company Inc. Publishers, 2021).

transmit diseases to other people[19] and have become a public health issue seeking attention in both industrialized and developing countries[20]. Every day a large amount of potentially infectious and hazardous waste is generated in healthcare hospitals and facilities around the world[21]. With the increased growth of medicalcare facilities, the quantity of biomedical wastes generated has also increased rapidly[22].

### 2.1.1 DEFINING THE CONCEPT

The World Health Organisation has defined medical waste as the "waste generated by healthcare activities, including used syringes and needles to the soiled dressings, diagnostic samples, body parts, fluids like blood, chemicals, drugs, medical devices, and radioactive materials"[23]. It refers to all waste generated by healthcare activities and related sources, including hospitals and other facilities like clinics, laboratories, and research centers, autopsy centers, research centers, and animal testing laboratories, blood banks, and nursing homes for the elderly[24]. It has been categorized as the waste generated during immunization, diagnosis, or treatment of animals or humans.

As per the Controlled Waste Regulations (1992) of the United Kingdom, Clinical waste means,

*(i) any waste consisting of animal or human tissues, blood, other body fluids, excretion, medicines, and other pharmaceutical substances, swabs or dressings, or needles, syringes, and other sharps, being waste which unless rendered safe may prove hazardous to any person coming into contact with it, and*

(ii) *any other waste that arises out of medical, dental, veterinary, nursing, pharmaceutical or other practices like diagnosis, treatment, care, research or*

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[19] Mathur V, Dwivedi S, et al., *Knowledge, attitude and practice about biomedical waste management among healthcare personnel: A cross-sectional study*, 36(2) INDIAN J. COMMUNITY MED. 143-144, (2011).

[20] Leonard L, *Healthcare waste in South Africa: A civil society perspective*, https://www.researchgate.net/publication/277011966_Health_Care_Waste_in_Southern_Africa_A_civil_society_perspective (last accessed: Jun. 25, 2021)

[21] Nikos E. Mastorakis, C. A. Bulucea, et al., Holistic approach of biomedical waste management system with regard to health and environmental risks, 5(3) INT. J. ENERGY ENVIRON. 309, (2011).

[22] Rao N., *Biomedical Waste Management*, 10(1) ENVIRON. SCI. INDIAN J. 21, (2015).

[23] WHO, HEALTHCARE WASTE, https://www.who.int/topics/medical_waste/en/ (last visited: Jun. 5, 2021)

[24] World Health Organization, Safe Management of Wastes from healthcare activities, 2014, https://www.who.int/water_sanitation_health/publications/wastemanag/en/ (last accessed on: Jun. 5, 2021)

*collection of blood, etc., being waste might cause infection to any person coming into contact with it*[25].

The Medical Waste Tracking Act, 1988 of United States defined "Medical waste" as any solid waste generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing biologicals[26]. However, this is not an exclusive definition but includes:

- culture dishes, glassware, and lancets
- surgical instruments and gloves that are discarded
- discarded needles
- bandages that are soiled or soaked with blood
- cultures, swabs & stocks
- removed body parts or organs (appendices, tonsils, or limbs), etc.

Usually, the terms medical waste, hospital waste, infectious, and regulated medical wastes are often used interchangeably with medical wastes since there is no universally accepted definition for these terms[27]. In consistence with the meaning given by the United States Environmental Protection Agency, the term medical waste refers to all the wastes generated at any healthcare or healthcare-related facility[28]. However, the absence of a standard definition of medical waste has led to a lack of standardization of medical waste streams and disposal receptacles[29].

[25] The Controlled Waste Regulations of 1992, Reg. 1(2), SI1992/588 (United Kingdom).
[26] The Solid Waste Disposal Act, 42 U. S. C. § 6903 (40), 1988.
[27] Y.C Jang, Infectious/Medical /Hospital Waste: General Characteristics, DOI: 10.1016/B978-0-444-52272-6.00508-0 (Last accessed: Jun. 25, 2021).
[28] Y.W Cheng, F.C Sung, et al., *Medical waste production at hospitals and associated factors*, 29 WASTE MANAG. 440, (2009).
[29] EInsa, M. Zamorano, R Lopez, Critical review of medical waste legislation in Spain, 54 RESOUR. CONSERV. RECYCL. 1048, (2010).

## 2.2. WHO's CLASSIFICATION

The World Health Organisation has classified healthcare waste into the following types[30].

- Infectious waste: it includes wastes such as blood and other body fluids, discarded laboratory samples, cultures and other infectious agents from diagnosis or autopsies, animal wastes (from veterinary institutions), waste from infected patients like swabs, dumped medical equipment, etc.

- Chemical waste: Chemical waste comprises expired disinfectants, laboratory chemicals, and solvents, disposed of X-ray films, elemental mercury, and discarded lead aprons, foils, scrap amalgam, and other cleaning agents.

- Cytotoxic waste: It is a kind of waste that contains genotoxic particles such as cytotoxic drugs, having teratogenic or carcinogenic impacts. It causes several health issues both within and outside the hospital environment. Antineoplastic or cytotoxic drugs prevent the growth of living cells when administered to the human body. Genotoxic waste covers these cytotoxic drugs as well as other radioactive materials.

- Biotechnological or microbiological wastes: These biological wastes consists of specimens of human or animal cell cultures, laboratory cultures, infectious particles arising out of biomedical research, toxins generated, and other equipments or devices used in the culture.

- Pathological waste: It includes anatomical wastes like body parts, human fetuses, animal carcasses, tissues, organs, fluids like blood, saliva, and extracted tooth, etc. Some of these pathogens are highly dangerous, possessing increased levels of pathogenicity and resistance to treatment[31].

[30] *Supra* note 23
[31] Askarian M, Vakili M, et al., *Hospital waste management status in university hospitals of the Fars province, Iran*, 14 INT. J. ENVIRON. HEALTH RES. 295, (2004).

- Pharmaceutical waste: wastes from pharmaceutical products consist of discarded or expired, or partially used medicines like ointments, tablets, drugs, syrups, and other liquid solutions like massage oils.

- Pressurized containers: This category comprises containers with gas or pressurized liquids, containers with powdered materials, aerosol cans, or other gas-like containers.

- Radioactive waste: Wastes generated from radiotherapy and research laboratories such as glassware, absorbent papers, excreta, and body fluids of patients with radionuclides, contaminated packages, etc., fall under this category.

- Sharps: These substances cause cuts or wounds and are at a high risk of causing deadly diseases to healthcare workers and professionals if not appropriately managed. It consists of needles, blades, scalpels, nails, scissors, razors, knives, broken glass pieces, bone chips, and infusion sets.

- General or Non- hazardous waste: It consists of waste that does not pose chemical, radioactive, biological or any physical hazard.

Other categories:

- Soiled waste: it consists of contaminated substances such as used cotton, bandages, plaster casts, dressings, lined beddings, etc.
- Wastes containing heavy metals: It includes litters that consist of heavy metals such as mercury, lead, cadmium, etc., and its derivatives like discarded thermometers, manometers, and batteries.
- Food wastes: this category of waste consists of food particles that directly contact persons with infectious diseases.
- Incinerated ash: It contains ashes generated from the incineration process of biomedical waste.

Of the total healthcare wastes produced, 75-90% are non-hazardous, while the remaining 10-25% of the biomedical wastes are regarded as hazardous[32] (toxic, contagious, or radioactive) and can lead to a variety of environmental and health risks[33]. And when it comes to India, this range could vary from 15% to 35%, depending on the total amount of waste generated[34]. On a global scale, medical waste is the second most hazardous waste after radiation waste[35].

## 2.3 THE RISK FACTOR

The healthcare sector is at high risk with increasing possibilities of work-related diseases and injuries, mainly due to non-compliance with the standard protocols of waste management and safety measures against occupational hazards. Healthcare facilities generate much biomedical waste, which is potentially hazardous and can endanger the life of workers, patients and members of the community if they are not adequately handled[36]. Healthcare wastes are dangerous if not handled properly. Poor management of healthcare waste exposes health laborers, waste handlers, and the community to the toxic effects of wastes generated from health activity[37]. Generally, as compared with municipal wastes, the biomedical wastes generated during vaccination, diagnosis, and treatment are more infectious.

The hazards of poor management have aroused concerns worldwide and have far-reaching effects on human health and the environment[38]. Inadequate and improper handling of these wastes poses serious public health concerns and has a significant impact on the

[32] Sharma R., M. Sharma, et al., *The impact of incinerators on human health and environment*, 28(1) REV. ENVIRON. HEALTH 67, (2013). About 10–25% of the total wastes generated by healthcare organizations are biomedical wastes that are hazardous to humans and the environment.

[33] Harhay M.O, Halpern S.D, et al., *Health care waste management: A neglected and growing public health problem worldwide*, 14 TROP. MED. INT. HEALTH 1414, (2009).

[34] Chitnis V, Vaidya K, et al., *Biomedical waste in laboratory medicine: Audit and management*, 23 (1) INDIAN J. MED. MICROBIOLOGY 6, (2005).

[35] Arab M, Baghbani R. A, et al., *The Assessment of hospital waste management: A case study in Tehran*, 26(3) WASTE MANAG. RES. 305, (2008).

[36] Muluken A, Haimanot G, et al., *Healthcare waste management practices among healthcare facilities of Gondar town, Northwest Ethiopia*, 7(3) HEALTH SCI. J. 315 (2013).

[37] Mathusuthan Kumarasamy & Vasanthiny Jeevaratnam, *Review on Management of Hospital Waste in An Efficient Manner*, 3 (7) INT. J. ENVIRON. AGRIC. RES. 55, (2017).

[38] Mathur, P., S. Patan, and A.S. Shobhawat, *Need of biomedical waste management system in hospitals–An emerging issue–A review*, 7(1) CURR. WORLD ENVIRON. 117, (2012).

environment[39] by spreading microorganisms from healthcare facilities into the atmosphere[40]. So the unsafe handling of wastes poses a grave threat to human health and safety and the environment and for the current and future generations[41].

The United States tops the list of medical waste production globally with 6 million tonnes of wastes per year as per the recent reports of the U.S Environmental Protection Agency. Healthcare waste is a serious issue even in India since; it is the second-highest populous country globally[42]. In India, about 50 to 60% of the total solid waste generated is biomedical waste.[43] But, sufficient data on the generation of biomedical waste and its content is not available, even for cities like Mumbai and Calcutta[44].

The average rate of biomedical waste production in India was around 615 tonnes per day until 2020. However, a hike in the generation of wastes with the pandemic in action posed a great danger to humanity. As of June 2021, Covid-19 related biomedical waste generation in India is about 203 tonnes/day[45] (in addition to the 615 tonnes mentioned above). During a pandemic, any waste generated by a healthcare establishment is considered infectious.

### 2.3.1. CONCEPT OF HAZARDOUS WASTES

Hazardous and poor management of biomedical waste has become a matter of concern, particularly in light of the far-reaching effects, affecting human and animal health and the environment[46]. Hazardous waste is one, which exhibits any of the characteristics such as being

[39] Fluke C., *Handling hazardous waste*, 6 J. HEALTH MATER. MANAG. 72, (1998).
[40] K. Brichard, *Out of sight, out of mind- the medical waste problem*, The Lancet 359, (2002).
[41] Chartier Y, et. al., Safe Management Of Wastes From Healthcare Activities, (2014), https://www.euro.who.int/__data/assets/pdf_file/0012/268779/Safe-management-of-wastes-from-health-care-activities-Eng.pdf (accessed on: Jun. 23, 2021)
[42] Subrammani. T, et al., *Healthcare waste management system*, 4(6) INT. J. ENG. RES. APPL. 255, (2014).
[43] Hirani D. P, Villaitramani K. R, et al., *Biomedical Waste: An Introduction to Its Management*, 1(8) INT. J. INNOV. RES. ADV. ENG. 82, (2014).
[44] Rajasthan State Institute of Health & Family Welfare, Health Care Waste Management: Evaluation Study, 2009, http://www.sihfwrajasthan.com/Studies/Report%20HCWM.pdf (last accessed: Jun. 29, 2021)
[45] Central Pollution Control Board, Covid-19 Biomedical Waste management status, June 2021, https://cpcb.nic.in/covid-waste-management/ (last accessed: Jun. 29, 2021)
[46] Sharma. S & Chauhan S.V, *Assessment of the biomedical waste management in the three apex Government hospitals of Agra*, 29(2) J. ENVIRON. BIOL. 159, (2008).

flammable, reactive, explosive, corrosive, radioactive, infectious, irritating, sensitizing, or bio-accumulative[47].

Hazardous waste means any waste with one or more of the following characteristics - ignitability, corrosivity, reactivity, and toxicity[48]. So the waste posing a potential hazard or threat to humans or living organisms due to their properties are known as hazardous wastes. It gets magnified biologically and can be fatal due to its detrimental effects. Healthcare or medical waste encompasses a significant quantity of dangerous substances[49]. Hospital wastes are chemically hazardous, infectious, and often radioactive and are a serious health hazard to the community if inappropriately treated or disposed of[50].

'Hazardous biomedical waste' consists of the following types of wastes[51]:

- anatomical waste of humans or animals (including tissues, organs, body parts, etc.);
- microbiology and bio-technology waste (such as laboratory cultures, microorganisms, human cell cultures, toxins, etc.);
- waste sharps (such as hypodermics needles, scalps, broken glass, syringes, etc.);
- discarded pharmaceuticals and cytotoxic drugs;
- soiled waste ( e.g., bandage dressings, materials contaminated with blood, plaster casts, etc.);
- soiled waste (discardable items such as catheters, tubes, etc. but does not include sharp wastes);
- liquid waste that originates from any infected areas;
- animal waste (generated during research or experimentation, from veterinary hospitals, etc.);

[47] Shareefdeen Z.M., *Medical waste management, and control*, 3(12) J. ENVIRON. PROT. 1265, (2012).
[48] Saleh H.E-D.M, Introduction to Hazardous Waste Management, Management of Hazardous Wastes 1, (2016) http://doi.org/10.5772/64245
[49] Bilal Ahmed Khan, Longsheng Cheng, et al., Healthcare waste management in Asian developing countries: A mini-review, 37(9) Waste Manag. Res. 863, (2019).
[50] Priyadarshini, N. R., S. Srikantaswamy, et al., *Characterization of biomedical waste of Mysuru city Hospitals*, 5(9) INT. J. ENG. SCI. & RES. TECHNOL. 452, 456, (2016).
[51] Nikos E. Mastorakis, et al., Environmental and health risks associated with bio-medical health management, Development, Energy, Environment, Economics, http://www.wseas.us/e-library/cnferences/2010/Tenerife/DEEE/DEEE-47.pdf. (last accessed: Jun. 26, 2021)

- incineration ash and
- chemical waste.

It includes waste such as sharps, human tissue or body parts, and other infectious materials.[52]Generally, high-income countries generate up to 0.5kg of hazardous waste per bed per dayon an average.

Biomedical waste comes under the category of toxic or hazardous waste under the Basel Convention[53]. The Convention declared that Bio-Medical and Healthcare wastes too come under its purview of toxic and hazardous wastes[54].

### 2.3.2 HEALTH HAZARDS OF BIOMEDICAL WASTE

With the rapid growth of healthcare facilities, there has been a surge in the generation of biomedical wastes and illegal recycling activities at a higher rate. So in an era where many new viruses are catalyzing the world over, it becomes essential to assess the potential health risks associated with the wastes generated from these healthcare facilities.

Non-compliance with the segregation standards combines medical and municipal wastes, making the whole system hazardous. The presence of pathogenic and infectious substances in biomedical waste often worsens the situation in most developing countries[55]. Healthcare wastes are potentially the source of dangerous microorganisms infecting patients, healthcare personnel, and even the public. The exposure to highly infectious and pathogenic waste materials, including body parts, soiled wastes like plaster casts and contaminated bandages, laboratory culture wastes like blood and other bodily fluids, contaminated medical instruments, surgical and pharmaceutical by-products all lead to the spread of chronic diseases. Emissions from incinerators and open burning result in the production of harmful gases, which

[52] Baveja G., Muralidhar S & Aggarwal P, *Hospital waste management – An Overview*, 5 HOSP. TODAY 485, 486, (2000).

[53] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx (last visited: Jun. 27, 2021)

[54] The Basel Convention Secretariat, http://archive.basel.int/ convention/bc glance.pdf. (last accessed: Jun. 27, 2021)

[55]Odumosu B. T, *Biomedical Waste: Its Effects and Safe Disposal*, in Chandra R (eds.), ENVIRONMENTAL WASTE MANAGEMENT 86, (CRC Press, 2015).

are responsible for causing respiratory diseases as well as cancer among human beings[56]. Improper management of biomedical waste is responsible for several acute outbreaks such as severe acute respiratory syndrome (SARS)[57].

Disposal of these wastes, along with the municipal garbage or in open dumps or near water bodies, leads to various communicable diseases. Numerous infectious diseases like cholera, tuberculosis, hepatitis, etc., spread through improper disposal or inappropriate treatment of waste materials like human blood, sweat, or other body fluids, through contaminated organs, etc. Not just disposal, even recycling of biomedical wastes like sharps and needles, without sterilization and adequate safety measures contribute to the transmission of viruses.

Persons at risk

The persons who come in direct or indirect contact with these hazardous waste materials are adversely affected by its consequences. All individuals, whether within a healthcare establishment generating hazardous wastes or outside it, handling such wastes or is exposed to its effects, are at potential risk. This category includes doctors, patients, bystanders, fetuses, nurses, other auxiliaries, and allied service workers like the laundries, waste handlers, transport personnel, and even scavengers. The general public, including men, women, and children, are also prone to the risks associated with bio-medical wastes.

The primary health risks related to poor management of biomedical waste include nosocomial infections in patients and healthcare professionals, injuries to waste handlers from sharps and needles, and the risk of hazardous chemicals and diseases to the general public.

Hazards out of infectious wastes and sharps

Infectious wastes contain large varieties of microorganisms that are pathogenic and these might enter the human body by any means such as through an abrasion, cut, or by inhalation, or ingestion. The generic definition of infectious waste is "capable of producing an infectious

[56] B. Ramesh Babu, et al., *Management of Biomedical Waste in India and Other Countries: A Review*, 4 J. INT. ENVIRON. APPL. SCI. 66, (2009).
[57] Ephraim, I.P, A. Ita, and O. Eusebius, *Investigation of soils affected by burnt hospital wastes in Nigeria using PIXE*, 2(1) SPRINGERPLUS 208, (2013).

disease"[58]. The microbial infections caused by exposure to biomedical wastes include systemic and local infections[59]. That is, exposure to blood, saliva, or other body fluids or aerosols might carry infectious materials such as HIV, hepatitis C, or other bloodborne or fluid body pathogens[60]. Besides this, biomedical wastes also act as a breeding bed for various pests, vermins, and mosquitoes, transmitting insect-borne diseases like malaria, lymphatic filariasis, etc.

Improper handling of sharps leads to needle stick injuries, thereby causing bloodborne pathogens such as HBV, HIV and HCV, etc[61]. The transmission of Hepatitis B and HIV (Human Immunodeficiency Virus) through injuries or abrasion caused by contaminated needles, were proved at many instances. Hypodermic needles thus pose a serious danger of disease transmission. The infections caused by sharps contaminated with blood often result in infertility, dermatitis, hormonal cancers, genital deformities, asthma, and neurological disorders and even spread diseases like cholera, typhoid, and AIDS[62]. As per the World Health Organization's (WHO) Report of 2000, of the total number of accidents from sharps, 66,000 healthcare workers were infected with hepatitis B, while 16,000 with hepatitis C and about 5,000 were infected with HIV infection. Besides causing cuts and abrasions, these pathogenic sharps might also infect wounds and worsen the casualties.

[58] Office of Technical Assessment, U.S. Congress, Issues in Medical Waste Management-Background Report (Oct. 5, 1988), https://ota.fas.org/reports/8825.pdf (last accessed: Jun. 27, 2021).

[59] Ira F. Salkin, Review of health impacts from microbiological hazards in healthcare wastes (2004), https://www.who.int/water_sanitation_health/medicalwaste/en/microbhazards0306.pdf (Jun. 27, 2021, 10:04 AM).

[60] Nejad, S. B., B. Allegranzi, et al., *Health-care-associated infection in Africa: a systematic review*, 89 (10) BULL. WORLD HEALTH ORGAN. 757, (2011).

[61] IPEN Study Group, New Delhi, *Bio-medical waste management: Situational analysis and predictors of performances in 25 districts across 20 Indian States*, 139 INDIAN J MED. RES. 141, (2014).

[62] Adedigba, M. A., S. O. Nwhator, et al., *Assessment of dental waste management in a Nigerian tertiary hospital*, 28(9) WASTE MANAG. RES. 769, (2010).

Examples of infections that can be caused by hazardous medical waste[63]

| Infective Agent | Transmission Agent | Type of Infection |
|---|---|---|
| Mycobacterium tuberculosis, Streptococcus pneumonia, measles, SARS Covid-19 virus, etc. | Inhaled secretions, saliva | Respiratory Infections |
| Bacillus anthracis | Skin secretions | Anthrax |
| Neisseria meningitides | Cerebro-spinal fluid | Meningitis |
| Ebola, Marburg, Lassa & Junín viruses | Blood & secretions | Hemorrhagic fever |
| Hepatitis A virus | Faeces | Hepatitis A |
| Hepatitis B & C virus | Blood & other body fluids | Hepatitis B & C |
| Human Immunodeficiency Virus(HIV) | Blood, sexual secretions, other body fluids | AIDS |
| Herpes virus | Eye secretions | Eye infections |
| Streptococcus | Pus | Skin Infections |

Source: World Health Organisation

Hazards from chemical and pharmaceutical waste

The use of many pharmaceuticals and chemicals in hospitals can be toxic, flammable, explosive corrosive and thereby cause harm to human health. Heaps of expired and unwanted drugs and chemical products are often found outside the hospital premises, causing chronic burns and injuries. And absorption or inhalation of these chemicals might result in intoxication. For example, the corrosive nature of disinfectants, antiseptics, etc. can cause damage to eyes, skin and mucous membranes by contact and even cause burns. Healthcare workers, including nurses, anesthetists, pharmacists and other auxiliaries, were at an increased risk of dermal and respiratory diseases due to exposure to these substances.

Likewise, inadequate burial or disposal of pesticides in torn bags often leads to groundwater contamination and its unsafe burning can result in poisoning. Besides, discharge of the residues of these chemicals into sewages pollutes water bodies mainly when it consists of heavy metals like lead, mercury, or phenols.

[63] A. Prüss, E. Giroult, and P. Rushbrook, Safe management of wastes from healthcare activities, World Health Organisation (1999), https://apps.who.int/iris/bitstream/handle/10665/42175/9241545259.pdf (Jun. 27, 2021, 10:14 AM)

Hazards from genotoxic waste

The hazardous nature of genotoxic wastes depends on its toxicity and the extent of exposure. It mainly affects the waste handlers who are exposed to these substances at the time of treatment of drugs and other chemicals. It reaches our body either by inhaling dust or by accidental consumption of food contaminated with these genotoxic substances or through mouth pipetting. People often get exposed to this waste during chemotherapies through direct contact with the secretions or other fluids. The potential health risks or hazards connected with the handling of these substances are manifested by increased urinary levels of mutagenic compounds in exposed workers and an increased risk of abortion[64]. So adequate care must be taken during the disposal and treatment of genotoxic wastes since its consequences are disastrous for both man and the environment.

Hazards from radioactive waste

The severity of disease resulting from radioactive wastes is determined on the basis of the duration and kind of exposure. The toxic substances in radioactive wastes can harm the genetical characteristics and cause severe injuries on human tissues that might necessitate amputating of different body parts or even result in death. Radioactive wastes might also lead to specific malignancies, respiratory and cardiac disorders, fetal malformation, etc[65]. And the health workers who engage in the cleaning and handling of such wastes are at a high risk of its after-effects.

Even though the impacts are predominantly on those who scavenge upon these disposal sites, other infections spread through more resilient channels and adversely affect the life of the general public. There were instances from Latin America wherein untreated sewage discharges from cholera hospitals had contributed to the spread of the epidemics.

[64] Stucker I, et. al., Risk of spontaneous abortion among nurses handling antineoplastic drugs, 16 SCAND. J. WORK, ENVIRON. HEALTH 104, (1990).

[65] Castegnaro M, Adams J, et al., Laboratory Decontamination and Destruction of Carcinogens in Laboratory Waste: Some Antineoplastic Agents, IARC Scientific Publications, No. 73, (1985). https://publications.iarc.fr/Book-And-Report-Series/Iarc-Scientific-Publications/Laboratory-Decontamination-And-Destruction-Of-Carcinogens-In-Laboratory-Wastes-Some-Antineoplastic-Agents-1985 (last accessed Jun. 29, 2021).

Recycled biomedical wastes

Hospital wastes such as syringes, fluid bottles, and infusion bags are collected and recycled without proper disinfection and brought into the markets for sale. Waste materials contaminated with blood and other fluids like syringes, needles, cotton, bandages, etc. are recycled and used for making toys, earbuds, etc., without even disinfecting them. Repackaging and sale of syringes found in waste dumping sites are common. As per the Syringes & Needles Manufacturing Association of India, almost 20% of the disposed off needles and syringes are recycled and kept for resale. These recycled sharp-wastes often carry deadly viruses such as Hepatitis B & C virus. In India also, surgical waste like cotton and bandages are utilized in making mattresses and quilts[66].

### 2.3.3 REPERCUSSIONS OF BIOMEDICAL WASTE ON THE ENVIRONMENT

The environment is the surrounding in which a person lives influenced by social, biological, physical, and cultural factors[67]. While hospitals try to protect and save human life, on the other hand, the by-products generated by these establishments pose significant damage to the environment[68]. The environmental impacts of these pathological waste materials are increasing daily with the constant rise in population and the number of hospitals. The poor or inadequate management of hospital wastes causes environmental pollution and leads to the transmission of various diseases like cholera, typhoid, and hepatitis[69].

As per the estimates made on the emissions from this sector, the healthcare sector was responsible for 12% of the acid rain, 10% of greenhouse gas emissions, 9% of air pollutants, and

[66] Chary V.S., Medical Waste Management Practices in Bidar City and Strategies for Safe Disposal, Issue Paper, Administrative Staff College of India, Hyderabad, (1998).
[67] MEGAN LONDON, ENVIRONMENT HEALTH AND SUSTAINABLE DEVELOPMENT, (Open University Press, 1st ed., 2006).
[68] Manyele, S. V. and C. M. Mujuni, *Current status of sharps waste management in the lower-level health facilities in Tanzania*, 12(4) TANZAN. J. HEALTH RES. 261, (2010).
[69] Babanyara Y. Y, D. B. Ibrahim, et al., *Poor medical waste management practices and its risks to human health and the environment: A Literature Review*, 11(7) INT. J. ENVIRON. HEALTH SCI. ENG. 1, 5, (2013).

about 2% of other carcinogenic pollutants in the world[70]. Indiscriminate disposal of biomedical wastes has resulted in land, air and water pollution.

- Air Pollution

Here, it refers to both indoor as well as outdoor air pollution. Poor ventilation can be one of the causes of indoor pollution that leads to diseases such as the Sick Building Syndrome (SBS). In the case of outdoor pollution, pathogens enter the atmosphere through transportation and open dumping of untreated biomedical wastes. Generation of greenhouse gas and other particulate emissions are the challenges arising out of these waste dumping sites[71]. Open burning of these wastes often leads to respiratory diseases through inhalation of chemical pollutants by the residents. The incineration of medical wastes also releases carcinogenic gases like dioxins and furans into the atmosphere[72]. Besides these, the toxicity in radioactive emissions arising out of research and other activities also poses a severe risk to the environment. The radioactive emissions and radioactive wastes from research and radio-immunoassay activities emit a considerable amount of radioactive gas into the air[73].

- Water Pollution

Wastewater or liquid waste from hospitals has a devasting effect on humans and plants, and animals. Wastewater from the healthcare institutions consists of destructive chemical compounds and pharmaceutical products, having global environmental impacts and lethal impact on the aquatic ecosystem. The untreated liquid wastes that pass through sewages lead to ground and surface water contamination[74]. It alters the pH level of water bodies and harms marine life. The

[70] Eckelman, M. J. and J. Sherman, Environmental impacts of the US health care system and effects on public health, 11(6) PLOS ONE e0157014, 2016, DOI: 10.1371/journal.pone.0157014 (Jun. 27, 2021, 11:45 AM)

[71] Karthikeyan S. R. Balasubramanian and K. Iouri, *Particulate Air Pollution from Bushfires: Human Exposure and Possible Health Effects*, 69(21) J. TOXICOL. ENVIRON. HEALTH 1895, (2006).

[72] Burd M, *Reducing the risks related to the handling and disposal of healthcare waste*, 20 PROF. NURSES 40, (2005).

[73] Dalal P, *Management of Infectious Biomedical Waste of Ujjain City*, 1(2) INT. J. ADV. RES. 52, (2013).

[74]Rao H. V, *Disposal of hospital wastes in Bangalore and their impact on environment*, The Third International Conference on Appropriate Waste Management Technologies for Developing Countries, Nagpur, February 25–26, 841, (1995).

pollutants from waste disposal sites might also seep into the soil to contaminate groundwater levels. Besides, the dioxin released during incineration enters the water bodies and pollutes it[75].

On an assessment made in the waste dumpsite in Sewapura near Jaipur, it was found that the groundwaters were polluted by the seepage of toxic substances from these wastes[76]. Studies have also shown that heavy metals in leachate were exceeding the drinking water standards[77]. Incineration of biomedical waste releases a high concentration of heavy metals and polycyclic aromatic hydrocarbons (PAHs), resulting in the unfavorable release of large amounts of hazardous materials contaminating the groundwater[78]. The landfill leachates from biomedical wastes containing heavy metals pose a severe threat to the environment, especially in the case of unlined landfills where dissipation of leachate into groundwater occurs[79]. Nevertheless, another concern is that these heavy metals are non-biodegradable that, instead of decomposing, these pile up in the environment.

Discharge of sewage from hospitals- Medical and pharmaceutical wastes often impairs the functioning of wastewater treatment plants and inadequate treatment of sewage sludge and liquid wastes from hospitals, mixing up toxic chemicals in water, polluting the whole ecosystem. This wastewater often contains antibiotics released through human excreta. Studies have shown that hospital sewage is 2-10 times more resistant to antibiotics than domestic sewage, propagating bacterium like methicillin-resistant Staphylococcus aureus (MRSA).

[75] Ravikant, C.V., Jaiswal, S.P., et al., *Effluent Treatment Plant: Why and How?* 14(1) J. ACAD. HOSPITAL ADM. 33, (2002).

[76] Gautam, A., G. Pathak, and A. Sahni, *Assessment of groundwater quality at municipal solid waste dumping site-Sewapura, Jaipur*, 6(2) CURR. WORLD ENVIRON 280, (2006).

[77] Al Raisi, S. A. H., H. Sulaiman, et al., *Assessment of heavy metals in leachates of an unlined-landfill in the Sultanate of Oman*, 5(1) INT. J. ENVIRON. SCI. DEV. 61, (2014).

[78] Heera, S., and A. Rajor, *Bacterial treatment and metal characterization of biomedical waste ash*, J. WASTE MANAG. 1, 5, (2014).

[79] Al Raisi, S. A. H., H. Sulaiman, et al., *Assessment of heavy metals in leachates of an unlined-landfill in the Sultanate of Oman*, 5(1) INT. J. ENVIRON. SCI. DEV. 62, (2014).

- Land Pollution

Bio-medical wastes include discarded medicines, ash, and chemicals used and generated during the disposal and treatment of infectious wastes, which leads to soil pollution. Excessive amounts of nutrient elements such as phosphates, nitrates, and heavy metals in soil harm the crops and are harmful to both animals and human beings[80]. The heavy metals contained in these wastes such as lead, cadmium, mercury etc. enters into the food chain through absorption by plants and disrupts it. The unscientific and inadequate disposal of these wastes often alters soil texture beneath the dumping sites and changes the ph level of the whole soil ecosystem.

Several studies have proved that residing near landfills increases the risk of cancer, congenital disabilities, and low birth weights in newborns. Likewise, cadmium content on the topsoil in waste dumping sites makes it unsuitable for human settlements or for agricultural purposes.

Some of the primary heavy metals forming part of biomedical wastes, which in turn contaminate the soil over dumping sites or incinerators, include:

- LEAD

Lead is often the by-product of radiography and one of the significant metals contained in biomedical waste. Like silver and mercury, it is lethal and does not break down in the soil but accumulates in living nature. Excessive exposure to these substances might lead to complications such as hypertension, reproductive toxicity, carcinogenicity, renal function, neurotoxicity, etc.

- MERCURY

Mercury can be commonly seen in manometers, thermometers, and other equipments like batteries, fluorescent tube lights, and specific other electronic devices. Healthcare waste is one of its major sources and is generated in huge

[80] Mehta, G., Hospital Waste Management, National Guidelines (Draft) prepared for GOI/WHO project IND EHH 001, Lady Hardinge Medical College and Associated Hospitals, New Delhi, 1998.

quantities during the incineration process. It often leads to mercurial pollution of underground as well as surface water and taints the soil.

- SILVER

Silver is yet another toxic metal found in healthcare establishments. Even though it is an antibacterial element, the bacteria that are resistant to silver will also have resistance to antibiotics[81].

- Risks of incineration

The incineration of biomedical wastes is also an alarming issue since it emits harmful chemicals like dioxins, furans and the ash produced contains toxic metals like mercury and lead. The incineration process converts the toxic medical wastes in a solid or liquid state into a gaseous form such as nitrogen oxide, sulfur dioxide and other particulate matter. It has an intense adverse impact on the environment.

The incinerated ash contains toxic pollutants such as chlorinated plastics, mercury, and other solvents. This increases the risk of acid rain, groundwater contamination, and health hazards affecting the eyes, the respiratory tract and causes cancer in human beings[82]. Incineration of plastic materials containing an element of chlorine produces dioxin, a powerful cancer-causing agent that destroys the immune system and results in congenital disabilities, endometriosis, etc. The furans, dioxins, and other air-borne toxic pollutants found in the residues or fly ash of incineration are harmful to the public's health.

[81] Senjen R & Illuminato I, *Nano and Biocidal Silver: Extreme germ killers present a growing threat to public health*, FRIENDS OF EARTH, 2009, https://foe.org/resources/nano-biocidal-silver/ (last accessed: Jun. 29, 2021, 9:35 AM)

[82] B. Ramesh Babu, et al., *Management of Biomedical Waste in India and Other Countries: A Review*, 4 J. INT. ENVIRON. APPL. SCI. 65, 67, (2009).

### 2.3.4. RAMIFICATIONS OF COVID-19 RELATED WASTE

As per the World Health Organisation, an epidemic outbreak means the occurrence of disease cases above average expectancy[83]. Covid -19 is an epidemic scenario that has several ecological and environmental repercussions. The SARS-Covid 19 virus mainly spreads through droplets or close contact with the infected person or aerosol transmission[84]. Coming to the waste generation during the pandemic, there has been an increase in the use of PPE kits, masks, gloves, and hand sanitizers as a safety measure from contacting the disease[85]. And this abrupt increase harms the environment.

The reports from China indicated that a large number of clinical trashes, i.e., four times more than the ordinary wastes, were generated during the pandemic[86]. In Wuhan alone, 240 tons of additional medical wastes were produced per day[87]as an aftermath of the pandemic. Though, during the initial lockdown period, there was a reduction in the levels of pollutants like carbon monoxide, methane nitrogen oxide, sulfur oxide, black carbon (BC) and other particulate matters[88], they were only temporary benefits.

Disinfectants like sodium hypochlorite and chlorine were used in large quantities for cleaning and destroying the deadly virus from physical surfaces[89]. However, these chemicals are toxic and are harmful to both microorganisms and the environment. Likewise, the increase in usage of pesticides, detergents, soaps, and single-use plastics is taking a heavy toll on the

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[83] World Health Organization, Disease Outbreaks, https://www.who.int/environmental_health_emergencies/disease_outbreaks/en/ (last accessed: Jun. 29, 2021)

[84] Xiao F, Tang M, Zheng X, et al., *Evidence for gastrointestinal infection of SARS-CoV-2*, 158(6), GASTROENTEROLOGY, 1831 (2020).

[85] Shakil M. H, Munim Z. H, et al., *COVID-19 and the environment: a critical review and research agenda*, 745 SCI. TOTAL ENVIRON. 141022, (2020), https://doi.org/10.1016/j.scito tenv.2020.141022 (last accessed: Jun. 30, 2021, 9:45 AM)

[86] Saadat S, Rawtani D, et al., *Environmental perspective of COVID-19*, SCI. TOTAL ENVIRON., (2020), https://doi.org/10.1016/j.scito techno.2020.138870 (last accessed: Jun. 30, 2021, 9:50 AM)

[87] Yu H, Sun X, et al., *Reverse logistics network design for effective management of medical waste in epidemic outbreaks: Insights from the coronavirus disease 2019 (COVID19) outbreak in Wuhan (China*), 17(5) INT. J. ENVIRON. RES. PUBLIC HEALTH 1770, (2020).

[88] Srivastava S, Kumar A, et. al., *21-Day lockdown in India dramatically reduced air pollution indices in Lucknow and New Delhi*, Bull. Environ. Contam. Toxicol., (2020), https://doi.org/10.1007/s00128-020-02895-w (last accessed: June 30, 2021, 10:15 AM)

[89]Geller C, Varbanov. M, et al., *Human coronaviruses: insights into environmental resistance and its influence on the development of new antiseptic strategies*, 4(11) VIRUSES 3044, (2012).

environment[90]. The antibacterial agent triclosan in soaps is hazardous to human health and gives rise to bacteria strains that are antibiotic-resistant[91]. These chemicals often cause endocrine disruptions, liver cancer, and several other neurological disorders[92]. They do not degrade easily and are often found in the sewages or sediments of wastewater treatment plants, adversely affecting the aquatic flora and fauna[93]. Products with alcoholic content like sanitizers are also dangerous to aquatic life when spilled in rivers or oceans and can pollute groundwater[94] when spilled in soil.

There were many instances of masks and single-use plastics being dumped in open spaces, pathways, or across roads amid global efforts in preventing the fatal virus**.** It raises a matter of immediate public concern[95] since if it were to reach the ocean, it would pose a severe threat to aquatic or marine life. Even the improper disposal of gloves is not eco-friendly due to the chemicals used in its manufacture and is again a cause of concern[96]. As far as the occupational hazards to health workers are concerned, sanitation workers and other waste-handlers are not provided with any safety guards like PPE kits, splash-proof gowns, masks, gloves, safety goggles, etc., increases the chances of contracting the infection.

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[90] Pata U. K, *How is COVID-19 affecting environmental pollution in U.S cities? Evidence from asymmetric Fourier causality test*, 13(10) AIR QUAL. ATMOS. HLTH 1149, (2020).

[91] Yueh M.F, Tukey R.H, *Triclosan: a widespread environmental toxicant with many biological effects*, 56 ANNU. REV. PHARMACOL. TOXICOL. 251, 262, (2016).

[92] Gee RH, Charles A, et al., *Oestrogenic and androgenic activity of triclosan in breast cancer cells*, 28(1) J. APPL.TOXICOL. 81, (2008).

[93] Chalew T.E, Halden R.U, *Environmental exposure of aquatic and terrestrial biota to triclosan and triclocarban*, 45(1) J. AM. WATER RESOUR. ASSOC. 7, (2009).

[94] Mahmood A, Eqan M, et al., *COVID-19 and frequent use of hand sanitizers: Human health and environmental hazards by exposure pathways*, 742 SCI. TOTAL ENVIRON. 140561, (2020) https://doi.org/10.1016/j.scitotenv.2020.140561 (last accessed: June 30, 2021, 10:40 AM)

[95] Klemes J.J, Fan Y. V, et al., *Minimizing the present and future plastic waste, energy and environmental footprints related to COVID-19*, 127 RENEW. SUSTAIN. ENERGY REV. 109883, (2020), https://doi.org/10.1016/j.rser.2020.109883 (last accessed: June 30, 2021, 10:45 AM)

[96] Kumar V, Singh S. B, et al., *COVID-19: Environmental concern and impact of Indian medicinal system*, 8(5) J. ENVIRON. CHEM. ENG. 104144, (2020), https://doi.org/10.1016/j.jece.2020.104144 (last accessed: June 30, 2021, 10: 55 AM)

### 2.3.5. OCCUPATIONAL HEALTH HAZARDS

The health personnel are yet to distinguish health care waste from ordinary garbage[97]. They are at a high risk of getting infections due to increased exposure to medical wastes, mainly the bloodborne pathogens[98]. The risks associated with infectious waste generated in healthcare settings are accidental needle stick injuries, which can cause different types of hepatitis and HIV, as well[99]. Likewise, the rag pickers who sort out the medical garbage without adequate safeguards are at an increased risk of getting exposed to infections like tetanus and HIV. Such exposure to harmful chemicals and radioactive waste in clinical settings constitute health hazards, not just to healthcare workers but also to the residents near the hospital premises[100]. Out of the 35 million healthcare workers around the world, 3 million of them have been grossly exposed to the bloodborne pathogens[101] while 2 million of them to Hepatitis B, 0.9 million to Hepatitis C virus and about 1, 70,000 of them have been affected with HIV infection[102]. Studies have proved that 83% of nurses were at the highest risk of exposure to medical waste, and infections arising out of injuries from sharp wastes were also high[103]. Reports from India indicated 59% of respondents to be exposed to various body fluids and blood, and about 50 % of the nurses and 26% of doctors were found to be at an increased risk of these substances[104].

The waste handlers are also at an increased risk of being affected by communicable diseases. The main reason behind it is lack of adequate safety education, training, and

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[97] Haniffa R., *Management of healthcare waste in Sri Lanka*, 49(3) CEYLON MED. J. 1, (2011).

[98] Jaybhaye D, Dahire P, et al., *Needle-stick injuries among healthcare workers in tertiary care hospital of rural India*, 3 INT. J. MED. SCI. PUBLIC HEALTH 49, (2014).

[99] Amsalu A, Worku M, et al., *The exposure rate to hepatitis B and C viruses among medical waste handlers in three government hospitals, Southern Ethiopia*, 38 EPIDEMIOL. HEALTH, e2016001, (2016).

[100] Tait FN, Mburu C, et al., *Occupational safety and health status of medical laboratories in Kajiado county, Kenya*, 29 Pan Afr. Med. J. 1, 14, (2018).

[101] WHO, WORLD HEALTH STATISTICS, (2010), https://apps.who.int/iris/handle/10665/44292 (last visited Jun. 30, 2021).

[102] Diaz L. F & Savage G.M, Risks and Costs associated with the management of infectious wastes, WHO Report, (2003), https://www.who.int/water_sanitation_health/medicalwaste/decisionmguide_rev_oct06.pdf (last visited Jun. 30, 2021)

[103] Rutala W.A, Weber D.J., *Infectious waste - mismatch between science and policy*, 325 N ENGL. J. MED. 578, (1991).

[104] Triolo P.K, *Occupational health hazards of hospital staff nurses, Part II: Physical, chemical, and biological stressors*, 37 AAOHN J. 277, (1989).

information that they are not aware of the consequences of handling hazardous substances[105]. The cleaning staffs and the handlers of medical waste are the ones who are badly affected by the poor and inefficient safety measures. These workers are mostly illiterate, lack adequate safety measures like personal protective equipments or good quality masks and gloves. Further, spillage of toxic liquids from disposal bins and injuries arising from protruding sharp objects pose additional risks.

## 2.4. CONCLUSION

Thus, healthcare establishments are a source of hazardous and infectious biomedical wastes. Selection of the appropriate method for treatment and in setting priorities was not at all an easy task due to the existence of numerous socioeconomic factors.[106] Efforts should be directed towards the minimization of solid wastes from hospitals.[107] Moreover, there need to be additional safeguards for the treatment of medical waste. There have to be more stringent provisions and norms, especially to tackle the covid-19 related waste scenario.

[105] Franka E., A. H. El-Zoka, et al., *Hepatitis B virus and hepatitis C virus in medical waste handlers in Libya*, 72(3) J. Hosp. Infect. 259, (2009).

[106]Twinch E., Medical Waste Management, ICRC (International Committee of the Red Cross), (2011), https://www.icrc.org/en/doc/assets/files/publications/icrc-002-4032.pdf (last accessed: Jun. 30, 2021, 11: 20 AM)

[107] Shaida. M.N, Singla S., *Global Biomedical Waste Management: Issues and Practices*, 8(9S) INT. J. INNOV. TECHNOL. EXPLOR. ENG. 1055, (2019).

## CHAPTER: 3

## THE REGULATORY FRAMEWORK ON BIOMEDICAL WASTE DISPOSAL

### 3.1. INTRODUCTION

Waste generation is an inevitable outcome of healthcare activities. It has raised several environmental, health, and human rights concerns across the globe. The global community has identified biomedical waste disposal as a crucial issue requiring equal attention as air, water, or land pollution.

Indiscriminate and improper waste disposal has global health impacts and violates our basic fundamental rights guaranteed under the Constitution. Right to life, as we know, is a universally recognized human right[108]. Right to health, that is, the right to live in hygienic, safe and clean environment is a legally recognized right under A. 21[109]. The right to healthy and clean environment is a vital aspect of right to life enshrined under A. 21 without which, it would be impossible to enjoy a basic quality of life[110]. In *Virendra Gaur & Ors. v. State of Haryana*[111], the Apex Court has held that, the right to life under Art. 21 include preservation and protection of the environment and that, right to a healthy environment fall within the ambit of right to life. So a healthy mind and body emanates from the clean surroundings. The State has to protect and preserve our Mother Nature and all that it has bestowed on us. The state has an essential responsibility to improve public health under Article 47 of the Constitution.

The whole arena of Environmental jurisprudence in India revolves around Articles 21, 48A and Art. 51A (g). Article 48 A of the Constitution states that,

[108] U.N., Universal Declaration of Human Rights, 1948, 217 A (III), Article 3 r/w Article 25(1) https://www.un.org/en/about-us/universal-declaration-of-human-rights (last visited: Jul. 2, 2021)
[109] *Occupational Health & Safety Association v. Union of India*, A.I.R. 2014 SC 1469
[110] Dr. Abdul Haseb Ansari, *Right to a Healthy Environment to ensure Environmental Justice: An Overview with special reference to India, Philippines and Malaysia*, 4 M.L.J. xxv, (1998).
[111] 1995 (2) SCC 577

*"The State shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country"*[112].

Part IV A of the Constitution, on the other hand, imposes a corresponding duty under Article 51A(g):

*"To protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;*"[113]

A breach of these constitutional safeguards would result in adverse consequences on both ecology and human health. It was in *B.L Wadehra v. Union of India,*[114]wherein the mismanagement in handling Bio-Medical wastes first came to the apex court's attention as a gross violation of the Constitution's rights guaranteed under Article 21, 48 A and 51A(g). The court in this case issued certain adequate guidelines for the proper handling, disposal and treatment of healthcare wastes.

The Environment Protection Act, which seeks to protect and improve the ecosystem or the environment around us, imposes penalty (imprisonment for five years or rupees one lakh as fine) for non compliance of its directions[115] or contravention of the rules made under it[116]. And, where companies have committed the offense, the one who manages the same shall be held liable to punishment.

### 3.2. GUIDING PRINCIPLES ON WASTE MANAGEMENT

Certain generally accepted environmental principles form the basis of policies and legislations framed by the nation-states. These principles could be applied in the regulation of biomedical waste also. Firstly, "polluter-pays" principle recognizes waste generators' financial and legal responsibility in ensuring environment-friendly waste disposal. It fixes the liability on the producers of waste. Secondly, "precautionary" principle or the principle of precaution focuses on

[112] INDIA CONST. art. 48 A
[113] I.N.D.I.A. CONST. art. 51A(g)
[114] 1996 (2) SCC 594
[115] The Environment Protection Act, 1986, S. 5, Act No. 29, Acts of Parliament, 1986 (India).
[116] *Id.*

the safety and protection of health. It was recognized and adopted by the Rio Declaration on Environment and Development in 1992[117].

The Duty of care principle, on the other hand, deals with the moral or ethical responsibility to take due care. The purpose of the principle is best served when the persons dealing with the hazardous waste substances, including clinical waste, carry it out properly with due care. As per the proximity principle, hazardous wastes should, as far as possible, be disposed of at the source of origin. Lastly, the principle of informed consent requires the concerned stakeholders to be well apprised and informed about the potential risks involved and give due consent to participate in the process. It is usually applied in the case of setting up of common disposal facilities. Likewise, the polluter pays[118], proximity and precautionary[119] principles were employed by the Apex court to fix the liabilities of waste generators and lay down preventive measures to promote the ideal of sustainable development. Thus, appropriate waste management strategies must be employed to attain sustainable development, in view of the generations to come.

At the very same time, there were significant global efforts towards safe and proper management of hazardous and infectious medical wastes[120]. Various international instruments were drawn, and agencies were set up to address this global issue.

[117] United Nations Conference on Environment & Development, the Rio Declaration on Environment and Development, 1992, Principle: 15, http://www.un.org/documents/ga/conf151/aconf15126-1annex1.html (last accessed: Jul. 2, 2021).

[118] *Indian Council for Enviro Legal Action v. Union of India*, (2011) 8 SCC 161

[119] *M. C. Mehta v. Union of India*, (2004) 12 SCC 118.

[120] Shine E, *Gombajav E, Nishimura A, et. al., Health waste management in the capital city of Mongolia*, 28 WASTE MANAG. 435, (2008).

## 3.3. INTERNATIONAL CONVENTIONS & AGREEMENTS ON BIOMEDICAL WASTE MANAGEMENT

There are three major international conventions pertaining to the management of biomedical wastes with their basic goal of protecting the environment.

### 3.3.1. THE BASEL CONVENTION

The Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal[121] is an international legal instrument, specifically adapted to address the issues in transfrontier movement or trade-in hazardous and other kinds of wastes. It is a universal environmental treaty that intends to protect and save the environment as well as human health against all evils of hazardous waste. As of 2019, the Convention has 187 members[122] with global coverage of hazardous wastes, including medical wastes from hospitals, clinics, and other healthcare centers.

Tracing the history, with increased regulatory norms on environmental protection by most developed nations, the costs of waste disposal also went high in a few years[123]. This inturn prompted the private businesses as well as governments to resort to cheaper ways to get rid of these wastes[124]. And when the developing nations were ready to accept these wastes, a silent saga of international trade in hazardous wastes was born[125]. However, with the development of this trade, environmental issues began to intensify with shocking reports from the recipient countries[126]. It was an eye opener and it was at this juncture that the Basel Convention was adopted. The main aim of the Convention was to prevent illicit traffic and regulate international trade in wastes that are hazardous.

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[121] UNEP, Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Their Disposal, UNEP Doc. IG.80/L.12, 1989, http://www.unep.ch/sbc/baselcon.html (accessed on: May 5, 2021)

[122] Basel Convention- Thematic review of the United Nations High-Level Political Forum, https://sustainabledevelopment.un.org/content/documents/21789Thematic_review_of_the_UN_HLP_Basel_Convention_14.03.19.pdf (last accessed: Jul. 2, 2021)

[123] See D. Hackett, *An Assessment of the Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal*, AM. U. J. OF INTN'L LAW AND POLICY, 294 (1990).

[124] See: Brooke, *African Nations Barring Foreign Toxic Waste*, N.Y. TIMES, Sept. 25, 1988, 18, col. 1.

[125] See: Illegal Traffic in Toxic and Dangerous Products and Wastes, Report to the Secretary-General, United Nations General Assembly, 44th Session, Jul. 18, 1989, U.N. Doc. A/441362 (1989).

[126] See: C. R. Shearer, Comparative Analysis of the Basel and Bamako Conventions on Hazardous Waste, in 23 ENVIRONMENTAL LAW WASTE CONVENTIONS 141, (1993).

According to the Basel Convention, wastes (subject to transboundary movement) are hazardous, if it belongs to any of the categories listed in Annex I (such as clinical wastes from hospitals, clinics or medical centers, pharmaceutical wastes or wastes from drugs or medicines, chemical wastes etc.), or the hazard classes of which are listed in Annex III[127]. Though these wastes are not covered in the above annexes, it is considered hazardous if it is so defined by the national legislation of either of the parties to import, export or transit[128]. So, clinical waste is a recognized category under Annex I of the Convention.

The fundamental goals of the Basel Convention are:

- to minimize the toxicity and quantity of hazardous waste generation and as far as possible, to treat the wastes at the source itself
- to reduce the transit of hazardous wastes and to ensure an efficient and environmentally sound waste management
- to establish an adequate regulatory mechanism for regulating the transboundary movements of hazardous wastes (including clinical wastes).

India became a party to the Convention by duly ratifying it in 1992 and is thus, duty bound to adhere to its resolutions.

### 3.3.2. THE STOCKHOLM CONVENTION

Stockholm Convention on Persistent Organic Pollutants has been built up on the platform laid down by the Basel Convention of 1989[129] and the Rotterdam Convention of 1998[130]. The main aim of these Conventions were to protect and save the environment and human life

[127] The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Their Disposal, Art. 1, I(a), UNEP Doc. IG.80/L.12, http://www.unep.ch/sbc/baselcon.html (last accessed: Jul. 2, 2021)

[128] Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Their Disposal, Art. 1, 1(b), UNEP Doc. IG.80/L.12, available at, http://www.unep.ch/sbc/baselcon.html (last accessed: Jul. 2, 2021)

[129] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx (last visited Jul. 2, 2021)

[130] The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-14&chapter=27 (last visited: Jul. 2, 2021)

from harmful impacts of hazardous wastes and chemicals right from manufacture to its disposal.

As far as the Stockholm convention is concerned, the primary objective is the protection of the environment and human health from the P.O.P.'s (Persistent Organic Pollutants)[131]. Persistent Organic Pollutants are toxic substances contained in the fatty tissues of living organisms and are usually generated during the incineration or combustion processes of biomedical wastes[132]. Exposure to these pollutants often results in adverse consequences on health such as cancer, endocrine disruptions, reproductive disorders, birth defects, behavioural changes and even affects the growth and development of children. The Persistent Organic Pollutants (P.O.P.'s) like furans and dioxins take many years to degrade and gets accumulated in human tissues, aquatic ecosystems and thereby enters the food chain and consequently affects the environment, as a whole.

The Convention though adopted in 2001, was brought into force in 2004 and there are about 184 members as per the recent reports of 2021[133]. In 2006, a set of guidelines on the best available techniques and the provisional guidance on best environmental practices, including resource recovery, proper collection, segregation, transport, reduction and recycling of wastes[134], were released and India has ratified it. The Best Available Technical (B.A.T.) guidelines for Biomedical Waste incinerators and waste waters require the air emission levels of furans and dioxins to not exceed 0.1ng I-TEQ/Nm3 and it aims at transitioning towards alternative technologies[135].

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[131] Stockholm Convention on Persistent Organic Pollutants, 2256 U.N.T.S. 119, (2001).

[132] Priya Datta, Gursimran Kaur Mohi and Jagdish Chander, Bio-medical waste management in India: Critical appraisal, NCBI, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5784295/ (last accessed: Jul. 2, 2021, 10:33 AM)

[133] United Nations Treaty Collection, Stockholm Convention on Persistent Organic Pollutants, Chp. XXVII, available at: https://treaties.un.org/doc/publication/MTDSG/Volume%2011/Chapter%20XXVII/XXVII-15.en.pdf (last accessed: Jul. 2, 2021, 11:10 AM)

[134] Guidelines on the Best Available Techniques and Provisional guidance on Best Environmental Practices relevant to Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants, Dec 2004, at http://dev.dioksyny.pl/wp-content/uploads/Draft-BAT-BEP-Dec-2004.pdf (last accessed: Jul. 2, 2021, 11:15 AM)

[135] World Health Organization, WHO Core principles for achieving Safe and Sustainable Management of Health-Care Waste, (2007), http://www.who.int/water_sanitation_health/medicalwaste/hcwprinciples/en/index.html (last accessed: Jul. 2, 2021, 11:23 AM)

The main focus is on eliminating or reducing P.O.P. (Persistent Organic Pollutant) releases and establishing an adequate mechanism to tackle the increasing chemical pollutants. It aims at a future free of these toxic pollutants by minimizing the increased reliance of the economy upon these hazardous materials. Incineration of medical waste generates high amounts of toxic pollutants like furans and dioxins. As per the Convention, the member countries are bound to take adequate measures to reduce the listed P.O.P. emissions "with the goal of their continuing minimization and, where feasible, ultimate elimination"[136]. It advocates for safer alternatives and targets those P.O.P.s (Persistent Organic Pollutants) in action. And, it is the Global Environmental Facility, which acts as the financial mechanism for the Convention.

### 3.3.3. THE MINAMATA CONVENTION ON MERCURY

The Minamata Convention (MC) on Mercury is a global environmental treaty adopted in 2017 for the protection of human health and environment from the anthropogenic emissions or releases of mercury[137]. As per the Convention, mercury raises a global concern due to its persistent long-standing capacity to accumulate in the environment. It also causes certain adverse health effects like neurological and brain damage, kidney dysfunction, etc.

The treaty came into light in the backdrop of the Minamata disaster in Japan. Thousands of people were affected with an unknown neurological disease arising from consuming seafood contaminated with methyl-mercury. It was the result of large scale dumping of industrial wastes into the sea. This incident in turn, alarmed the world about the disastrous nature of mercury. The outcome of this realization was the conclusion of Minamata Convention, which recognized the need to address mercury as a global challenge.

The mercury releases usually arise out of biomedical, electrical, industrial and municipal wastes and have emerged as an alarming concern in most of the world's developing economies. The Minamata Convention seeks to phase-out medical equipments, pharmaceuticals and other

[136] The Stockholm Convention on Persistent Organic Pollutants, Article 5, 2256 U.N.T.S. 119, (2001).
[137] UNEP (United Nations Environment Programme), Minamata Convention on Mercury, 2013, available at: https://www.unep.org/news-and-stories/press-release/minamata-convention-agreed-nations (last accessed: Jul. 12, 2021, 3:45PM)

products that contain mercury and provides for their adequate and safe disposal. The focus is on the elimination of medical appliances with high mercury content[138].

India is one of the top anthropogenic mercury emitters in the world[139] and to reduce this emission, it has become a party to the Convention in 2014 and ratified the same in 2018. As per the 2018 reports, biomedical waste generation in India is about 520 tonnes per day which is much smaller than the e-waste and municipal solid waste generations[140]. However, medical wastes are a major source of the toxicant mercury, since it is increasingly used in medical instruments, pharmaceuticals and dentistry.

The Convention requires the parties to eliminate or reduce the mercury emissions from mining fields, incinerators, coal power plants, etc. and to ban the usage of batteries (except button-cell battery in medical devices), lamps, switches, cosmetics and soaps that contain mercury. It also addresses the issue of trade in mercury among nations. Besides this, it provides technical assistance to parties, monitors their functioning and evaluates the progress of its operations in achieving the twin goals of health and environmental protection against mercury pollution.

Likewise, as suggested by the WHO's guidelines, the governmental organizations should resort to recycling measures, use medical devices that are free from polyvinyl chloride (P.V.C.), conduct risk assessments and adopt sustainable technologies for fostering environmentally sound management of Biomedical Wastes[141]. Now let's analyze the legal framework in different nations of the world as regards biomedical wastes.

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[138] David Lennett & Richard Gutierrez, *Linking science and policy to support the implementation of the Minamata Convention on Mercury*, SPRINGER, https://link.springer.com/article/10.1007/s13280-017-1003-x (last accessed: Jul. 12, 2021, 3:55PM)

[139] Rafaj P, Bertok I, et al., *Scenarios of Global Mercury Emissions from Anthropogenic Sources*, 79 ATMOS. ENVIRON. 473, (2013).

[140] ASSOCHAM [Associated Chambers of Commerce and Industry of India], Unearthing the Growth Curve and necessities of Biomedical Waste Management in India, 2018, https://www.assocham.org/ ( last accessed: Jul. 12, 2021)

[141] World Health Organization Guidance: Safe Health Care Waste Management: Policy Paper, Geneva: World Health Organization, 2004, http://www.who.int/water_sanitation_health/medicalwaste/hcwmpolicy/en/index.html (last visited: Jul. 3, 2021).

### 3.4. POSITION IN U.S.A.

Hospital hygiene and safe management of medical wastes have become a legitimate necessity in hospitals across the world. In the United States, the 1987 incident of illegal medical garbage dumping in its beaches had prompted an immediate legislative action resulting in the enactment of the Medical Waste Tracking Act in 1988. The Act monitored the whole biomedical waste management process from the generation of the waste up to its final elimination. It acted as a regulatory measure against illegal dumping human anatomical waste, discarded body parts and other bio-hazardous wastes, imposing hefty fines on those posing a serious health threat. Guidelines on medical waste disposal were laid down under the public health law of 1389. Besides this, the NIOSH (National Institute for Occupational Safety and Health) was established to ensure the safety of health workers. Like the other developed nations, dumping medical wastes into landfills without pretreatment is prohibited. Autoclaving and sanitary landfills are the commonly used disposal and treatment facilities.

### 3.5. U.K.

Coming to the position in the U.K., there was no organized system of waste management until the 18th century. A legal definition for the term 'waste' came up only in 1992 with the passing of the Controlled Waste Regulation Act of 1992. Medical waste was recognized as a separate category. Every waste-generating healthcare facility or entity came under its purview. The Act laid down the significance of safe storage, transportation, disposal and handling of the clinical trash. As per the Agreement on International Carriage of Dangerous Goods by Road (A.D.R.)[142], clinical wastes were recognized under the dangerous goods category.

Segregation and adequate labeling of waste containers and bags were mandatory as per the rules framed. However, it is ironic that it took nearly around two centuries to formulate regulatory mechanisms regarding clinical wastes in a country like the United Kingdom.

[142] U.N. Economic Commission for Europe, Agreement on International Carriage of Dangerous Goods by Road (A.D.R.), 1968, https://unece.org/DAM/trans/danger/publi/adr/ADRagree_e.pdf (Jul. 3, 2021)

## 3.6. INDIA

THE INDIAN REGULATORY FRAMEWORK

As per the ASSOCHAM and Velocity's recent Report, India is likely to produce about 77.5 tonnes of biomedical waste p/day by the year 2022[143]. The rate is expected to increase with the current additional generation of covid19 related wastes. Mishandling of medical waste is not just a social or environmental concern but has become a complex legal issue affecting the rights of citizens. Therefore, comprehensive legal as well as judicial intervention is required to address this complex issue.

India is among the few nations to first lay down regulatory standards for the safe disposal and management of biomedical wastes. The State, by virtue of the powers conferred under Sections 6 and 8 read with S. 25 of the Environment Protection Act had enacted the Biomedical Waste (Management and Handling) Rules, 1998[144]. It aims at controlling and managing the disposal and treatment of hazardous medical wastes. It seeks to manage different activities like collecting, operation, treatment, disposal and transportation of wastes.

The 1998 Rules applied to all those engaged in the generation, collection, storage, treatment, disposal, handling or transportation of these biomedical wastes, in whichever form[145]. These Rules were further amended in 2000 and 2003. Though new draft rules were framed in 2011[146]Stipulating the application of Rules to every occupier regardless of outpatient service, laying down operator's duties, etc. It was not worked out due to a lack of common consensus in categorizing and fixing the standards. Thereafter, a new set of rules titled the Bio Medical Waste Management Rules, 2016 was enacted in 2016 by the Ministry of Environment, Forest and Climate Change. The main purpose behind the new rules was to address the lacuna in the earlier

[143] ASSOCHAM Velocity study, ASSOCHAM and Velocity, http://www.biovoicenews.com/wp-content/uploads/wp-post-to-pdf-enhanced-cache/1/indias-medical-waste-growing-7-annually-assocham-velocity-study.pdf (last accessed: Jul. 3, 2021, 11:35 AM).

[144]Biomedical Waste (Management and Handling) Rules, 1998.

[145] The BMW, Biomedical Waste (Management and Handling) Rules, 1998, Rule 2.

[146] The draft Biomedical Waste (Management and Handling) Rules, 2011

Rules regarding the regulation of biomedical waste disposals. These rules were modified again in 2018[147] and 2019[148], respectively.

The 2016 Rules laid down the operator's duties and applies to every occupier irrespective of the facilities they afford. It has brought in an exclusionary clause as regards radioactive and other hazardous wastes and biomedical wastes are classified into 4 colour codes as per the new rules. In contrast, the wastes were classified into ten different categories under the 1998 Rules. Also, the number of schedules was reduced to IV as per the new Rules. Outsourcing for disposal was not compulsory under the former Rules while it has been strongly recommended in the latter.

As regards segregation, cytotoxic drugs and chemical wastes were discarded in black bags as per the 1998 Rules while the new Rules provided for their disposal in yellow plastic containers. Likewise, while metal sharps were disposed of in white bags under the earlier rules, they are now using yellow bags. A significant change to be noted is that, while the 1998 Rules aimed at the disposal of wastes, the 2016 Rules focus more on recycling medical wastes.

The 2018 Amendment to the Rules brought in a few minor changes regarding the CPCB's (Central Pollution Control Board) 2019 Guidelines and the Plastic Waste Management Rules of 2016. One of the aims was to wipe out the usage of 'chlorinated plastic' containers, gloves and bags (except blood bags) by 2019. The 2019 Amendment was made to insert an explanation to R. 4(d) as regards ‘Chlorinated plastic bags,’ to not include effluent bags, abdominal or urine bags, etc.

### 3.6.1. THE BIOMEDICAL WASTE MANAGEMENT RULES, 2016

The preamble to the Rules emphasized that it aimed to improve in the collection, processing, treatment, segregation, disposal and transport of biomedical wastes in a manner, which is environmentally sound[149], so as to reduce waste generation and its harmful impacts. The application of the new Rules was extended to hospitals, dispensaries, clinics, nursing homes, laboratories, clinical establishments, blood banks, vaccination and other medical

[147] Biomedical Waste Management (Amendment) Rules, 2018
[148] Biomedical Waste Management (Amendment) Rules, 2019
[149] The Biomedical Waste Management Rules, 2016

camps[150]. However, its application is restricted to radioactive wastes, hazardous wastes and chemicals, e-waste and solid wastes, etc. There are separate rules and regulations promulgated under the Environment Protection Act, 1986.

The new Rules had defined the term 'healthcare facility' to mean a place for immunization, diagnosis or treatment of humans or animals, regardless of the size or activities of the healthcare system[151]. It has given a broad definition for the term 'occupier'[152] and laid down his duties. The occupier is bound to assure that the squander created do not pose any unhealthy consequences. The term 'operator'[153] was also defined on similar lines as that of the 1998 Rules, as a person owning the CBMWTF (Common Bio-medical Treatment Facility).

The Rules consist of mainly 18 Rules and 4 schedules. The first schedule deals with different categories of waste classified on the basis of its accumulation, segregation, handling, treatment and disposal methods. While the second Schedule lays down the standards for disposal and treatment, the third Schedule is concerned with the duties and responsibilities of various authorities under the Rules. Lastly, Schedule IV deals with the labeling of biomedical waste bags and containers.

The Biomedical Waste Management Rules, defines the term "bio-medical waste" as, *'any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining to that or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules*'[154].

[150] The Biomedical Waste Management Rules, 2016, Rule 2(1)

[151] The Biomedical Waste Management Rules, 2016, Rule 3(j)

[152] The Biomedical Waste Management Rules, 2016, Rule 3(m): Occupier means 'a person having administrative control over the institution and the premises generating biomedical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, healthcare facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called.'

[153] The Biomedical Waste Management Rules, 2016, Rule 3(n): 'Operator of a common bio-medical treatment facility' means 'a person who owns or controls a Common Bio-medical Treatment Facility (C.B.W.T.F.) for the collection, storage, transport, treatment, disposal or any other form of handling of biomedical waste.'

[154] The Biomedical Waste Management Rules, 2016, Rule 3(f)

The different categories of waste as colour coded by the 2016 Rules include:

| Category | Waste Type | Type of Containers or Bags to be used | Treatment and Disposal options |
|---|---|---|---|
| **1.Yellow** | **(a)** Human Anatomical Waste (human organs, tissues, body parts, fetus below the viability period etc.)<br>**(b)**Animal Anatomical Waste (animal carcasses, tissues, body parts, including experimental wastes) | Yellow colour plastic bags (non-chlorinated) | Incineration, plasma pyrolysis or deep burial |
| | **(c)** Soiled Waste (plaster casts, bandages contaminated with body fluids like blood) | | Incineration, autoclaving or micro-waving. |
| | **(d)** Discarded Medicines like cytotoxic drugs or antibiotics-with plastic ampoules, vials etc. | Yellow colour-<br>(non-chlorinated) | Returned back to the manufacturer for Plasma Pyrolysis or incineration at >12000C temperature |
| | **(e)** Chemical Waste (Eg. discarded disinfectants). | Yellow colour plastic bags | Incineration, Plasma Pyrolysis or Encapsulation |
| | **(f)** Chemical Liquid Waste<br>liquid used in X-ray film making, discarded Formalin, body fluids, liquid wastes from labs, etc. | Separate effluent treatment system | Pre-treated & discharged in accordance with the Schedule III norms. |
| | **(g)** Discarded linen & beddings (contaminated with body fluids) | yellow plastic bags | Non- chlorinated chemical disinfection. |
| | **(h)**Biotechnology, Microbiology & other laboratory wastes (cell cultures, stocks & specimens). | Autoclave safe plastic bags or containers | Pre-treatment - on-site sterilization, followed by incineration |
| **2.Red** | Contaminated Recyclable Waste | Red colour plastic bags | Autoclaving, micro-waving |

| | | | |
|---|---|---|---|
| | (bottles, tubes, catheters, needleless syringes, gloves, etc.) | (non-chlorinated) | followed by shredding and recycled. |
| **3.White** | Waste sharps including Metals, discarded needles, scalpels, blades and other contaminated sharps. | Leak, tamper & puncture proof containers | Autoclaving, Dry Heat Sterilization, sanitary landfills or concreted waste sharp pits. |
| **4.Blue** | (a) Discarded or Broken Glassware (free from cytotoxic substances)<br>(b) Metallic Bodily Implants | Blue coloured cardboard box with label | Disinfection, microwaving or hydroclaving and then recycling. |

Source: Bio-Medical Waste Management Rules, 2016

## 3.7. **MANAGEMENT OF BIOMEDICAL WASTES**

Management of biomedical waste implies the procedures or steps to be followed to protect the environment and human health from any kind of adverse consequences arising out of the poor handling of wastes. It aims at achieving a safe, secured and economical disposal of wastes from diagnosis and treatment[155].

### 3.7.1. Storage, segregation, packaging & transportation


[155] *G. J. Multiclave (India) Pvt. Ltd. v. The State of Telangana*, W.P. No. 19727 of 2016. Sep. 1, 2017 (A.H.C.), 3.

The key to effective healthcare waste management is the segregation or classification of waste into certain well-defined categories. The task of segregation of untreated medical wastes into different bags and containers with proper labeling lies with the generator of waste[156].

### 3.7.2. Labelling

The waste-laden bags or containers are labeled to trace their origin and monitor the volume of wastes generated from each area. It usually contains the details of the particular healthcare facility, the time and date of collection, etc. Most often, the globally accepted biohazard symbol is used to mark the biomedical waste containers.

After that, it is the duty of the operator to transport the same to an off-site treatment facility. As regards storage, untreated biological waste materials (e.g. anatomical waste) should not be kept beyond 48 hours. Likewise, laboratory wastes have to be sterilized or disinfected before packaging and transfer to treatment sites.

LABEL FOR BIO-MEDICAL WASTE CONTAINERS/BAGS


### 3.7.3. Bar Coding System

The Rules of 2016 had stipulated an institutionalized barcoding system to track and trace the collection, treatment, disposal and recycle of healthcare waste. As per the provisions, the occupier of a healthcare facility had to establish a system of barcoding with respect to the

[156] Bio-Medical Waste Management Rules, 2016, Rule 8.

containers sent for disposal[157], and the operators of CBMWTFs had to establish the barcoding system as well as the GPS (global positioning system) for handling the biomedical wastes[158].

### 3.7.4. Liability of occupiers and operators

It is the owner or occupier of a healthcare facility or an operator of a treatment facility who is responsible for the environmental damages or damage caused to the public health resulting from an improper waste management[159]. They are liable to an action under Sections 5 and 15 of the Environment Protection Act for violation of the provisions of the Rules. The Rules laid down the responsibilities of an owner of occupier of a healthcare facility, such as, storing the segregated waste in color-coded bins, pre-treatment of laboratory wastes, ensuring the safe handling of waste by health workers, etc.

The occupier was bound to ensure that waste handling does not cause any harm to the environment or human health. He should provide for safe and secure storage of isolated medical wastes in accordance with Schedule I and make arrangements for pre-treatment of laboratory waste, blood samples, etc., through on-site sterilization and disinfection as prescribed by the WHO[160] and then provide for the final treatment and disposal[161].

## 3.8. DISPOSAL AND TREATMENT OF BIOMEDICAL WASTE - THE WASTE MANAGEMENT TECHNIQUES

Biomedical waste has to be treated and disposed of in accordance with Schedule I of the Rules and also in compliance with the standards prescribed under Schedule II by the health care facilities and common bio-medical waste treatment facility[162]. As per the Rules, a "bio-medical waste treatment and disposal facility" means any facility wherein treatment, disposal of bio-

[157] Bio-Medical Waste Management Rules, 2016, Rule 4(i)
[158] Bio-Medical Waste Management Rules, 2016, Rule 5(c)
[159] Bio-Medical Waste Management Rules, 2016, Rule 18
[160] World Health Organization, Guidelines on Safe Management of Wastes from Healthcare activities, 2014, https://www.euro.who.int/__data/assets/pdf_file/0012/268779/Safe-management-of-wastes-from-health-care-activities-Eng.pdf (accessed on: Jul. 3, 2021)
[161] The Bio-Medical Waste Management (Amendment) Rules, 2018
[162] The Biomedical Waste Management Rules, 2016, Rule 7(1)

medical waste or processes incidental to such treatment and disposal is carried out and includes common bio-medical waste treatment facilities[163]. The occupier has to send the segregated waste to a common bio-medical waste treatment facility for the purpose of treatment and its final disposal[164]. There is a proviso to this clause stating that infectious and laboratory wastes have to be pre-treated through processes like autoclaving or microwaving before its final disposal.

Likewise, where there is no common facility for treatment available, equipments like incinerators, microwaves, autoclaves, shredders, etc., could be used by the occupiers with the prior permission of the concerned authorities. There are different waste management techniques available for the disposal and treatment of healthcare wastes such as:

### 3.8.1. OFF-SITE WASTE DISPOSAL MEASURES:

Degradation or decomposition of clinical wastes at the site of generation is not always possible and as such they are moved to terminal areas and other off-site disposal methods are resorted to. Some of the measures include:

- Incineration

Incineration is a thermal oxidation process of combustion at high temperatures (>1000C), reducing the organic compounds into inert substances and enabling easy decomposition. It involves converting solid waste particles into gaseous form, which is again treated before releasing into the atmosphere. It reduces the waste mass to about 96% depending upon the composition of particles. As per the United States E.P.A. (Environmental Protection Agency), roughly about 80% of healthcare wastes generated yearly are burned[165]. The energy or the electricity generated during the whole process is of high demand in European nations.

Rotary kiln, multiple hearths, liquid injection, catalytic combustion, etc., are some of the different incinerators. The incineration of biomedical wastes has to be

[163] The Biomedical Waste Management Rules, 2016, Rule 3(g)
[164] The Biomedical Waste Management Rules, 2016, Rule 7(2)
[165] Lee C. C., G.L. Huffman, et al., *Medical Waste Management: the state of the art*, U.S. E.P.A., Office of Research & Development, Cincinnati, OH, (1991).

conducted in controlled facilities ensuring complete combustion and reduction of adverse consequences on the environment[166]. In *B. L Wadehra v. Union of India*[167], the Apex Court issued certain directions to the central government and the Delhi Municipal Corporation and even to A.I.I.M.S., Delhi to erect and establish incinerators by all hospitals and nursing homes for disposing of the clinical wastes generated.

Most of the incinerators have inbuilt pollution control systems to clean up the toxicity in medical wastes. Medical wastes are usually burnt through prefixed hearth incinerations with air control systems. The material particles are burned or incinerated. What remains is the incombustible part known as the bottom or fly ash, which can be deposited along with the municipal waste (if non-hazardous). If hazardous or toxic, the fly ash should be disposed of in accordance with hazardous waste management facilities.

Incineration is a popular method applied to dispose of the animal or human anatomical waste, laboratory waste, discarded medicines, etc. However, it is unsuitable for wastes involving chemical reactants such as disinfectants, gas containers, radiological wastes, etc. The 2016 Rules[168] lays down the incineration standards and as per its operation standards, there should be a combustion efficiency of at least 99% at a minimum temperature of 800 degree Celsius. The Rules have also prescribed the emission standards of incinerators especially, concerning furans and dioxins (0.1ngTEQ/Nm3), which had to be complied within two years. The operator or occupier is bound to regularly monitor the gaseous emissions and report the same to the concerned Pollution Control Boards.

However, incinerators are against the fundamental principles and basic spirit of the Basel Convention, Kyoto Protocol, etc. There exists a strong opposition against incinerators across various nations of the world. It is completely banned in countries like the Philippines.

[166] Thornton. J, et al., *Hospitals and plastics, Dioxin prevention and medical waste incinerators*, 111(4) PUBLIC HEALTH REP. 298, (1996).
[167] (1996) 2 SCC 594.
[168] The Biomedical Waste Management Rules, 2016, Schedule II

- Land Disposal

Landfills are specially designed for disposing of wastes into the land through pits or open dumps. But, the open dumping of biomedical waste is prohibited. Deep burial of medical wastes is permitted in rural areas without adequate treatment facilities. And it should be done only with the prior approval of the prescribed authorities[169].

It is usually resorted to after the processes of shredding, treatment and decontamination of waste. At times, even contaminated and untreated wastes are also dumped into these landfills. Systematic techniques like inertization, plastic encasing, molten glass technique etc., prevent leaching. The encapsulation technique is used for disposing of pharmaceutical wastes and sharps in containers filled with cement or clay. The Inertization technique on the other hand involves mixing up of the medical wastes with materials like cement to prevent its seepage into ground water.

Specially constructed concrete sanitary landfills provide for a safe disposal of medical wastes, reducing the risks of water and soil contamination. Bioreactor landfills help in decomposition of biodegradable waste particles like laboratory wastes after proper treatment. Selection of appropriate disposal sites after a due environmental assessment is as important as the management of medical wastes. It should not be constructed near residential areas, waterbodies, wells, forests or an area prone to floods or erosion. The burial pits should have a depth of at least 2 meters and is to be sealed with galvanized iron slabs. However, hazardous and corrosive wastes are kept out of the purview of sanitary landfills.

- Plasma Pyrolysis

The by-products of human activities are often used as a fuel in harnessing energy. Plasma Pyrolysis is a thermal process through which the waste materials are treated or processed at high temperatures to generate energy. It is an environmentally sound technique using plasma to break down organic compounds in wastes to

[169] Biomedical Waste Management (Amendment) Rules, 2018, Schedule II.

commercially useful products. It assures a high conversion rate of more than 99%. The installation costs are almost the same as that of incinerators but unlike incineration, it produces only commercially viable by-products. The thermal efficiency is higher and CO2 emissions are much less as compared to incineration. It is most suited for the disposal of anatomical wastes (both animal and human), chemical wastes and contaminated recyclable wastes. The emission and operating standards laid down for incinerators are also applicable to Gasification or Plasma Pyrolysis[170].

It is a fast heating technique whereby, the ultraviolet radiation from the burner destroys and treats the pathogenic substances in medical waste and the residue is safe to be deposited with the general waste. Thus, this method ensures a safe and secure disposal of medical wastes[171].

### 3.8.2. ON-SITE TREATMENT OF MEDICAL WASTE

In a notable decision by the Gujarat high court, it was held that, permitting the biomedical waste disposal without processing it, poses a greater evil, leading to a serious health hazard[172]. Processing or pre-treatment of hospital wastes such as blood samples, microbiological wastes, blood stained instruments etc., through sterilization was essential to deactivate the presence of harmful components. On-site sterilization has to be conducted in accordance with the WHO guidelines on Safe management of healthcare wastes, 2014[173].

- Autoclaving

The thermal treatment facility of autoclaving is often used to disinfect pathogenic and infectious wastes like surgical dressings and sharps. It uses heavy pressurized containers at high steam and temperature to destroy pathogens and bacteria in medical wastes. It is a popular as well as a reliable sterilization method using saturated steam and pressure to reduce toxicity of the bio-hazardous trash. These are mostly automated reducing risks of needle-prick injuries and other exposures.

[170] Biomedical Waste Management Rules, 2016, Schedule II.
[171] Katoch S.S., *Biomedical waste classification and prevailing management strategies*, Proceedings of the International Conference on Sustainable Solid Waste Management, 169, (2007).
[172] *Whether the case is involving a substantial question of law v. State of Gujarat*, S.C.A. No: 12235 of 2017, Sep. 21, 2017 (G.H.C.), 59.
[173] *Supra* note: 161

The decontaminated and toxic free waste materials are then transported to bio-medical waste disposal sites for their safe disposals. It is an inexpensive, nontoxic, rapid and environmentally sound technique, which is easy to operate and monitor. It is highly recommended for the destruction of microbiological and disease-causing pathogens. However, an autoclave cannot treat medical wastes involving chemical substances, such as chemotherapy waste or toxic drugs.

Medical waste are not considered to be fully treated unless, the temperature, pressure and time indicators of an autoclave indicate the same[174]. The 2016 Rules lay down certain validation tests for an autoclave which every operator or occupier is bound to observe.

- Chemical disinfection or treatment

Chemical treatments are done to deactivate the pathogenic particles in liquid wastes and purify them before being discharged into the drains. This is usually done on sites to avoid any spillage or leakage of these liquid substances. Before the discharge of liquid wastes, the owner or occupier should ensure that the pH level of the water is within a range of 6.5-9.0, and that suspended particles, grease and oil level are all within the permissible limits[175].

It is also used to sterilize and shred the chemical particles in other hospital wastes before its final disposal. The process is carried out using disinfectants like chlorine, calcium oxide or sodium hydroxide. The application of 1 or 2% sodium hypochlorite[176] with 30% of chlorine reduces the efficacy of pathogens and other microorganisms in medical wastes. However, wastes to be sterilized by Plasma Pyrolysis should not be treated using these chlorinated disinfectants due to its explosive nature.

- Microwaving

Like most other sterilization methods, this electromagnetic radiation technique also uses heat or thermal power to decontaminate the toxicity of medical wastes. Microwave radiation is mostly suitable for treating the sludge or semi-solid

[174] Bio-Medical Waste Management Rules, 2016, Rule 8
[175] *Supra* note: 150
[176] *Supra* note 148

substances in healthcare waste. The heatwaves or radiations from the microwave increase the semi-liquid substance's temperature level to about 100 degree Celsius, releasing energy. The medical wastes have to be shred into smaller pieces and have to be wet to enable easy penetration. A humidifier can also be used if the wastes are too dry; it is the moisture in them which enables the steam or waves to reach out to the infectious microbes. The whole process makes the medical garbage nontoxic and non-infectious, facilitating its safe deposition into landfills.

Microwaving is less expensive as compared to incineration and can even melt the used syringes. However, as per the U.S. Environmental Protection Agency, the technique it is not always suited for the destruction of pathological waste. As per the 2016 Rules, microwaving is not applicable for treating cytotoxic substances, radioactive wastes, contaminated body parts, animal carcasses or hazardous and heavy metals in India.

- Recycling

  Though contaminated, there are certain categories of medical wastes which could be segregated, treated, sterilized and recycled, with due permission from the concerned authorities, such as plastic bottles, tubes and glass equipments. For this, the occupiers and operators have to maintain records regarding the waste materials sent for recycling purposes which shall be subject to an inspection by the prescribed authorities[177].

### 3.9. AUTHORITIES PRESCRIBED UNDER THE RULES

The Biomedical Waste Management Rules prescribe a list of authorities to be in charge of medical waste management and are entrusted with implementing and enforcing the Rules. It includes:

1. The MoEFCC (Ministry of Environment, Forest and Climate Change)
2. Ministry of Health and Family Welfare (MoHFW)
3. The Central Ministry for Animal Husbandry and Veterinary
4. MoD (Ministry of Defence)
5. Central Pollution Control Board (CPCB)

[177] The Biomedical Waste Management Rules, 2016, Rule 7(10)

6. SPCBs (State Pollution Control Boards) or PCC (Pollution Control Committees)
7. Municipalities or Corporations, Gram Panchayats and Urban Local Bodies.

The functions of each of these authorities are clearly set out in Schedule III of the Rules.

3.9.1. Prescribed Authority

There are committees and boards constituted for the implementation of waste management Rules, depending on whether it is a Union territory or State. The State Pollution Control Boards are the prescribed authorities for implementing the Rules in States[178]. It grants authorization for healthcare and waste treatment facilities upon an application by the operator or occupier. The procedure for grant, revocation or cancellation of authorization has been provided under Rule 10 of the 2016 Rules. There is also a provision for appeal to the Secretary of State Government against the prescribed authority's order[179]. The authorized persons are bound to maintain adequate records on production, accumulation, storage, treatment, and handling of wastes, according to the government's or C.P.C.B.'s guidelines.

Besides this, there is an advisory committee under the health secretary's chairmanship to supervise and advice on the improvements in the existing Rules. The Committee consists of the representatives of various Departments, Pollution Control Boards, Municipal Corporation, etc.[180]

- The Ministry of E.F.C.C. (Environment, Forest and Climate Change)

This Ministry frames policies, notifications, and amendments on waste management Rules from time to time. It regularly monitors the enforcement of Biomedical Waste Management Rules' enforcement and provides financial assistance and adequate training to the Boards and its members.

[178] The Biomedical Waste Management Rules, 2016, Rule 9(1)
[179] The Biomedical Waste Management Rules, 2016, Rule 16
[180] The Biomedical Waste Management Rules, 2016, Rule 11.

- Central Pollution Control Board

Some of the functions of the Central Pollution Control Board as provided under Schedule III of the Rules include:

- To prepare and submit new guidelines to the Ministry
- To coordinate the activities of various State Boards
- To lay down specifications and standards regarding the operation of new technologies and specifications regarding disposals or treatment, etc.
- To lay down the specifications regarding the establishment of treatment facilities for biomedical waste
- To inspect and monitor health care and treatment facilities
- To assist (technical or financial) to research in biomedical waste.
- To review the reports of State Pollution Control Boards and to compile them for submission before the concerned Ministry.

- The State Pollution Control Authority- the Boards and Committees

Some of the functions of the State Boards or Committees (in respect of Union Territories) include:

- Compilation of data on production and disposal of healthcare wastes
- Submission of the annual report to CPCB (Central Pollution Control Board)
- To grant, renew, cancel or refuse authorization under Rules 7 and 8
- Monitor the implementation of the Rules in States and ensures compliance with the authorization conditions
- To take action against any violation or non-compliance with its provisions by owner or occupier (Rule 18)
- Facilitate and organize training programs for its staff on hospital waste management
- To perform any other duties as assigned to it by the concerned Ministry through rules and guidelines.

## 3.10. CONCLUSION

Thus, the primary duty of every healthcare administrator is to ensure proper management of hospital wastes in a safe, sound & eco-friendly manner. However, it has been about five years since the Management Rules for Biomedical Waste were notified, and no such significant improvements are evident in any key area. The process is all tricky as it has become all the more complex with the COVID-19 scenario, alarming the need to renew the authorities' focus on the matter, which is not merely directory but mandatory.

# CHAPTER 4

# THE SYSTEM OF BIOMEDICAL WASTE MANAGEMENT IN INDIA - AN ANALYSIS

## 4.1. INTRODUCTION

The depletion of resources on one hand and demand for more and more resources had laid stress on the efficient management of the existing resources. The management of healthcare waste is an issue requiring urgent insistence in the developing as well as the developed nations of the world due to its environmental, economic, and social impacts[181]. With the ever-increasing population and rise in the number of healthcare institutions, the medical wastes are also escalating on a day to day basis[182]. The WHO's report on about twenty- two developing nations, including India, revealed that around 18% - 64% of the healthcare institutions have a poor healthcare waste management[183].

Waste management is something that involves a cost, an initial investment. So most of the healthcare establishments outsource their waste to external agencies (waste treatment facilities) and thereby evade the investments involved and the restrictive environmental regulations[184]. Selection of an adequate medical waste treatment facility is a crucial task depending on the experience[185], environmental regulations, governmental policies, and costs involved. Through an amendment in the 1998 Rules, the common treatment facility for biomedical wastes was brought in.

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[181] Gumus, T. A., *Evaluation of hazardous waste transportation firms using a two-step fuzzy-AHP and TOPSIS methodology*, 36 EXPERT SYST. APPL. 4067, (2009).

[182] Thakur. V & Ramesh. A., *Analyzing composition and generation rates of biomedical waste in selected hospitals of Uttarakhand, India*, 20(2) J. MATER. CYCLES WASTE MANAG. 878, (2018).

[183] Zhang, H. J., Zhang, Y. H., et al., *Investigation of medical waste management in Gansu Province, China*, 31(6) WASTE MANAG. RES. 656, (2013).

[184] Liao C. J., & Ho C. C., *Risk management for outsourcing biomedical waste disposal–using the failure mode and effects analysis*, 34 WASTE MANAG., 1324, (2014).

[185] Thakur, V., & Ramesh, A., *Healthcare waste management research: A structured analysis and review (2005–2014)*, 33(10) WASTE MANAG. RES. 856, (2015).

Common Biomedical Waste Management Treatment Facility

According to the Biomedical Waste Management Rules of 2016, "bio-medical waste treatment and disposal facility" means any facility whereby treatment and disposal of bio-medical waste or processes incidental to such treatment and disposal is carried out and includes common bio-medical waste treatment facilities[186].

A common disposal facility operator must obtain the requisite authorization from the concerned SPCB (State Pollution Control Board). The operator is paid a certain amount for the accumulation, conveyance, and treatment of the healthcare waste from healthcare facilities as per the beds the facility has. According to this facility, the wastes generated from different healthcare units are treated under one roof. The municipal authorities have been entrusted with the task of finding a suitable disposal site.

There are about 2, 40 000 healthcare facilities in India that generate 557 tons of medical wastes per day, and out of this, only 198 CBWTFs (Common bio-medical waste treatment facilities) and around 9000 healthcare facilities has the capacity and technological requirements to dispose of the wastes[187]. Even if these facilities are combined, only 518 tons could be processed, which falls short of the total production of 557 tons per day[188]. But the site and land requirements for Biomedical Waste Treatment facilities are not complied with, in most States.

## 4.2. FACTORS AFFECTING THE MEDICAL WASTE MANAGEMENT SYSTEM

Evaluation of an effective system of medical waste management depends on the following factors:

- Experience

Adequate waste management depends on the access of healthcare institutions to necessary skills and expertise[189], experienced staff members[190], their performance[191], etc. The performance

[186] The Biomedical Waste Management Rules, 2016, R. 3(g)
[187] Ministry of Environment, Forest and Climate Change, Annual Report, § 89, 2018-19, http://moef.gov.in/wp-content/uploads/2019/08/Annual-Report-2018-19-English.pdf (last accessed: Aug. 25, 2021)
[188] *Id.*
[189] Dickson, G. W., An analysis of vendor selection systems and decisions, 2 J. PURCH. 11, (1966).

history of waste disposal systems enables the hospital administrators to choose the right waste treatment facilitators.

- Relationship

The relationship and attitude of healthcare and waste disposal facilities towards workers, their role in ensuring the well-being of the community, the safety of waste collectors, etc., plays a significant role.

- Environmental factors

The geographical location[192] of the waste treatment facility has a significant impact in analyzing the effectiveness of the system. It has to be located away from the city considering the treatment plants' emission of harmful gaseous substances. It also depends upon how hygienic and safe[193] the treatment mechanisms are maintained, the extent to which environmental regulations are implemented, the level of pollutants emitted[194] from healthcare wastes etc.

- Economic aspects

The financial position of occupiers or operators[195], discounts offered to customers, the operational costs[196] incurred in running the treatment facility etc., are some of the economic factors.

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[190] Ho, C. C., *Optimal evaluation of infectious medical waste disposal companies using the fuzzy analytic hierarchy process*, 31 WASTE MANAG 1554, (2011).
[191] *Id.*
[192] Senthil, S., Srirangacharyulu. B, et al., *A robust hybrid multi-criteria decision-making methodology for contractor evaluation and selection in third-party reverse logistics*, 41(1) EXPERT SYST. APPL. 51, (2014).
[193] Dursun, Mehtap, Karsak, et al., *A fuzzy multi-criteria group decision making framework for evaluating healthcare waste disposal alternatives*, 38(9) EXPERT SYST. APPL. 11455, (2011).
[194] Thakur V., Mangla, S. K., *Change management for sustainability: Evaluating the role of human, operational and technological factors in leading Indian firms in home appliances sector*, 213 J. CLEAN. PROD. 852, (2019).
[195] Ho. W., Dey, K. P., et al., *Multi-criteria decision-making approaches for supplier evaluation and selection: A literature review*, 202(1) EUROPEAN J. OPER. RES. 19, (2010).
[196] Gumus, T. A., *Evaluation of hazardous waste transportation firms by using a two-step fuzzy-AHP and TOPSIS methodology*, 36 EXPERT SYST. APPL. 4067, (2009).

- Technological factors

Various technological advancements like the GPS facility for vehicles carrying biomedical waste, barcoding system to trace out the pathway of waste containers[197], etc. are some of the determining technological factors in analyzing the efficacy of the whole system of waste management.

### 4.3. WHO's BLUE BOOK ON HEALTHCARE WASTE

The World Health Organization's (WHO) "the Blue Book" on the Safe, Sustainable and Affordable Management of Health-Care Waste, 2014[198] lays down the regulatory principles that guide the making of national legislation and its practical application to tackle the biomedical waste disposal issues. It prescribes specific measures and techniques for the segregation, reduction and decontamination of healthcare wastes. As per WHO's Blue Book, a national level policy adopted on the management of biomedical waste should be one, which reflects the problems and needs of a country as well as upholds the relevant principles of international treaties and conventions, governing public health, environment and the safe hazardous waste management. And once it is drafted, the supporting regulations and rules could be developed in accordance with the changing needs. An effective regulation addresses the role of healthcare professionals and workers and lays down the guidelines for its enforcement. In the light of this document, let's analyze the existing Biomedical waste management Rules.

### 4.4. AN ANALYSIS OF THE INDIAN LEGAL FRAMEWORK ON BIOMEDICAL WASTE

The 1998 Rules[199] were a cause for jubilation as the first enactment on the healthcare waste management and disposal. However, it miserably failed to attain its objectives that the guidelines were mostly on paper without getting implemented. The sole reason for this could be attributed to the lackadaisical manner in which the government had handled it in creating awareness among the public and in ensuring its proper implementation. Many regions were under the dearth of its

[197] Saberi, S., Sarkis, J., et al., *Blockchain technology and its relationships to sustainable supply chain management*, 57(7) INT. J. PROD. RES. 2123, (2019).
[198] *Supra* note: 161
[199] Ministry of Environment and Forests Notification, Biomedical Waste (Management and Handling, 1998) Rules, New Delhi: Government of India Publications, 1998.

benefits to mitigate the risks posed by medical wastes. Against this background, the Biomedical Waste Management Rules, 2016 was promulgated, providing a new outlook to the country's waste management scenario.

The 2016 Rules came up with a positive sign extending its application to clinical establishments, vaccination camps, research laboratories, camps for blood donation, etc. Likewise, it had reduced the clinical waste categories to four, while there were about ten categories of biomedical wastes under the 1998 Rules. This, however, does not imply eliminating any of the categories, but they were combined into four color codes to ease the waste segregation process. It has provided a barcoding system to track waste containers or bags. It helps identify the generator and the mode of disposal in case of any violation of the norms of the CMBWTF (Common Bio-Medical Waste Treatment Facility).

Inspite of these regulations, the management of the wastes in the healthcare sector faces several challenges. The new rules had failed to produce the desired results. It has laid down different disposal and treatment options for bio-medical wastes. But in crowded cities, it is difficult to find suitable waste disposal sites especially those amidst residential areas that pose a serious health threat to the people in neighborhood. The law has prescribed specialized agencies for the disposal and handling of medical wastes. However, several establishments outsource it to private agencies or dump it into garbage sites for municipal wastes, which can lead to the spread of infectious diseases. Outsourcing waste disposals to private agencies (Eg., REEL, IMAGE, etc.) is very common in modern-day healthcare, mainly by small clinics that cannot afford the cost of disposal. Illegal disposals, violating the regulatory norms are rampant across the country. Segregation of medical trash is not often done at the on-site site or at the source. Instances of mixing up biomedical wastes with the general waste in municipal waste dumping sites are a common sight**.** It is the sanitation workers or the rag pickers who are more prone to its aftereffects.

Infectious wastes are generated from hospitals as well as laboratories, but only about 40% follows an adequate waste disposal plan, and the rest passes on to the municipal garbage without any consideration of its toxicity[200]. In a study conducted by Suruchi Pandey et al., it was

[200] Suruchi Pandey et al., *Bio-Medical Waste Management –a review of practices adopted by hospitals in Pune City*, 3(2) INDIAN J. FORENSIC COMMUNITY MED 110, (2016).

found that the staffs were not aware of the different colour codes for bio-medical wastes; all they knew was the 'yellow bag'[201]. They were not given adequate training or made aware of the resultant harm in handling hazardous medical waste, including contaminated sharps. There was a lack of awareness on the consequences of waste dumping and storage in the open[202] that, wastes were kept under patients' beds. Besides this, there were no separate lifting options for carriage of these toxic wastes and chances of spread of infections were high, mainly when these hospitals were located in residential areas.

Likewise, another survey conducted in Pune revealed that, a majority of hospitals and clinics were not aware of the existence of the management Rules regarding Biomedical waste[203]. That is, 45% of them were ignorant about the current scenario, 62% were not aware of the delicacy of the issue and about 55% of the staff had no adequate knowledge on waste collection, classification and treatment[204]. About 60 to 90 percent of hospitals did not possess any treatment mechanisms such as shredders, chemical disinfection, encapsulation or even incinerators and the position in states like Bihar, Jharkhand and West Bengal was that, more than 70% of the hospitals, neither segregated their wastes nor linked to a common treatment facility (CBWTF)[205].

As per the study conducted by the Centre for Science and Environment, 2017, it was found that Jharkhand had disposed about 2,200 kg untreated waste, constituting around 40% of the total wastes generated[206]. While all healthcare facilities must comply with the standards laid down by the Biomedical Waste Management Rules, the study reveals that on an average of 14 out of 19 healthcare institutions failed to comply with its procedures. It is significant to note

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[201] *Id.*
[202] *Id.*
[203] Dr. Anjali Acharya, Dr. Vasudha Ashutosh, et al., *Impact of Biomedical Waste on City Environment: Case Study of Pune, India*, 6(6) IOSR J Appl. Chem. 25, (2014).
[204] *Id.*
[205] World Health Organization, Report on Health-Care Waste Management (HCWM) Status in Countries of the South-East Asia Region (No: SEA-EH-593), 2017, https://apps.who.int/iris/handle/10665/258761 (accessed on: Aug. 25, 2021)
[206] Centre for Science and Environment, Over 40 per cent of bio-medical waste generated in Jharkhand goes untreated, seriously endangering public health: CSE's new study, https://www.cseindia.org/over-40-per-cent-of-bio-medical-waste-generated-in-jharkhand-goes-untreatedseriously-endangering-public-health-cse-68 (last accessed: Aug. 25, 2021)

that, most of these hospitals were unaware of the strict regulatory provisions under the Rules (R. 15) as regards the reporting of accidents within 24 hours of its occurrence[207].

Hyderabad, a leading producer of pharmaceutical waste in India, poses a severe threat to the ecosystem and health of its people. The water bodies are foaming, lakes are shrinking day by day and the toxic gas emissions from waste burners make these waters no longer fit for domestic purposes[208]. On the other hand, cities like Maharashtra had an efficient and effective waste disposal mechanism in compliance with the BMWM Rules of 2016, whereby CBWTFs were set up to treat and dispose of these harmful wastes. As per the Report of the Maharashtra Pollution Control Board, of the total amount of about 62,418 kg waste produced, nearly 62,134 kilograms were treated and disposed of during 2018-19[209].

Challenges in Indian Biomedical Waste Management System

People lack awareness on the repercussions of biomedical waste and its corrosive nature. Lack of proper awareness on the adverse health effects of biomedical trash, insufficient human and financial resources, poor management of waste disposals are some of the critical issues in connection with healthcare wastes[210]. Some of the challenges in the proper management of biomedical waste disposal system in India include:

- Absence of adequate Segregation

Segregation prevents the mixing up of infectious waste with noninfectious waste. An absence of proper segregation increases the amount of infectious waste generated since, a mixture of infectious components with general noninfectious waste makes the whole waste mass potentially

[207] *Id.*

[208] Changing Market Foundation, Hyderabad's pharmaceutical pollution crisis: Heavy metal and solvent contamination at factories in a major Indian drug manufacturing hub, 2018, https://changingmarkets.org/wp-content/uploads/2018/01/CM-HYDERABAD-s-PHARMACEUTICAL-POLLUTION-CRISIS-FINAL-WEB-SPREAD.pdf (last accessed: Aug. 26, 2021)

[209] Maharashtra Pollution Control Board, Annual Report, § 66, (2018-19), https://mpcb.gov.in/sites/default/files/about-us/annual-report/MPCB_AR_Eng16032020.pdf (last accessed: Aug. 26, 2021)

[210] World Health Organization, Safe Management of Bio-medical Sharps Waste in India, a W.H.O. Publication, (2005), https://apps.who.int/iris/handle/10665/206337 (last visited: Aug. 26, 2021)

hazardous[211]. The indiscriminate segregation of waste from generation to final disposal has become a common feature in Indian hospitals. Even if waste segregation at the generation site is effective, they are often mixed together during the process of collection resulting in loss of the whole purpose of segregation[212].

- Absence of appropriate Operational Strategy

The healthcare facilities should develop an operational strategy considering the storage capacity of containers, the site of treatment, rate of accumulation and thereby schedule the activities. The storage of infectious waste substances should be done in separate containers which are color-coded and leakage-proof. It has to be sterilized and thereafter taken to the treatment facilities like incinerators or sanitary landfills[213] for final disposal. However, in many hospitals, there is no proper segregation of wastes that, they are handled through open bins causing spillage[214] and disposal of waste sharps are mostly done without mutilation or decontamination. These sharps are again recycled and reused, leading to further spread of infectious diseases.

- Inefficient Regulatory Measures

The authoritative body for the enforcement of waste regulations is the Central and State Pollution Control Boards. However, they lack adequate power and commitment towards implementation of the Rules. As such, there is non-compliance from the part of healthcare institutions even after repeated demands and deadlines[215]. The lackadaisical manner in which the matter is handled by the Pollution Control Boards, poor coordination between Departments, absence of adequate interest in enforcing the laws, etc., adds to this phenomenon. Besides this there is no specialized agency entrusted with the task of creating awareness[216] among people. The Rules have not yet received the required publicity that most of the small-scale healthcare institutions are unaware of the existing legal framework on biomedical waste disposal. Also, a

[211] S. Gupta and R. Boojh, *Report: Biomedical waste management practices at Balrampur Hospital, Lucknow, India*, 24 WASTE MANAG. RES. 586, (2006).
[212] A.V. Athavale, G. B. Dhumale, *A Study of Hospital Waste Management at a Rural Hospital in Maharastra*, 9(1) J. ISHWM 21, 24, ( 2010).
[213] A.D. Patil & A. V. Shekdar, *Healthcare waste management in India*, 63 J ENVIRON MANAGE. 211, (2001).
[214] *Supra* note: 213
[215] A. K. Dwivedi, S. Pandey, et al., *Fate of hospital waste in India*, 1(3) BIOL. MED. 27, (2009).
[216] L. K. Verma, *Managing Hospital Waste is Difficult: How Difficult*?, 9(1) J. ISHWM, 46, (2010).

drawback of the existing Rules is that it has not addressed the issues like standards of waste collection, classification, storage, measures for sake-keeping and handling such hazardous wastes, etc.

- Disregard to the Green Protocol

The persons engaged in the procurement of healthcare byproducts belong to different backgrounds that they do not possess adequate knowledge and training on environmental protection. Recycling and reuse of waste materials consisting of metals and glasses after sterilization can result in waste minimization. Likewise usage of non-chlorinated polythene bags emits much less dioxin during incineration as compared to bags that contain polyvinyl chloride[217]. Likewise, replacement of mercury thermometers with those free from mercury helps in reducing environmental damage. By updating their purchase policies towards more environmentally sustainable products, healthcare institutions can help achieve the Green Protocol to its fullest extent.

- Waste collection and Reuse

The recycling and reuse of plastic substances used in healthcare is one of the most thriving businesses in India with a business estimate of 50 million from Delhi alone. The profitable monetary gains and ignorance about its aftereffects encourage such rag-picking and reuse activities on a full swing. It is the hospital authorities and not the rag pickers who are liable for this. These picked up wastes are finely packaged with labels and then sent back to the medical shops for purchase by the susceptible ones[218].

- Lack of Commitment of top level management

The healthcare facilities and Governments mostly relied on a single waste disposal mechanism without adopting a clear-cut measure for collection and quantification of waste data, its types or the generation points. Lack of adequate funds or budget for hospitals, both government and private, were yet another issue. So they flouted the legal norms and rules as a convenient measure rather than following the waste disposal standards. Even the top-level management had

[217] B.Kaiser, P.D. Eagan et al., *Solutions to Health Care Waste: Life-Cycle Thinking and "Green" Purchasing*, 109(3) ENVIRON. HEALTH PERSPECT. 205, (2001).
[218] *Supra* note 217

turned a deaf ear towards the waste management problem. Thus, there is a blatant violation of regulatory norms in phasing out biomedical wastes.

- Deficiency in existing facilities

In India, the efforts to ensure adequate storage, accumulation and treatment facilities had turned futile or were limited to a large extend. Due to the insufficiency of lands or sites for landfilling or deep burial, the wastes are indiscriminately dumped into open pits and bins along roads, residential areas, near water bodies, etc. This culminates in vector borne diseases, air, water and soil contamination, etc. On-site waste treatment methods are more feasible for large healthcare institutions while they are beyond the scope of small clinics. So there needs to be an all acceptable common disposal system providing for free and adequate supply of segregation bags, its collection, transportation and final disposal using an efficient technology[219]. The existing techniques do not satisfy the essential disposal requirements or promote innovations in accordance with the changing patterns of waste streams.

- Absence of Institutional Arrangements

Management of medical waste depends to a large extend on the active participation of the administration and trained staff in the accumulation, segregation, storage, conveyance and disposal. In India, mostly the house-keeping staff and ward attendants carry out these activities within the hospital premises. There has to be a specially constituted inspection team presided over by the organizational head, other department heads, nursing superintendents, and the waste management supervisor to look into the proper management of medical waste in a hospital. They are required to function on the aid and advice of the environmental and infection control officers. However, absence of such a management committee is one of the drawbacks of the existing system.

- Financial Constraints

The installation of advanced systems or techniques in healthcare units requires huge capital and current expenditures so as to meet the requirements of sufficient manpower, equipments, devices

[219] S.K.M. Rao, R.K.Ranyal, et al., *Biomedical Waste Management: An Infrastructural Survey of Hospitals*, 60(4) MED. J. ARMED FORCES INDIA, 381, (2004).

and disinfectants. The normal practice in Indian hospitals is that there is no separate fund allocation for waste disposals as such. An estimated average of about 3000 rupees per tonne of medical wastes is required to be invested by a healthcare unit. Besides this, additional investments for creating awareness among healthcare professionals and workers are also incurred. As stated earlier, these financial constraints are one of the major reasons for rampant violations of regulatory norms.

- Lack of awareness and adequate training

There is lack of proper understanding and knowledge regarding the potential hazards on human health for healthcare workers engaged in collecting and handling clinical wastes. They are constantly being exposed to hazardous medical trash and the impact that it poses. Through informative posters, labels, seminars, training and orientation programs etc, the ill effects of biomedical wastes can be communicated to the staffs and other members in a health institution[220]. The Indian healthcare institutions are mostly unaware of the cost benefits of appropriate waste management practices. An estimated cost-benefit savings of about 40% to 70% can be achieved through proper implementation of the medical waste minimization programmes[221].

- Disinclined attitude towards Change

Even though alternative technologies are prescribed under the Bio-medical waste Management (BMWM) Rules, people's mindset takes too long to adapt to changes. People mostly prefer incinerators as the only solution while alternatives like autoclaves, hydroclaves and other advanced techniques are available. Careless and indiscriminate dumping of wastes are prevalent and the plight of waste handlers without PPE kits, masks and gears also signifies the nature of current waste handling practices.

- Lack of Societal Pressure

Studies have shown that various Environment protection organizations and groups exert significant pressure on institutions for the promotion of programs on adequate environmental

[220] A.K. Dwivedi, S. Pandey, et al., *Fate of hospital waste in India,* 1(3) BIOL. MED. 28, (2009).
[221] T.L.Tudor, C.L. Noonan, et al., *Healthcare waste management: a case study from the National Health Service in Cornwall, United Kingdom*, 25 WASTE MANAG. 606, (2005).

management[222]. But this is not available in India, especially with respect to Indian healthcare institutions. Even though a literate person has the knowledge that improper waste management leads to communicable diseases, his lackadaisical attitude often prevents him from solving the issues.

### 4.5. IMPLEMENTATION OF THE BMWM RULES, 2016

Taking note of the current scenario, it is evident that regulation of biomedical waste and implementation of laws have not been adequately made in India. And this failure in implementation eventually affects our environment and health of the people. An alarming area of concern is the increased pharmaceutical pollution that creates the so-called "superbugs". The residue, from antibiotics when released into water bodies or to the environment, raises the AMR (Anti Microbial Resistance) level, reducing the resistance power in human body against a particular virus. As of 2019, globally, there are nearly about 70000 people who have lost their lives due to a rise in AMR infections[223].

Rule 2 of the BMWM Rules stipulate that the application of the new Rules shall extend to hospitals, dispensaries, clinics, nursing homes, laboratories, clinical establishments, blood banks, vaccination and other medical camps. But the state should have been prudent in enlightening the concerned stakeholders of the risks involved before imposing a rule like this. Currently, there are no awareness campaigns or programmes in these institutions (hospitals, diagnostic centres, vaccination camps, etc.) for the purpose of sensitizing the waste handlers on the significance or necessity of adequate waste disposal. It throws light upon the blatant lacuna in law.

Further, Rules 8(1) the BMWM Rules prohibit mixing up untreated medical waste with the general wastes and Rule 8(2) provided for the on-site segregation of biomedical waste into separate bags and containers as per Schedule I of the Rules. However, many current instances show that wastes are neither segregated at their source nor disposed of separately. Dumping of clinical wastes along with municipal garbage itself nullifies its whole purpose. The rules

[222] H.Walker, L. Di Sisto, and D.McBain, *Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors*, 14 J. PURCH. SUPPLY MANAG. 73, (2008).
[223] World Health Organization, New report calls for urgent action to avert antimicrobial resistance crisis https://www.who.int/news/item/29-04-2019-new-report-calls-for-urgent-action-to-avert-antimicrobial-resistance-crisis (last visited: Aug. 26, 2021)

conferred absolute power on the local self-government bodies as well as on the Central and State Pollution Control Boards. These pollution control boards had to conduct inspections in healthcare facilities. Those found guilty of flouting the Rules were viewed with serious consequences, including shutting down the healthcare premises. It requires the SPCBs to submit an annual report regarding implementing the BMWM Rules to the Central Pollution Control Board (CPCB). The 2018 Amendment Rules laid down the format for submitting the reports. Experiences from other nations show that, adequate capacity building options have to be resorted to for an effective and efficient implementation of Biomedical Waste Management Rules.

As per CPCB's annual report of 2018-19, about 23,942 healthcare facilities had violated the Biomedical Waste Management Rules and around 18,210 healthcare facilities were warned for violating the Rules[224]. Despite rampant mismanagement of biomedical wastes, no person has so far been penalized or punished under S. 15 of the Act[225]. It shows a poor implementation of the Rules by the executive considering the large volumes of medical wastes generated per day, and with more than 13% of the healthcare facilities violating its norms.

The existing rules provide for stringent waste disposal techniques such as incineration, chemical treatment, landfilling, etc. However, these techniques are expensive and even operators of treatment facilities charge a high rate beyond the reach of small-scale clinics. This is one of the reasons for illegal dumping. Several hospitals and healthcare facilities were not in a position to invest huge amounts in phasing out clinical wastes, including blood bags, plastic bags (chlorinated) and gloves or to create a system of barcoding for identifying waste containers or bags[226]. These neighborhood clinics are also not equipped with sufficient manpower, and it would not be feasible for a single doctor to handle the waste disposal and medical emergencies. A recent study revealed that, only about 70% of the medical wastes in India are treated through techniques like incineration while, 30% is still left out, which are either illegal dumped or mixed

[224] Central Pollution Control Board, Annual Report 2018/2019, 143, (2019), https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMTExOV8xNTk3MDM3NTM0X21lZGlhcGhvdG8xOTY1Ni5wZGY= (last accessed: Aug. 27, 2021, 10:30 AM)

[225] The Environmental Protection Act, 1986, S. 15, Act No. 29, Acts of Parliament, 1986 (India).

[226] P. Datta et al, *Biomedical waste management in India: Critical appraisal*, 10(1) J. LAB. PHYSICIANS 6, 9, (2018).

up with the general garbage on roadsides[227]. Besides this, various reports and studies have pointed out that incinerators in hospitals mostly do not function properly[228]. Reports from various states have revealed instances of constant violation or infringement of the Biomedical Waste Management Rules[229] and the Guidelines issued by the Central and State Pollution Control Boards.

Concerns in Biomedical Waste Management

Hospital waste management has raised the following concerns regarding:

1. The low rate and delay in authorization grants.
2. The linkage between biomedical waste inventorization and authorization grant.
3. It was difficult to track biomedical wastes, segregated into different color codes (like red, yellow, and blue), their collection, processing etc., were difficult.
4. The management and tracking of incinerators and burial sites
5. Upgradation of incinerators in common treatment facilities, their timelines as fixed by CPCB, etc.
6. The practicability of barcoding system
7. Recycling of biomedical wastes, tracking and quantification of wastes for the purpose of recycling, etc.

- Inventorization & Authorization

As per the 2016 Rules, healthcare establishments are bound to take authorization from the concerned State Pollution Control Boards. The process is complex, requiring these Boards to track adequate compliance with the procedures. Authorization is given only when the healthcare facility enters into a contract with treatment facilities (CBWTF) for its waste disposal. However, only 40% of them are granted authorization, while a 40% still do not apply for authorization. A major hurdle in granting authorization is the long time consumption process of attaining consent for operation (CTO), requiring clearances of different agencies.

[227] Singh A and Saha K, COVID-19 and biomedical waste management, 2020, https://www.sprf.in/post/covid-19-and-biomedical-wastemanagement (last accessed: Aug. 27, 2021, 10:40 AM)
[228] S. Singh, Mismanaging Hospital Waste, 36(16) ECON. POLITICAL WKLY. 1298, (2001).
[229] The Biomedical Waste Management Rules, 2016

Biomedical waste inventorization could lead to an underestimate. It is the information given in the application for authorization, used to measure the total amount of wastes generated from healthcare facilities. Still there are numerous healthcare establishments, which have not yet applied for authorization; therefore, there is a lack of proper estimate on the quantity.

- The waste disposal cycle- Incineration, deep burial and recycling

The Biomedical Waste Management Rules seeks to ensure a safe, well managed and efficient incineration to fully burn out the harmful substances and that there exist no toxic gas emissions out of the treatment facilities. But there is no proper regulation of incinerators at the Common treatment facilities. Regular monitoring systems for analyzing the emission standards have to be installed by these incinerators which are to be connected to the Central and State Pollution Control Boards' websites. Even though CEMS (Continuous Emission Monitoring System) was installed at certain CBWTFs, it lacked a proper functioning mechanism and the data was neither sufficient nor linked to the Pollution Control Boards' websites.

The toxicity of metal compounds in the generated ash is within the prescribed limits under the Hazardous Waste Management Rules of 2016. It can be deposited at municipal waste disposal sites. However, there is no barcoding system to trace the disposal of the ash generated during incineration. The existing bar code system as stipulated by the BMWM Rules of 2016 for the collection, segregation and conveyance processes has not yet been implemented to its fullest core.

Regarding recycling, the medical waste Rules ensures a proper tracking of these wastes to ensure that it has been managed and disposed of safely. The occupier of healthcare units and operators of a CBWTF should maintain sufficient records of recyclable items. The recyclers have to obtain a valid authorization certificate and get registered with the concerned Pollution Control Boards. They make a payment for the wastes collected for recycling. However, there exist no mechanisms to track the pathway of recyclable waste. The system needs to be updated with a barcoding system that helps trace the source of waste and acts as a restraint upon the sale of untreated and non- sterilized recyclable byproducts by the CBWTFs. It helps in tracking back untreated waste to the treatment facilities, holding the operators accountable. Scientific quantification and barcoding acts as a check upon the illegal dumping of recyclable wastes.

Likewise, deep burial of wastes are allowed only in the remote and rural areas where a Common waste treatment facility is not available or accessible. It is carried out only when the State Pollution Board has conferred an express permission as regulated by the standards prescribed under Schedule III. As per the Schedule, the burial pit should have a depth of 2 meters, a distance of 6 meters from ground water levels and covered with equal layers of soil. However, how far will these standards be complied with is a question of concern. The number of hospitals which have been granted authorization for burial so far is also a question of concern.

- The Barcoding or the Waste tracking system

The Rules of 2016 has stipulated for barcoding the biomedical waste boxes and containers send out for disposal. These are tracked using a GPS and the entire process has to be completed within the specified time. However, the same has not been fully implemented and many areas are still left out. The additional or extra rates charged for facilitating it could be attributed as a reason for its incomplete implementation. Also, there still exists chaos as to, whether it is the healthcare unit, operator, or the Pollution Control Boards which are bound to establish the barcode system.

- Management of General waste

General wastes are also generated along with the biomedical garbage in hospitals. However, the Biomedical Waste Management Rules, 2016, do not address such a category and are managed under a separate set of rules. Healthcare general wastes fall under the category of solid waste under the Solid Waste Management Rules of 2016. Though the local authorities have specialized collection measures for such wastes, there have been situations where these wastes were dumped in the open, within the hospital premises[230].

[230] Centre for Science and Environment, Managing Biomedical Waste in India, COVID-19 and Beyond, 2020, https://www.cseindia.org/managing-biomedical-waste-in-india-10378 (accessed on: Aug. 27, 2021)

## 4.6. JUDICIAL RESPONSES

Despite having noble intentions, the approach of judiciary towards the problems in clinical waste management had not been streamlined in accordance with the Rules. The *B.L. Wadehra* case[231], is an example of the point that, inspite of clearly laid down court directives, the absence of adequate data on the healthcare establishments is a hurdle in the enforcement of regulatory norms. The court directed strict compliance with the procedural formalities regarding waste handling, disposal and treatment, imposing obligations on the Central and State Pollution Control Boards.

The Judiciary had played an active role in managing biomedical wastes through various notable decisions of the National Green Tribunal and the Apex Court. In *Haat Supreme Wastech Pvt. Ltd v. State of Haryana & Ors*.,[232] the National Green Tribunal ruled that even treatment plants for biomedical wastes are bound to obtain the environment clearance certificates in accordance with the law. It held that the incinerators processing biomedical wastes emit numerous pollutants like furans, dioxins, heavy metals (like lead or mercury), etc., and adversely affect human health, safety, and the environment. In *Mahesh Dubey v. Chattisgarh Environment Conservation Board & Ors*.[233], while dealing with the issue of biomedical waste mismanagement, the Tribunal directed the formation of Committees to prepare an all-inclusive inventory of healthcare facilities and to draw an action plan for the effective and efficient implementation of the Biomedical Waste Management Rules. Likewise, in *C.S. Prakash & Ors. v. The HUDA & Ors.*[234]it was held that, the protection of health and ecology falls within the ambit of A. 21 of the Indian Constitution. Before construction of multispecialty hospitals, care should be taken about the health of people in the locality and in obtaining approval from competent authorities regarding biomedical waste disposal.

The hazards of medical waste mismanagement not only affects the health of occupiers of an institution but also the people in its vicinity, and injuries due to needle sticks, leading to infectious diseases, are a matter of concern not just for the health workers, but also for

[231] (1996) 2 SCC 594
[232] MANU/GT/0089/2015
[233] MANU/GT/0140/2016
[234] (2001) ILR 2 AP 323

the community as a whole[235]. The court, in *Environment Monitoring Forum & Anr. v. Union of India & Ors.*,[236] held that, the onus is on the healthcare institutions which generate medical garbage to take steps, ensuring that the wastes are handled without posing any adverse consequences on the environment or human health.

In Re: *Kasala Malla Reddy & Ors*.[237], the court dealt with the issue of pharmaceutical waste pollution in water bodies (the Musi and Manjira River basin), causing the AMR (Anti Microbial Resistance) levels to increase, which adversely affects the life of the poor villagers. The court made a direction to the State Government to constitute expert committees to look into the matter and to report back the same. Again in *Meera Shukla v. Municipal Corporation, Gorakhpur & Ors.*[238], the Tribunal took cognizance of the illegal dumping of healthcare and pharmaceutical wastes leading to an increased ground and surface water contamination. The Pollution Control Boards (both Central and States) were asked to take appropriate measures forming monitoring committees to check upon the matter.

Recently the Apex Court had in *M.C Mehta v. Union of India*[239], dealt with the issue of open dumping of medical wastes in Delhi. The court directed the Central and Delhi Pollution Control Boards and the EPCA and concerned departments to immediately clear the wastes and issue notices to hospitals to segregate and properly dispose of their litter. The court also emphasized the need for urgent adoption of the barcoding system as stipulated by the Rules of 2016.

Likewise, in a recent matter wherein the National Green Tribunal took Suo Motu cognizance of the news article titled "*Dumping of Garbage foiled near Anamalai, trucks seized*"[240] (published in the Chennai edition of The Hindu Dt. 9.04.2021) and directed the Government of Kerala to submit a report on implementing the Biomedical Waste Management Rules, 2016 in the bordering districts. However, the information filed on behalf of the State indicated a scientific treatment of medical wastes through the IMAGE facility and further degradation of non-biodegradable substances through the local authorities.

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[235] *Maitree Sansad v. The state of Orissa and Ors*., (2007) 103 CLT 191.
[236] MANU/KE/0894/2003
[237] *Kasala Malla Reddy & Ors. v. State of Andhra Pradesh & Ors*. (2017) S.C.C. OnLine NGT 1914
[238] (2019) S.C.C. OnLine NGT 866.
[239] W.P. (C) No. 1333/2019 (PIL-W)
[240] O. A No: 100 of 2021, Apr. 16, 2021 (NGT).

## 4.7. CONCLUSION

Safe and secure biomedical waste management is not only a legal necessity but also a social obligation. The blatant violation of the rules has become an everyday affair, requiring an immediate response from the authorities. It is duly attributable to the lack of awareness, concern, and motivation among the key stakeholders and the slackness among the Government authorities. Even though the judiciary has played its part well, it was insufficient to ensure proper compliance with the rules. Radical and innovative measures should be adopted to tide over the menace of ever-increasing biomedical wastes. The State has to resort to strict legal actions against such miscreants to ensure rigorous enforcement of India's biomedical waste management legislation.

# CHAPTER: 5

# THE COVID-19 WASTE DISPOSAL AND THE COMPETENCY OF THE EXISTING REGULATION - AN ANALYSIS

## 5.1. INTRODUCTION

Today, we are all trying to swim across the pool created by the pandemic. COVID-19 has resulted in an abrupt change in the global health scenario, affecting almost all world nations. Wiping out millions, it has emerged as one of the most severe epidemics the world has ever seen. The World Health Organization defined epidemics to be "the outbreak of disease cases over normal expectancy."[241]Inefficient management of any pandemic would result in a global crisis.

COVID-19 pandemic had a devastating impact on health, education, and the environment. It is something that affects all walks of life and society. It took the whole world to stand on a knife's edge. Spreading through human droplets, physical contacts, or air, it infected millions and left many dead. It was even declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization in January 2020[242].

The pandemic has severe environmental and potential health hazards arising out of its darker side from the wastes generated during the outbreak. The virus is highly contagious, that indiscriminate handling of the covid 19 related biomedical waste would only aggravate the spread. Inappropriate management of these wastes amplifies the frequency of virus' sweep. It has, in turn, posed a novel as well as a critical challenge on the existing biomedical waste regulations and imposed an additional burden on the whole waste management system. The term 'COVID19 waste' has not been defined anywhere. However, it refers to any kind of waste generated during the diagnosis, treatment, isolation, or quarantine of Covid patients. During the

[241] World Health Organization (WHO), Water, Sanitation, Hygiene and Waste Management for COVID-19: Technical Brief, March 2020, https://apps.who.int/iris/handle/10665/331305 (last visited: Sep. 21, 2021)

[242] World Health Organization, WHO Director-General's statement on IHR Emergency Committee on Novel Coronavirus (2019-nCoV) 2020, https://www.who.int/director-general/speeches/detail/who-director-general-s-statement-on-ihr-emergency-committee-on-novel-coronavirus-(2019-ncov) (last visited: Sep. 21, 2021)

initial drive, even food waste, hospital beddings, and pillows were regarded as Covid19 medical waste.

Managing healthcare wastes was one of the most crucial challenges of the world medical fraternities during the pandemic era. The presence of vast piles of hazardous waste materials like used syringes, needles, dressings, body parts, fluids, testing or laboratory wastes, discarded medicines, devices, toxic chemicals, metals and, PPE kits and diagnostic samples, in particular, were a common sight during this pandemic. In China, the city of Wuhan had witnessed an upward slope in the biomedical waste generation of about 600% amid the COVID-19 outbreak[243]. There was an increase of about 5mt of medical wastes per year to about 300mt/year in the United States during the pandemic outbreak.

With the existing infrastructural facilities and inefficient safety measures, the governments had to face a tough confrontation from the healthcare sector regarding the pandemic's management. As a result, there were sudden improvisations and alterations in medical policy standards, and governments established numerous testing centers to cope with the new health crisis. Social distancing norms were imposed, self-quarantine measures made compulsory for symptomatic and infected persons, and the use of PPE kits was made mandatory for healthcare professionals as a precautionary measure as well as to contain the spread of the SARS CoV2 virus. The usage of personal protective equipment is inevitable during an outbreak such as COVID-19. As per the World Health Organization (WHO), there is a requirement of about 25 units of surgical or medical masks & gowns, 50 unit gloves, and a single unit of face masks (N95) and face shields per patient for a single day[244]. It also recommended raising the PPE production to about 40% to meet the increasing global demand for such safety pieces of equipment[245].

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[243] Jiajun W., Cement Industry in China Assisted with Disposal of Covid-19 Healthcare Waste, (2020), https://www.zkg.de/en/artikel/zkg_Cement_industry_in_China_assisted_with_disposal_of_Covid-19_healthcare_3535100.html. (last accessed: Sep. 21, 2021, 9:15 AM)

[244]UNICEF, COVID-19 Impact Assessment and Outlook on Personal Protective Equipment, (2020), https//www.unicef.org/supply/stories/covid-19-impact-assessment-and-outlook-personal-protective-equipment#:~:text¼A%20consolidated%20UN% 20inter%2Dagency,and%208.8%20million%20face%20shields (last accessed: Sep. 21, 2021, 9:20AM)

[245] World Health Organization, Shortage of PPE's Endangering Health Workers Worldwide, (2020), https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workersworldwide (last visited: Sep. 21, 2021)

However, such an enhancement in the global production and utilization of safety measures had an adverse consequence of an increase in healthcare outputs, specifically, covid related clinical wastes. It has altered worldwide waste management and generation patterns altogether, unveiling the fragility and vulnerability of the healthcare sector. This, in turn, reveals or showcases how far the clinical industry is susceptible to external influences.

The pandemic created an immediate tremor and panic in public, leaving men in a state of fear and chaos. The terms rapid antigen and RTPCR tests, social distancing, nationwide lockdown, quarantine, PPE kits, facemasks had all become part of our everyday usage and day-to-day lives. Vaccines and vaccine trials have also recently joined this category. At the very same time, there was unprecedented growth in the quantum of medical wastes. There was an explosion in the number of wastes generated from healthcare facilities due to the Covid scenario. Huge stockpiles of healthcare wastes can be seen outside hospitals, CFLTCs (first-line treatment centers), diagnostic and testing centers, laboratories, quarantine centers, etc., which has, in turn, choked the whole health ecosystem.

Such a massive and unexpected increase in the volume of biomedical wastes during a pandemic could be attributed to the high rate of consumption of single-use materials in the treatment of Covid patients as well as in the manufacture and trial of vaccines[246]. In China, which felt the first wave of Covid 19, the sudden rise in healthcare wastes was about six-folds, (240 tons/day) more than the pre-pandemic scenario[247]. Covid wastes are generated mostly from hospitals and research institutes, where drug and vaccine trials are usually carried out. It includes waste generation from healthcare facilities and households, as part of the home quarantine measures.

Covid related medical wastes such as facemasks, gowns, needles, gloves, etc. carry traces of pathogenic as well as infectious agents[248]that form the hazardous components in the spread of the virus. And, due to the presence of these infectious agents, CMW falls under the

[246] Klemes J.J., Fan Y.V., et al., *Minimizing the present and future plastic waste, energy and environmental footprints related to COVID-19*, 127 RENEW. SUSTAIN. ENERGY REV. 109883, (2020).
[247] Ma Y, Lin X, et al., *Suggested guidelines for emergency treatment of medical waste during COVID-19: Chinese experience*, 2 WASTE DISPOS. SUSTAIN. ENERGY. 81, (2020).
[248] World Health Organization, Coronavirus Disease (COVID-19), World Health Organization Situation Report 134, (2020), https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports (last accessed: Sep. 21, 2021, 9:45AM)

category of hazardous wastes. Covid-19 has escalated the generation of biomedical wastes and the magnitude of potentially infectious wastes also increased, which is evident from the large-scale littering of facemasks, gloves, and other protective gears[249]. Besides this, during a pandemic, all kinds of waste generated from hospitals are considered hazardous or infectious wastes[250].

Inappropriate treatment of these wastes increases the chances of further spread and re-infection. Improper segregation and handling of covid wastes lead to further contamination and spread that the trash gets mixed up with the municipal waste, increasing the possibility of transmission[251]. Poor and inappropriate management of the infectious covid wastes is a significant concern in the proliferation of the virus.

China witnessed an aggregate of 142,000 tonnes of biomedical wastes with an increase in the capacity of domestic waste treatment facilities from about 4902.8 tonnes to 6022 tonnes per day as an aftereffect of the SARS CoV2 outbreak[252]. A momentous increase can be viewed even in European countries such as France with a 40% - 50% increase rate and the Netherlands with an average of 30%–50% increase in total waste production.

[249] Torkashvand J, Jonidi Jafari A, et al., *Municipal solid waste management during COVID19 pandemic: A comparison between the current activities and guidelines*, J ENVIRON HEALTH SCI. ENG., (2021), https://doi.org/10. 1007/s40201-020-00591-9 (last accessed: 21 Sep. 2021, 9:55 AM).

[250] Wei W, Zheng D, et al., *Radiotherapy workflow and protection procedures during the Coronavirus Disease 2019 (COVID-19) outbreak: Experience of the Hubei Cancer Hospital in Wuhan, China*, 148 RADIOTHER. ONCOL. 203, (2020).

[251] World Health Organization, Rational Use of Personal Protective Equipment for Coronavirus Disease 2019 (COVID-19), (2020), https://www.who.int/publications/i/item/rational-use-of-personal-protective-equipment-for-coronavirus-disease-(covid-19)-and-considerations-during-severe-shortages (last visited: Sep. 21, 2021)

[252] Tang W., *The National "Epidemic-Related" Medical Waste realizes that the Daily Medical Waste Treatment Market needs to be standardized*, 21CBH March 12, 2020), http://www.21jingji.com/2020/3-12/xNMDEzODFfMTU0MjIxNQ.html. (last visited Sep. 21, 2021, 10:10 AM)

## 5.2. THE STATE OF AFFAIRS IN INDIA

With an approximate rate of 3.37 crore people been affected by the virus, India holds the second-highest position (after the United States) among nations, which are worse affected by the pandemic[253]. Even though there were genuine efforts on the part of the state to tackle the spread, it had failed to attain impeccable standards as regards the management of covid related medical wastes. The efforts to combat the pandemic had only resulted in generating large quantities of medical wastes from various healthcare institutes, quarantine centers, and laboratories. The enormous rise in volume of biomedical wastes, as an aftermath of the Covid 19 pandemic had, in turn, jeopardized the environment and health of people in the community. And the flaws in the system of medical waste management are attributable to the lack of adequate resources, manpower, and deficiency in regulatory norms.

As per the media reports, there has been a considerable volume of more than 100 tonnes of Covid related medical wastes generated per day, within a year of the pandemic[254]. About 17% of these wastes come from one of the most affected states i.e, Maharashtra. As per the recent reports of the Central Pollution Control Board, the daily waste products from the health sector alone have reached an average of about 850 tonnes per day[255]. A recent study has estimated that a COVID patient in India generates approximately 3.41 kg per day of COVID-related biomedical wastes, 50.44% of which is the yellow category medical wastes[256]. However, the per bed generation of medical wastes varies from 0.3kg to 1kg per day[257] indicating an increase of about 15 times more than the rates which existed earlier, in treating Covid patients.

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[253] Worldometer, Coronavirus cases, https://www.worldometers.info/coronavirus/ (last accessed: 17 Sep. 2021, 4:45 PM).

[254] NDTV, Report on Biomedical Waste, https://swachhindia.ndtv.com/coronavirus-pandemic-exposes-broken-system-of-bio-medical-waste-management-experts-dis cuss-the-issue-and-solutions-49427/ (Accessed on: Sep. 22, 2021, 2.30PM)

[255] Central Pollution Control Board, Report on COVID-19 Waste Management, Central Pollution Control Board, (2020), https://cpcb.nic.in/ (last visited: Sep. 22, 2021)

[256] P.S. Thind, A. Sareen, D.D. Singh et al., *Compromising situation of India's bio-medical waste incineration units during pandemic outbreak of COVID-19: Associated environmental-health impacts and mitigation measures*, 276 ENVIRON. POLLUT., 116621, (2021).

[257] M. Goswami et al., Challenges and actions to the environmental management of Bio-Medical Waste during COVID-19 pandemic in India, 7 HELIYON, 6, (2021).

According to the latest data of CPCB (Central Pollution Control Board), India had generated about33000 tonnes of COVID biomedical wastes, during June – December 2020[258]. The current status of Covid19 biomedical waste production in India as per the very recent reports of June 2021 is 164 tonnes per day, which touched the highest peak of 250 tonnes p/day in May 2021[259]. The statistics also revealed the states of Maharashtra, Kerala, and Gujarat to be the topmost covid waste generating states in India in proportion to the number of positive cases in these states. The National Capital Territory of Delhi also contributes a major share in the total covid waste generation. It was found that more than 50% of these States and Union Territories had inadequate facilities for waste disposals[260]. The National Green Tribunal also highlighted the capacity limitation for waste treatment in certain areas and cities as a result of the spike in biomedical waste generation[261].

An alarming fact to be noted here is that, the recent report shows Kerala to be the highest covid waste (CBMW) producing states with an average of 23.71 tonnes in May, and which rose to 26.95 tonnes in June, 2021[262]. Gujarat occupied the second place in waste generation with 21.98 tonnes, followed by Maharashtra with 19.02 tonnes of covid biomedical wastes. However, the report of June 2021 indicates Tamil Nadu to hold the second place with 26.04 tonnes followed by Karnataka[263]. But Kerala still leads in the average biomedical waste generation during the pandemic scenario.

[258] *Supra* note:256
[259] Central Pollution Control Board, Generation of COVID 19 related biomedical waste in States /UTs, June 2021, https://cpcb.nic.in/covid-waste-management/ (last accessed: Sep. 22, 2021, 3:20 PM)
[260] Singh A and Saha K, COVID-19 and biomedical waste management, (2020), https://www.sprf.in/post/covid-19-and-biomedical-wastemanagement (last accessed: Sep. 22, 2021 3:15 PM)
[261] *Supra* note 15
[262] *Supra* note 260
[263] *Id.*

### 5.2.1. **THE RISK FACTOR**

A peculiar feature of Corona Virus is that, it exists on physical surfaces like glass, plastics, metals, paper, etc, for a long time ranging from an hour to even days. Same is in the case of Covid related biomedical wastes whereby, the pathogenic substances exist for days on these waste materials, raising a major concern on the safety of the waste handlers. The virus stays viable for hours on cardboard boxes and about 2-3 days on waste sharps and metals posing a severe threat on the workers engaged in sanitation and waste collection. The SARS Cov2 viruses are capable of surviving on plastics for about 6 hours to 5 days on steel surfaces to about 6 days and in case of used and discarded PPE kits, the viruses are said to exist upto a week and that, a mere handling of such wastes would expose the workers to severe disease contamination[264].

A recent study by Australian researchers has even found the virus's viability to be alive in common surfaces like glass, steel, and currency notes to about 28 days[265]. This shows that the infectious agents could survive for more extended periods on common surfaces having regular human contacts. It raises an alarming concern for an immediate pandemic response.

Considering the extremely contagious nature and viability of the virus, it is evident that the health workers, as well as the residents in the locality, are highly prone to an increased risk of contamination. People get exposed to the virus through mere touch, inhalation or contact with the discarded covid wastes. So this gives a brief insight into the infectious nature of covid related medical wastes and it shows how a healthcare institution from which a person receives coronavirus cure could itself be a source of contacting the virus[266].

During the pandemic, proper handling, disinfection, and disposal of biomedical wastes that arose out of quarantine, home isolation, and healthcare facilities were not addressed to its full extent. The healthcare preparedness was poor with much less handling time and resources for infrastructural development as regards disposal of Covid wastes. The advent of the virus brought

[264] Chin A., Perera M., et al., *Stability of SARSCoV-2 in different environmental conditions*, (1) THE LANCET MICROBE, 1, (2020).
[265] Shane Riddell, Sarah Goldie, et al., *The Effect of temperature on persistence of SARS-CoV-2 on common surfaces*, 17(145) VIROL. J. 1, 7 (2020).
[266] Doremalen, N. Van., et al., *Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1*, 382 N. ENGL. J. MED. 1564, (2020).

in an entire transition in the waste management pattern, affecting the lives of the poor workers since even a single instance of illegal dumping would infect them.

### 5.2.2. PLIGHT OF SANITATION WORKERS

In the collective fight against the dreadful Coronavirus, it is not just the frontline workers (doctors, nurses, and other healthcare professionals) who are the real warriors, but it also includes the efforts and services of sanitation workers, waste handlers, and other medical staff. They form the critical stakeholders in effective covid waste management.

A study by Dalberg Advisors has estimated an average of 5 million workers being engaged in sanitation work in India, and out of which 50% were women[267]. However, they fall under the most fragile, marginalized and vulnerable categories of the social ladder. They still belong to the socially and economically disadvantaged class of citizens. Likewise, in India, there exist about 2-4 million rag-pickers who are even ignorant about the basic precautionary measures. The waste collectors, handlers and the rag-pickers are the ones highly prone to the virus-laden and infectious medical wastes during an epidemic.

A major concern regarding the workers engaged in hospital waste handling and collection is the lack of adequate knowledge and awareness about the potential health hazards and risks involved. As a result of which, many had contracted the disease and some had succumbed to the virus. This is not the fault of workers alone, the non-technical staffs and even medical students lack sufficient knowledge on proper management of biomedical wastes[268]. Yet another reason for the rise in covid cases among these bottom level waste collectors is that they are unequipped with adequate safety measures and protective gears like PPE kits, shields, or gloves while handling these infectious wastes.

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[267] Dalberg Advisor, Sanitation Worker Safety and Livelihoods in India: A Blueprint for Action, (2017), https://www.susana.org/_resources/documents/default/3-3483-7-15427_26162.pdf. (last accessed: 22 Sep., 2021, 4:35 PM)

[268] Pandey A., Sharma P, et al., *Revised biomedical waste management guidelines, 2016- knowledge, attitude and practices among healthcare workers in various healthcare facilities of Central India*, 8(12) INT. J. SCI. RES. 4, (2020).

## 5.3. CURRENT ISSUES IN COVID WASTE MANAGEMENT

One can see a dramatic rise in the quantum of biomedical garbage at the onset of covid 19. The sudden surge in medical wastes as a consequence of the current outbreak of corona virus had disrupted the whole system of healthcare waste management in India. The common waste treatment facilities found it cumbersome to deal with unexpected large quantities of waste generated in this pandemic scenario. [269]

Accidental contact with the infectious waste at its source or a contact with the disposed of items led to the further spread of the virus. It is also a reference to the careless handling of clinical wastes and the poor maintenance of healthcare operations. Lack of proper segregation and basic amenities such as chlorinated or non-chlorinated plastic containers and bins often mix municipal garbage with hazardous covid wastes. Outsourcing of the waste disposals to 3rd party companies at high costs and an inefficient monitoring system often results in illegal dumping of wastes[270]. Unregulated disinfection and treatment of hospital wastes are concomitant to the upsurge in the amount of wastes.

The abrupt advent of the coronavirus necessitated an emergent use of facemasks, hand sanitizers, face shields, gloves, and disinfectants to prevent transmission. The unforeseen demand for safety gear and single-use equipment to face the challenge posed by the corona virus had a significant impact on the creation of yellow category medical wastes (Y-BMW)[271]. It had a probable environmental risk arising out of the incineration of these yellow category medical wastes. Further, the contagious nature of the disease had blurred the possibilities for recycling and the pathogenic wastes are mostly dumped into landfills for natural degradation.

Simultaneously, resale of disposables such as plastic wrappings, sharps, gloves, and other hazardous wastes from covid isolation wards in black markets was common, posing an additional threat of disease transmission. With a faulty implementation of the existing legal principles, such mishaps continue to dominate the waste management system in India. Inappropriate waste

[269] Singh, N., Tang, Y., et al., *COVID-19 waste management: Effective and successful measures in Wuhan, China*, 163 RESOUR. CONSERV.RECYCL. 105071, (2020).
[270] Hopman J., Allegranzi, et al., *Managing COVID-19 in low- and middle income countries*, 323 (16) J. AM. MED. ASSOC., 1549e1550, (2020).
[271]Ogunseitan O.A, *The materials genome and COVID-19 pandemic, Journal of Occupational Medicine*, (2020), https://doi.org/10.1007/s11837-020-04207-3 (last accessed on: 22 Sep. 2021, 11:35 PM)

management practices during a pandemic are in turn a reflection of how inefficaciously the pandemic is handled. The onsite segregation of waste is done in a deplorable manner consequent to an exponential increase in the quantity of wastes and thereby, elevating the environmental risks. The health workers and waste handlers are not sufficiently equipped with safety guards or other protective devices like goggles, safety footwear, or gloves. It still, remains a concern in covid waste disposal.

The truth is that the nation does not possess sufficient infrastructural and manpower requirements to handle an outbreak like Covid and so is the case with huge amounts of medical wastes produced as a consequence of it. The existing 198 CBMWTFs, captive incinerators (only 225 in number), and other treatment options were inadequate to deal with the average daily generation of about 700 tonnes of biomedical wastes. As per the report submitted by EPCA, there was an increment of about 25 – 349 tonnes of medical wastes per day during May-July, 2020 and the rate was expected to double then itself[272]. The new wave in waste production had only helped in stirring up the havoc of biomedical waste disposal.

The want for necessary data and information on the exact volume of waste created during COVID-19 intensifies the problem. As far as the healthcare waste handlers are concerned, the unprecedented rise in clinical waste took them to a state of insecurity and fear due to uncertainty in work and increased occupational risks and stress of getting exposed[273]. The inchoate waste disposals and absence of a waste tracking system have elevated the risks of contracting various diseases and adversely affected the human environment. The pandemic has also paved way for many other health hazards due to the highly infectious and contagious nature of the SARS CoV2 virus.

[272] EPCA report 112 Hospital waste management for COVID-19, http://www.indiaenvironmentportal.org.in/files/file/EPCA-report-Hospital-waste-management-for-COVID-19.pdf (Sep. 22, 2021)

[273] Shammi M, Bodrud-Doza M, et al., *COVID-19 pandemic, socio-economic crisis and human stress in resource-limited settings: a case from Bangladesh*, 6(5) HELIYON 1, 8, (2020).

There are only 200 Common Biomedical Waste Treatment Facilities (CBMWTFs) in India with less than 60% capacity and are deficient to meet the increased waste creation since, March 2020[274]. The existing facilities are incapable of treating the huge quantum of biomedical wastes produced in these tough times. The majority of states and Union Territories had come down to the threshold capacity in managing the clinical wastes.

Recycling infected plastic wastes such as PPE kits poses a higher risk of transmission of the virus especially among those engaged in the recycling work[275]. So recycling of covid wastes has been restricted to prevent re-infection and further contagion. But it has only increased the volume of wastes generated and further, the faulty segregation practices had worsened the whole situation. Likewise, PPEs (Personal Protective Equipment) are made out of materials like polyethylene, PVC polymer polypropylene, etc., and its incineration or burial poses a critical challenge on the environment. A huge volume of plastic wastes, generated due to the covid spread, are heaped around hospitals and roadsides posing a substantial danger to the ecosystem. The harmful emissions during incineration of such plastic wastes expose people to severe respiratory damage. It is an irony that the main focus of the coronavirus is also the respiratory organs. Several studies have proved a cardinal relation between the increased ambient concentrations of the air pollutants like PM, SO2, CO and NO2, and the surging rate of COVID-19-induced-mortality[276].

[274] Ramteke S and Sahu B.L, *Novel coronavirus disease 2019 (COVID19) pandemic: Considerations for the biomedical waste sector in India*, 2 CASE STUD. CHEM. ENVIRON. ENG. 100029, (2020).

[275] Tenenbaum L, *The amount of Plastic Waste is surging because of the Coronavirus Pandemic*, FORBES, Apr. 25 2020, https://www.forbes.com/sites/lauratenenbaum/2020/04/25/plastic-waste-during-the-time-of-covid-19/#7c4e661f7e48 (last accessed: Sep. 22, 2021)

[276] Gupta A., Bherwani, H., et al., *Air pollution aggravating COVID-19 lethality? Exploration in Asian cities using statistical models*, ENVIRON. DEV. SUSTAIN., (2020), https://doi.org/ 10.1007/s10668-020-00878-9 (last accessed: Sep. 22, 2021)

## 5.4. COVID-19 WASTE MANAGEMENT – THE REGULATORY FRAMEWORK

The generation of COVID-19 related medical garbage is considered hazardous and contains infectious agents which necessitate separate handling, disinfection, and disposal[277]. The disinfection process reduces the potential risks of further disease transmission, ensuring the safety of waste handlers.

The Covid 19 medical wastes should be separately dealt with because mixing it up with the general municipal garbage would contaminate the whole public with the virus. There are certain steps to be observed while handling such covid related wastes. It includes:

- Proper segregation of covid wastes from other wastes
- Accumulation and storage of these wastes in separate containers or bins,
- On-site decontamination and transport of waste in vehicles with separate labels, and
- disinfection or treatment of wastes at high temperatures and its final disposal.

Strict compliance with these steps helps in the total eradication of covid wastes. An appropriate waste treatment strategy and adequate disposal of Covid Medical Wastes (CMW) would prevent as well as control the spread[278]. Healthcare workers should be equipped with necessary safeguards and given proper training in the effective handling and management of clinical wastes. It should be made a priority for reducing the potential health and environmental risks posed by it.

Different disinfection strategies are employed at various levels of Waste Management to treat the diverse waste types[279]. The standard waste disinfection technology, as far as COVID-19 waste is concerned, is the incineration technique. It is one of the superior and promising technologies as far as covid wastes are concerned and would be equally efficient in the disinfection of pharmaceutical and pathological covid wastes. It is a popular and widely used

[277] Mallapur C., Sanitation Workers at Risk from Discarded Medical Waste Related to COVID-19, India Spend, 2020, https://www.indiaspend.com/sanitationworkersat-risk-from-discarded-medical-waste-related-to-covid-19/ (last accessed: Sep. 22, 2021 4:55PM)

[278]Cutler S., Mounting Medical Waste from COVID-19 Emphasizes the Need for a Sustainable Waste Management Strategy, (2020) https://ww2.frost.com/frostperspectives/managing-the-growing-threat-of-covid-19-generated-medicalwaste/ (last accessed: Sep. 22, 2021 4:55PM)

[279]Ilyas S., Srivastava et al., Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management, 749 SCI. TOTAL ENVIRON. 1, 3, (2020).

technique that reduces a great amount of wastes and is most suited for clearing the pathogens and infectious particles in hospital waste. So it helps contain the virus to a large extend. This is one of the reasons why the common treatment facilities in India prefer this method. Even microwaving and steam sterilization could be relied on as the next best option. Likewise, a combination of microwaving and chemical disinfection could also be applied at a later stage for breaking down pathogenic substances. However, incineration often results in the large-scale emission of dioxins, and serious exposure to such substances could damage the human immune and nervous systems, endocrine mechanisms and can even cause cancer[280].

Thus, a post- covid scenario would strive at attaining an efficient waste management pattern with proper identification, accumulation, classification, storage, disinfection, and disposal of medical waste through adequate training and awareness among waste handlers[281]. It will also ensure an effective disease containment strategy as well as safeguard the environment around us.

### 5.4.1. WORLD HEALTH ORGANIZATION GUIDELINES

Considering the mounting anxiety over the effective disposal of biomedical waste, the World Health Organization came up with a set of interim guidance titled as the Water, sanitation, hygiene, and waste management for the COVID-19 virus[282]. It laid down guidelines for managing and handling infectious healthcare wastes including COVID-19 related wastes.

Its recommendations included the following:

- Assignment of responsibilities

For safe management of clinical wastes, there have to be a clear division of labor and proper assignment of responsibilities. The healthcare institution should be equipped with sufficient manpower and other resources to classify and dispose of the wastes safely.

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[280] World Health Organization, Dioxins and Their Effects on Human Health, (2016), https://www.who.int/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health#:~:text=Short%2Dterm%20exposure%20of%20humans,endocrine%20system%20and%20reproductive%20functions. (last visited: 23 Sep. 2021)

[281] Centers for Disease Control and Prevention (CDC), Guidelines for Environmental Infection Control in Healthcare Facilities, https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/medical-waste.html. (last visited: 23 Sep. 2021).

[282] *Supra* note 242

- Collection and storage

All clinical wastes generated during Covid are considered infectious and that, they should be accumulated and stored in separate labeled containers and boxes. The COVID-19 related garbage has to be sealed in leak and puncture-proof containers with a biohazard label. There need to be separate storage spaces for these wastes, which are adequately sanitized and safeguarded against vectors and pests.

- Treatment

Segregation and treatment of these wastes should be done on-site, before disposal and there should be a proper regulation if the wastes are treated off off-site.

- Handling of waste

Waste handlers have to mandatorily wear PPEs including boots, face masks, gloves, goggles, sleeved gowns, etc., and observe strict hand hygiene after removal of these equipments. On the other hand, increased use of these PPE kits and other safeguards would ultimately result in massive production of Covid related wastes. Hence, it is highly necessary to enhance capacities for handling and treating this healthcare trash.

- Alternate treatment technologies

Even alternate treatment options like autoclaving or microwaving could be resorted to and existing systems should take initiative in ensuring its sustained operation[283].

- In-situ treatment

Where there are no options for treatment of wastes off-site, it can be done in-situ using lime. For this, 10% of lime slurry should be applied in a 1:10 ratio by dividing the wastes into 10 parts. At the same time, any kind of waste substance, which is capable of being recycled and reutilized, should be mandatorily destroyed.

[283] World Health Organization, Safe management of wastes from health-care activities, (2014), https://apps.who.int/iris/bitstream/handle/10665/42175/924 1545259.pdf?sequence=1(last visited: Sep. 23, 2021)

However, these were not a committed set of guidelines for managing pharmaceutical or infectious covid wastes but have only presented certain basic precautions and measures. Further, there was an interim guideline on Infection Prevention and Control during Healthcare issued by the World Health Organisation when the COVID19 infection is suspected. It provided standard precautions for all patients and stipulated medical waste management through safe routine measures or procedures.[284]

### 5.4.2. THE CPCB GUIDELINES

The proactive role played by the Central Pollution Control Board in issuing guidelines and directions relating to management of Covid19 medical wastes, was worthy of credit. Initially, it was framed on the basis of the meager knowledge regarding COVID-19, as possessed by the Board members. Thereafter, the State Pollution Control Boards also came up with their own guidelines on safe management of CMW (Covid19 Biomedical Waste) in tune with the central guidelines. It specifically dealt with the scientific disposal and treatment of Covid- wastes[285]. The guidelines titled as the Guidelines for Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/Quarantine of COVID-19 Patients[286], were instrumental and remarkable in addressing one of the delicate issues of biomedical waste disposals during a pandemic.

It laid down certain instructions on disposal and treatment of wastes generated from Covid isolation Centres, quarantine camps, healthcare establishments, swab collection centers, labs and CBMWTFs. As regards the isolation wards, the following guidelines were issued:

- Separate or distinct colour coded bags (double layered and leak-proof) or bins.
- Separate collection and storage facilities with a clear 'Covid 19' label on the bins, to ensure a prioritized treatment and processing

[284] Interim Guidance, Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected, World Health Organisation, available at: https://www.who.int/publications-detail/infection-prevention-and-control-during-health-care-when-novelcoronavirus-(nCoV)-infection-is-suspected-20200125 (last accessed: Sep. 23, 2021)

[285] Aggarwal M., Pollution Watchdog releases guidelines to handle Covid-19 biomedical waste, Mar. 24 2020, https://india.mongabay.com/2020/03/pollution-watchdog-releases-guidelines-to-handle-covid-19-biomedical-waste/ (last accessed: Sep. 23, 2021, 10:30 AM)

[286] CPCB, Guidelines for Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/Quarantine of COVID-19 Patients, (issued on March 19, 2020).

- Maintenance of a distinct record for wastes from Covid isolation centers
- Disinfection of the containers used for storing covid related wastes and,
- Assignment of responsibilities among healthcare workers, for a timely collection and disposal of CMWs.

These guidelines were applicable even to laboratories and other testing or swab collection centers. It laid down specific responsibilities for those operating quarantine centres such as to collect the medical waste in yellow colour containers or bags and to hand it over to persons or treatment facilitators as entrusted by the concerned local body, etc. It involves places or institutions where persons suspected to have contracted the disease are observed for a span of 14 days. The general wastes produced from these institutions had to be disposed of in accordance with the Solid Waste management Rules of 2016.

After being brought into force, these guidelines were revised four times, the last two, on the basis of the direction given by the National Green Tribunal. The guidelines then listed out certain duties and functions of common treatment facilities (CBWTFs) such as to ensure a routine and regular sanitization for health and sanitary workers engaged in the collection and handling of covid related wastes and to provide them with necessary PPE kits. The guidelines were not merely directory but mandatory to ensure safety of workers. Even the vehicle carrying the infectious waste had to be disinfected. The operator of the CBWTF was bound to maintain specific records and to ensure a speedy disposal of Covid19 medical wastes.

Likewise, it laid down the duties of authorities such as pollution control boards and local bodies. The Boards had to ensure proper compliance with the provisions of BMW Rules of 2016 and to ensure a separate handling and treatment of covid wastes. And the local bodies were bound to authorize the CBWTF staffs, assign waste collectors, co-ordinate the activities of various quarantine and isolation centers, educate the workers on proper waste management practices and to equip them with adequate safety mechanisms.

As per the direction given by the National Green Tribunal, there had to be a more clear focus on the scientific management of wastes not just in the institutional level but even at the individual level. It asked the states to coordinate itself with Departments like Irrigation and Public Health to monitor and supervise the scientific gathering, storage and handling of Covid 19

wastes since, an unscientific disposal poses a serious threat to public health and the environment[287]. The tribunal urged for segregation of waste in a scientific manner as well as directed for use of digital technology in tracking Covid wastes from different sources[288].

So, as per NGT's directions, the CPCB launched an application, a digital tracking software called "COVID19BMW", to trace origin, carriage and disposal of Covid 19 trash. The waste generators and operators of various treatment facilities were to enter reliable data regarding the waste disposal, ensuring an appropriate monitoring and safe eradication of the hazardous wastes. Currently, the reports on the average daily production of Covid related clinical wastes are formulated on the basis of the data gathered from this application[289]. Besides this, the other revisions stipulated for equipping waste handlers with PPEs, its proper disposal and adequate training to the staffs[290].

### 5.4.3. SUPREME COURT DIRECTIONS:

The hon'ble Supreme Court has recently in *M.C Mehta v. Union of India & Ors.*[291], dealt with the issue of biomedical waste dumping in open spaces and in due consideration of the EPCA report[292], passed an order, with a few directions such as:

- mandatory usage of the COVID19BWM application (app) by municipal corporations and State Pollution Control Boards for regular monitoring of biomedical waste,
- State Pollution Control Boards have to ensure installation of online monitoring system (OCEMS) by the common treatment facilities
- The data thus gathered, should be shared with the Central and State Boards and efforts should be made to make this data available in the public domain

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[287] *In re: Scientific Disposal of Bio-Medical Waste arising out of Covid-19 treatment, Supra* note 15.
[288] *Id.*
[289] CPCB, Report on COVID-19 Waste Management, Central Pollution Control Board, 2020, https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/COVID19_Waste_Management_status_August2020.pdf. (last accessed: Sep. 21, 2021)
[290] CPCB, Guidelines for Handling, Treatment, and Disposal of Waste Generated during Treatment/Diagnosis/Quarantine of COVID-19 Patients - Rev. 4, 2020, Central Pollution Control Board, Government of India, https://cpcb.nic.in/uploads/Projects /Bio-Medical-Waste/BMW-GUIDELINES-COVID_1.pdf (accessed on Sep. 21, 2021)
[291] I.A No: 46339/2020 in WP (C) No: 13029/1985
[292] *Supra* note 273

- To implement a common barcoding system for the centre as well as the states through a collective initiative by the CPCB and the ministry of Environment, Forest & Climate Change[293].

However, considering the presence of numerous gaps in compliance of Biomedical Waste Management Rules[294], the implementation of the guidelines in the current context has become a considerable question mark.

## 5.5. A CRITICAL ANALYSIS OF THE EXISTING GUIDELINES

Inspite of earnest efforts on the part of CPCB, non-adherence to the guidelines was evident at every stage of disposal. Even though there were several revisions in these regulatory guidelines, no relevant improvements were apparent in the management of these wastes. There existed prominent challenges and lacuna in the proper implementation of these guidelines which is again attributable to the inconsistent and inadequate infrastructural and operational mechanisms across the country.

Firstly, the term 'covid waste' or 'covid related biomedical waste' was not defined under the existing guidelines. Therefore, it is not clear as to what amounts to covid waste and whatnot. People lack awareness on 'covid waste' leading to the inclusion of even food wastes under its category. Secondly, these guidelines have been framed on the basis of the "current knowledge" regarding Covid and in relation to the practices adopted during other communicable 'diseases like H1N1 or HIV'. This shows that the guidelines have been adopted without a detailed introspection into the nature and causes of Covid 19 and lacks competence. The fact that these guidelines have been drawn on the same lines as that of other common contagious diseases itself exhibits the lackadaisical manner in which the authorities have approached a pandemic like Covid-19. Moreover, these guidelines lack enforceability in the absence of any legal provision ensuring its strict compliance. It merely acts as a guiding light for those who wish to carry out judicious disposal of covid wastes.

[293] *In Re: M.C Mehta's* case, *Supra* note 292
[294] The Biomedical Waste Management Rules, 2016.

The weak monitoring mechanism and low rate of accountability are rectifiable only through an appropriate penal provision. The unscientific manner, in which the wastes were segregated, was a major cause for concern. As per a recent study, only 70% of the total biomedical wastes are getting properly treated through incineration, the remaining 30% are still dumped illegally or discarded into the municipal garbage bins on the roadsides[295]. The long time gap between collection and disposal of covid related waste, irregular segregation, and open dumping leads to further spread of the virus.

The diverse reports from media have constantly been affirming the existence of intricacies in the current waste disposal system all across the country. Lack of sufficient data on the total volume of Covid wastes generated has been a crucial setback of the existing system. Even though the Apex Court directed for a mandatory reporting of wastes through the COVID19BWM App, only around 184 CBMWTFs out of 198 had updated the status of wastes treated[296]. At first, more than one lakh waste generators had cooperated with the initiative but now, only about 5000-8000 of them share information on the quantum of wastes generated in the App[297]. So, this under-reporting of waste from innumerable sources is a matter of serious concern.

The waste generation in connection with covid not only occurs in healthcare facilities, but also at households and quarantine centers. This is where the real complication begins, because the local bodies will have to simultaneously track the covid patients as well as make arrangements for gathering biomedical wastes from the households situated within their jurisdiction. It is a difficult task considering the dynamic list of individual households. So, there is no clarity in the creation of Covid related wastes by households since, there is adequate tracking mechanism to record the same.

[295] Singh A and Saha K, COVID-19 and biomedical waste management, (2020), https://www.sprf.in/post/covid-19-and-biomedical-wastemanagement (last accessed: Sep. 22, 2021 3:15 PM).
[296] Central Pollution Control Board, Generation of COVID 19 related biomedical waste in States /UTs, Status Report, January 2021, https://cpcb.nic.in/covid-waste-management/ (last accessed: Sep. 22, 2021)
[297] Centre for Science & Environment, Under-Counting and Under representation of data dogs management of COVID-19 biomedical waste, https://www.cseindia.org/under-counting-and-under-representation-of-data-dogs-management-of-COVID-19-biomedical-waste-10871 (last visited: Sep. 22, 2021 3:25 PM)

The high cost involved in management of COVID-19 BMW (Biomedical Waste) is one of reasons why small scale healthcare institutions revert back from implementing it. Likewise, all states are not equal in available capacities in terms of material or financial resources so as to strictly comply with the existing guidelines. Only a few states such as Delhi, Maharashtra, Gujarat and Karnataka could afford to implement the waste management strategies to its full extent, considering their existing infrastructural facilities. There still exist areas that lack a proper Covid waste treatment facility and that, they rely on other cities or states for treating the medical waste or even depend on burial systems. As per the CPCB records, for the eight northeastern states in India, there exist only about 5 common treatment facilities (CBMWTFs), and that, these states still rely on conventional methods of burial of hospital wastes.

The loopholes in regulatory mechanism, the lack of adequate knowledge among waste handlers regarding the regulatory norms and absence of technical training in waste disposal strategies are certain issues in the effective implementation of the guidelines. A lax regulation often defeats the whole purpose of waste management. Therefore, the lacuna in policy and its implementation, specifically in relation to the monitoring capacities, has to be addressed and rectified immediately.

Vaccination blues

Biomedical wastes are generated not only in the process of treatment of Covid patients but also through the prevention of the disease. It is a reference to the current vaccination drive, which generates heaps of waste sharps in terms of, one syringe per dose of vaccine. The restriction on the reuse of such waste sharps ends up in the generation of billions of syringes and needles a year, adding to the existing biomedical waste burden. The recent assessment report of the CSE (Centre for Science & Environment) had estimated a generation of over 1.3 billion discarded needles and syringes out of vaccination centers[298]. As per the operational guidelines of 2020, the Covid vaccination wastes have to be disposed of in yellow color-coded and separately labeled bags or containers.

[298] *Id*.

## 5.6. CONCLUSION

The highly contagious nature of the Covid19 pandemic and its rapid transmission among human population has left us all in a state of angstiness. And, the stupendous rise in the volume of biomedical waste due to Covid, posed a critical challenge on the current waste management regulations across the world.

Considering the catastrophic nature of the virus, it is highly essential to revise the existing waste management strategies and regulations to thwart potential threats of the disease. Likewise, the unregulated and illegal dumping of covid wastes in open spaces poses an imminent danger on the environment and its resources, which inturn calls for an immediate action by the legislature, through an updation on the existing guidelines. Appropriate scientific strategies should be developed for the management of single-use materials and plastics such as PPE kits, which are used widely during a pandemic. Significant efforts must be laid on building capacity of waste handlers through proper training, awareness and bestowment of adequate safety equipments for the safe handling of hazardous clinical wastes.

Also, there exist an exigency to restructure the entire regulatory mechanism of biomedical waste disposals, so as to improve its efficiency, coverage and capacity to face future disasters. There has to be a more rigorous monitoring mechanism and operational standards to ensure transparency and efficiency in the working of CBWTFs and the focus must be on environmentally sound technologies for waste disposal. Thus, the current pandemic situation had been a learning experience for both the public as well as the governments so as not to repeat their past mistakes and to handle future disastrous situations in a more judicious way.

It can be stated that the pandemic did create any new biomedical waste issue in India but has only aggravated the severity of challenges in the biomedical waste sector[299]. The nightmare is not yet over and is still continuing and so is the trend in explosion of medical wastes.

[299] Rajak R, Chattopadhyay A, et al., *Assessment of bio-medical waste before and during the emergency of novel Coronavirus disease pandemic in India: A gap analysis*, WASTE MANAG. RES. 1, 10, (2021), DOI: 10.1177/0734242X211021473, (accessed on: Sep. 23, 2021, 10:25 AM).

# CHAPTER: 6

## CONCLUSIONS & SUGGESTIONS

Biomedical or healthcare waste refers to the waste generated by healthcare facilities or research institutes engaged in any activity for the protection and promotion of healthcare of the citizens. It is one of the leading pollutants released as an aftereffect of research, immunization, diagnosis, or treatment activities. This waste category includes sharps, pharmaceutical discards, chemical or radioactive wastes, pathological and infectious substances like discarded PPE kits, etc. These wastes lead to increased risk of disease transmission out of accidental contacts and needle stick injuries and result in adverse environmental consequences such as land, air, and water contamination. It has been globally estimated that more than 5.2 million populations, including four million children, die every year due to diverse diseases caused by improper disposal of healthcare wastes[300].

The outbreak of AIDS, Ebola, MERS-CoV, and the recent SARS-CoV, etc., had marked an exponential rise in the quantum of medical wastes due to the excessive or immoderate use of single-use disposable materials in preventing the morbidities. The disease pathogens and infectious agents exist in these wastes for hours and even days, increasing the risk of transmission, by mere contact. It is highly essential to make necessary arrangements for the proper and effective management of these biomedical wastes. It is not a mere moral responsibility but a legal liability of every healthcare service provider.

The Biomedical Waste Management Rules of 2016 is an excellent piece of legislation for regulating the collection, handling, and disposal of biomedical wastes in India. However, lack of adequate infrastructure, resources and the huge investments involved often lead to poor implementation. Deficiency in the system could be traced to careless handling, unregulated treatment, and illegal dumping, resulting in the mixing up of hazardous medical wastes with the general municipal garbage. Resale and re-use of virus-laden waste sharps and materials are also a common sight.

[300] Rahman M. M, Griffiths MD, et al., *Biomedical waste amid COVID-19: perspectives from Bangladesh*, 8 LANCET GLOB. HEALTH e1262, 2020.

The incompatibility of on-site waste treatment facilities is yet another cause for concern. These facilities use various techniques such as chemical disinfection, autoclaving or steam-sterilization, treatments based on high temperatures like microwaving, incineration, etc., as prescribed by the Biomedical Waste Management Rules. However, the rigid regulatory pollution standards and the huge costs involved in its installation are major hurdles in operating these facilities. So, this places more reliance on the Common treatment facilities, enhancing the need for improved regulation of these facilities. India had only around 200 CBMWTFs (Common Bio-Medical Waste Treatment Facilities) and nearly 225 captive incinerators, which is predominantly insufficient to meet the increasing waste treatment requirements, especially in the current global scenario. So, this shows that it has been five years since the BMWM Rules were enacted, and still, not all Union Territories or States were able to develop their common treatment facilities.

The unavailability of up-to-date and sufficient data on biomedical waste, especially in recent years, i.e., 2019 and 2020, and the under-reporting on the volume of medical garbage acts as a major limitation of the current biomedical waste management system. Likewise, various studies have shown that around 70% of the States had not implemented any monitoring mechanism stipulated under the Rules. So, there exists no regular monitoring of the wastes generated from healthcare facilities or disposed of in waste treatment facilities. The judiciary's approach in this context has also not produced fruitful results to be in tune with the existing regulations. Though there were sincere efforts from the part of the Apex Court as well as the National Green Tribunal in addressing the issue, those were not effective enough to ensure implementation of the Rules or to fulfill the set-out standards.

Now, coming to the Covid19 associated biomedical wastes, healthcare establishments across the nation had framed policies on managing wastes arising out of covid isolation and treatment centers. These policies were framed based on the BMWM Rules of 2016, the National IPC guidelines[301], and international documents like the World Health Organization and the CDC (Centers for Disease Control & Prevention) guidelines of 2020. The CPCB (Central Pollution Control Board) came up with its own guidelines on the management of Covid related wastes.

[301] Ministry of Health and Family Welfare, Guidelines on Infection Prevention and Control in Health Care Facilities, (issued in January, 2020)

In general, all types of healthcare wastes generated during a pandemic are considered hazardous. However, currently, there are no legislations or even proper guidance in India that provide for a clear definition of the term 'Covid waste' or a specification as to what constitutes a covid related biomedical waste. It was why even food wastes and patient beddings were considered covid wastes during the first wave of the virus. As per the CPCB guidelines, biomedical wastes from isolation homes had to be gathered in specific color-coded (yellow) bags and entrusted to an authorized intermediary as engaged by the CBWTF for the purpose of waste collection from such households and quarantine centers[302]. While certain States were able to establish a proper covid-waste collection mechanism, some states are still lagging. Most of the northeastern states have not even developed a CBWTF (Common Biomedical Waste Treatment Facility).

A major share of covid19 wastes (mainly from households) is treated as domestic solid waste than disposing of it at a CBWTF. At the same time, the used masks, gloves, and PPE kits had to be incinerated as per the guidelines but, the same were not possible in the case of households. Covid19 wastes generated at households also carry the same degree of intensity and risk and should be handled with due care and caution. Although the local bodies were entrusted with managing these wastes, there was no proper regulation, and the guidelines failed in their implementation at the grassroots level. The guidelines issued by the CPCB thus look attractive on paper but not in actual practice.

The IMA had already expressed its inability to continue with the medical waste management programs due to the unavailability of funds. The civic bodies and the agencies engaged by them in the collection of covid related wastes have also become overburdened with the massive rise in the volume of wastes. Likewise, there is a lack of adequate training and awareness among the healthcare workers and waste handlers regarding the new Covid related guidelines.

The right to a clean, healthy, and pollution free environment is the fundamental and inalienable right of every person. The efficient management of healthcare waste is a journey or pursuit, which could not be attained in a single instance. The goals of biomedical waste management are achievable only when each of the elements involved shares a common commitment towards

[302] Guidelines for Handling, Treatment, and disposal of waste generated during treatment/ diagnosis/Quarantine of Covid-19 patients, 2020, Rule c, (issued on March 19, 2020).

abiding by the existing rules and regulations. There should be a common consensus among healthcare facilities, workers, and CBWTFs with the support of a strong administrative and legislative framework to ensure the proper implementation of the Rules.

6.1. Research Findings

The research sought to explore the existing legal frameworks on biomedical waste disposal in India, its efficacy to curb indiscriminate waste disposals, and its viability in tackling the menace of Covid19 biomedical wastes. It gives an insight into what the waste handlers, healthcare facilities, and legislators must do to improve the current medical waste scenario. This theoretical framework has closely observed the fabric and pattern of the existing regulations, practices, and issues around them. Through a critical analysis of the legal regime, the researcher has attempted to address the concerns and challenges before the executive, and also examined the impact of covid19 wastes on the current regulatory mechanism.

The stakeholders did not comprehensively articulate the regulatory measures since it involved several scientific and technical interpretations. There were no effective or explicit communication strategies to get across to the people at various activity levels. The primary finding was that there existed a considerable gap between the policy and practices. It is evident from, the earlier mentioned, CPCB's annual report[303] that around 24000 HCFs/CBWTFs were flouting the BMWM Rules, and non-compliance with the emission standards was found in 20 out of 22 CBWTFs. The violations are expected to rise in the wake of the pandemic. The fact that the defaulters are not levied heavily for their violations leads to a repetition of these defaults. Diverse instances have indicated that the legal responsibility has been reduced to mere paperwork.

Thus, the conundrum is not with the Biomedical Waste Management Rules but in its implementation. Though the rules contain stringent provisions, it has not been comprehensively implemented. The various works of literature on the point also revealed that the Rules lacked implementation.

[303] *Supra* note 225.

Battling the covid issue has also created intricate environmental and humanistic challenges, requiring immediate State action. An equally alarming issue is the Covid19 related waste disposal. However, currently, there are no regulatory standards regarding the Covid19 medical wastes except for the CPCB guidelines, which is a mere guidance and lack enforceability. So, as per the research hypothesis, the researcher seeks to conclude that the existing legal framework, including the rules and guidelines, is insufficient to combat India's Covid-19 associated waste disposal.

Amendments are yet to be made in the Biomedical Waste Management Rules to recognize covid related medical wastes as a category and ensure strict monitoring and enforcement of its provisions. Moreover, any failure in taking appropriate and necessary measures would leave an indelible scar on our healthcare system.

## 6.2. SUGGESTIONS

It is quite easy to make improvements in the waste management system by pioneering the lower level or local healthcare facilities. But to have a far-reaching impact, an active governmental intervention is required. The first and foremost step is to enlighten the concerned ministry with the changes to be brought in the national biomedical waste regulation. It is a significant step in ensuring a sustainable and successful system of medical waste management towards which, all healthcare facilities could look upon. Rules and regulations are something which mobilizes governmental efforts towards proper utilization of resources and are often used to bring about changes in the existing healthcare scenario.

- Clarity in Definition

Before improving the regulatory system, the relevant terms should be clearly defined in scientific terms, covering all its elements and reflecting the goals as set out in the waste management strategy. A well-defined waste category ensures that the problem is half-solved. As such, the existing Rules should be revised to include within its category, the 'Covid19 wastes', to address the current deficiencies in the management of Covid19 associated biomedical wastes.

- Scientific segregation of wastes

Irrespective of the final disposal and treatment methods, it is crucial for every healthcare institution to properly segregate its biomedical wastes. The classification and categorization of biomedical waste by healthcare facilities should be based on collection, processing, treatment, and disposal. Diligent and earnest segregation of medical waste into different categories leaves out a very small portion to be disposed of by the CMWTFs. So steps should be taken to ensure its proper compliance by constituting bodies within a healthcare institution to monitor and control such practices. Under the power conferred by the SPCBs, the concerned local bodies should conduct regular inspections into these healthcare facilities, ensuring strict compliance with the segregation protocol.

- Waste sharps management

Secured disposal of waste sharps should be monitored with high priority and its safe collection, transportation and disposal should adequately be accounted for. A clear-cut management strategy should be developed for training the workers against the risk of needle-stick injuries.

- Minimization of hazardous materials

Policies should be developed and adopted to minimize or reduce the use of hazardous substances like lead and mercury, the disposal of which poses a serious environmental and health risk. Alternative technologies like electronic or digital mechanisms could also be resorted to in the diagnosis of diseases. Hospitals must use pollution-free, less hazardous, or nonhazardous materials in treatment or diagnosis.

- Regulation of incineration and Online Emission Monitoring System

There must be a consistent and continuous regulation of the incineration process to ensure that it is operated at moderate temperatures, preventing the emission of toxic gases. The issue of poor performance in the Emission monitoring systems should be addressed immediately. There must be a regular monitoring of the emission standards released by the OCEMS (online monitoring system). There must be an adequate mechanism to ensure an up-to-date reporting of this data in

the website of the concerned Pollution Control Boards, so that the data becomes accessible to the public as a whole. And, this would ensure a transparent functioning of these facilities.

- Barcoding system

There has to be an urgent improvement in the tracking of medical wastes. The system of barcoding as stipulated by the Rules of 2016 has not been fully implemented. So, it is highly essential to track the volume and processing of biomedical wastes. There must be a single integrated and centralized waste tracking mechanism for the nation to fulfill the goals enshrined under the Rules. The barcoding system should be regulated by the Pollution Control Boards itself and not left to the discretion of the CBWTFs, which would defy its whole purpose. Likewise, the data monitoring systems need to be improved for an effective and well-structured recording and tracking of biomedical waste generation.

- Tracking the recycling process

The medical wastes sent for recycling and the ash generated during incineration should also be tracked by extending the barcoding mechanism to cover recyclers. It has to be ensured that these wastes are recycled by authorized persons only. Enabling a barcoding system helps the Central and state Pollution Control Boards fix responsibilities in case of violation of the waste management Rules or Guidelines and trace the recycling of these wastes.

- General Waste

The general wastes from healthcare facilities are governed by the Solid Waste Management Rules of 2016. Since Covid19 has classified even general wastes as infectious, there has to be a clear demarcation between the types of waste falling under each category.

- Segregation of Covid19 wastes from households

In these pandemic times, there needs to be more rigid segregation of the infectious biomedical wastes generated at households because an equal amount of Covid19 related wastes are created at households also. The legislature must consider the possibility of including home isolations within the purview of healthcare facilities under the Rules. Also, the authorities should reach out

to every level of the population and create adequate awareness among them on the necessity of segregation of covid waste from the general domestic garbage.

- Framing of Policies

Healthcare facilities must develop policies to dispose of clinical wastes by integrating processes in evaluating its performance and regular training for health workers. For instance, the Safdarjung Hospital in Delhi framed and issued policies for governing biomedical waste disposal during the pandemic[304]. It accumulated the wastes at regular intervals, undertook category-wise disinfection, and ensured that the wastes were treated within 48 hours of collection. So, this practice could be adopted by other healthcare facilities also.

- Capacity building and Governance of CBMWTFs

The governments should focus on capacity building by setting up more and more CBMWTFs (Common Treatment Facilities) accessible for all, irrespective of the size of the healthcare facility. Preference must be given to cost-effective treatment techniques that are affordable even for small-scale clinics.

The functioning of these common facilities should be closely monitored to avoid any kind of illegal practices that would pose a greater risk to the environment. A separate department should be designated to supervise the activities of these CBWTFs to ensure proper compliance with the rules.

- Investment in Environment-Friendly Techniques

It is ironic that incineration of biomedical wastes merely transfers the risk of infectious waste to a more hazardous one. So the existing regulations must provide for alternative technologies. Healthcare systems should focus on developing environmentally sound, cost-effective and safer technologies for the disposal of medical wastes. Strategies must be adopted to encourage cooperation between the public and private sectors in developing new, safe, and environment-friendly technologies to treat these wastes.

[304] SJH, SJH Policy on Bio-medical waste management for BMW from patients in novel Corona Virus Ward/OPD, https://ncdc.gov.in/WriteReadData/l892s/9390326671580949311.pdf (last accessed: Sep. 30, 2021)

A feasible technology should be chosen only after a clear understanding of the goals to achieve and the wastes to be treated. However, the emphasis must be on the 'management of waste' rather than on the technology used. It is also necessary to set the national operating standards for efficient and controlled working of these technologies.

- Creating awareness among health workers

There has to be a more rigorous implementation of the rules by creating awareness among those handling or dealing with these biomedical wastes. Awareness campaigns should be organized among frontline workers and other waste handlers on the harmful effects of Covid19 related clinical wastes and its risks due to accidental exposures or contacts. Healthcare staff should also be given adequate training in the current waste management practices. The training and education programs should cover all workers, from healthcare professionals like doctors and nurses to the attenders, sanitation workers, to even rag pickers, enlightening them on the dire need to follow precautionary measures. Though the rag pickers fall outside the formal waste management cycle, they play a pivotal and integral role in breaking down the clinical waste burden. So their personal safety should also be considered a priority.

- Bar on reuse of Covid19 related wastes materials

Measures should be brought in to restrict practices such as resale and reuse of Covid19 wastes, which leads to an increased risk of contamination. The dealers engaged in such unauthorized practices should be brought under the penal provision of the regulation.

- Integration of the activities of Local Bodies

The activities of local bodies should be integrated, assigning them certain key responsibilities to ensure implementation of the rules even at the grassroots level. Their activities should be directed towards a streamlined monitoring of the disposal of covid wastes from households. The activities of District level committees (monitoring committees) should also be integrated under a unified system of management ensuring accountability and reliability of data.

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# APPENDIX

## THE NATIONAL UNIVERSITY OF ADVANCED LEGAL STUDIES

**Kalamassery, Kochi - 683503, Kerala, India**

### CERTIFICATE ON PLAGIARISM CHECK

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