POST-COVID 19 PANDEMIC IN INDIA: BIOMEDICAL WASTE MANAGEMENT CHALLENGES

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ABSTRACT

The discovery of the newly found COVID-19 virus has shed more light on the importance of managing biomedical waste. Developing countries like India have already struggled with the proper collection, segregation and management of healthcare due to financial, operational or technical constraints. The current pandemic comes with new risks and challenges making India even more vulnerable. This biomedical waste generated is not only a potential threat to human life but also has an adverse effect on the environment. The paper aims to understand the role of India in the management of Biomedical waste generated as a by-product in our fight against COVID-19. The study has been done to understand the laws and policies in India in the management of such waste and their effectiveness in reaching its objective.

Keywords*: Biomedical Waste, Biomedical Waste Management, BMW, COVID-19, COVID-19 Waste Management*

I. Introduction

DECLARED AS a global pandemic by the World Health Organisation (hereinafter referred as "WHO") on March 11, 2020, the outbreak of the COVID-19 has put a substantial burden on healthcare facilities (hereinafter referred as "HCFs") worldwide. The tally of COVID-19 cases around the globe has reached up to 196,192,848**,** with 4,197,030 deaths worldwide.[1] As

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[1] WHO Health Emergency Dashboard, India, *available at:* https://covid19.who.int/region/searo/country/in (last visited on July 28, 2021).

shown in Table 1, India, with 31,484,605 active cases and 422,054 death, is within the top five countries to be deeply affected by this pandemic. With this increase in infected patients, the pandemic has put a lot of pressure on the HCFs. This demands special arrangements by the health care system around the world to make special provisions like setting up of research facilities, isolation camps and quarantine buildings.

SR. NO	COUNTRY	TOTAL CASES	NEW CASES	TOTAL DEATHS
	World	19,61,92,848	+2,49,917	41,97,030
1.	United States of America	3,53,53,923		6,27,351
2.	India	3,14,84,605	+1,194	4,22,054
3.	Brazil	1,97,49,073		5,51,906
4.	Russia	61,95,232	+22,420	1,56,178
5.	France	60,26,115		1,11,695
6.	United Kingdom	57,45,526		1,29,303
7.	Turkey	56,38,178		51,048
8.	Argentina	48,75,927		1,04,352
9.	Colombia	47,47,775		1,19,482
10.	Spain	43,68,453		81,323

Table 1

Source: WHO

To counter the highly infectious nature of the disease, there has been an unpreceded demand for Personal Protective Equipment (hereinafter referred to as "PPE") kits and other single-use medical care equipment apart from products like reagents, chemicals, medicines, etc. Furthermore, the demand for superior quality hygiene PPE kits has also increased the production and consumption of the kits domestically. This has led to increased production of Bio-medical waste (hereinafter referred to as "BMW")[2]. To put it simply, BMW is such waste that is generated from any kind of medical procedures such as diagnoses, immunisation etc in healthcare facilities, research centres and laboratories or even at home.[3] The increased production of PPE kits etc could also be inferred from a report[4] that shows an increase in its production by 40 per cent monthly as against the 6.5 per cent increase between 2016-2020. It is estimated that the disposal of single-use face masks may generate 66kT of the yellow

[2] Oladele A Ogunseitan, "The Materials Genome and COVID-19 Pandemic*"* 72 *The Journal of The Minerals, Metals & Materials Society* 2128 (2020).
[3] P. Datta, G.K. Mohi, "Biomedical waste management in India: Critical appraisal" 10 *J Lab Physicians* 6 (2018).
[4] Covid-19 – PPE demand & supply perspective – Final Report, 2020 & 2021, *available at:* https://bit.ly/3rkLvcJ (last visited on May 15, 2022).

category of Biomedical waste (hereinafter referred as "Y-BMW")[5] per capita in one year.[6] BMW is further divided into four categories depending upon the source of production. Yellow waste generally includes human and animal anatomical waste, placenta, foetus, soiled waste, pre-treated microbiological and biotechnological waste, pharmaceutical and cytotoxic waste; linen and mattresses etc.[7] Detail discussions and the kinds of BMW are discussed in great detail ahead in the paper.

This unanticipated increase in the amount of BMW has created an additional burden on the BMW management system in countries worldwide.[8] Even the most reputed waste management systems in the world have been struggling to manage this surge in BMW in the last 15 months.[9] It was estimated that Wuhan city in China alone produced 240 tons of waste per day[10] during the peak of their first wave of the pandemic which was six times the regular production in the city. As a consequence of this, the authorities in China implemented more stringent strategies for waste management. The authorities in the United States of America also came up with policies to manage their waste products which are estimated to be increased from 5 MT/y to 300 MT/y.[11] The Republic of South Korea alone is estimated to have produced approximately 2000 T of BMW between the duration of January 20, 2020, to May 30, 2020.[12]

[5] One of the categories in which bio-medical waste is categorised under the Biomedical Waste (Management and Handling) Rules, 2016.

[6] A.L. Allison, EA Dempster, *et.al*, "The environmental dangers of employing single-use face masks as part of a COVID-19 exit strategy", 3 *UCL Open: Environment Preprint* 23 (2021).

[7] Bio-Medical Waste Management Rules, 2016, India, *available at:* https://dhr.gov.in/document/guidelines/bio-medical-waste-management-rules-2016 (last visited on May 15, 2022).

[8] Shortage of personal protective equipment endangering health workers worldwide, WHO, *available at*: https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide. (last visited on May 15, 2022).

[9] Parteek Singh Thind, Arjun Sareen, *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 *Environmental Pollution* 2 (2021).

[10] Mandy Zuo, "Coronavirus leaves China with mountains of medical waste", *South China Morning Post,* March 12, 2020, *available at:* https://www.scmp.com/news/china/society/article/3074722/coronavirus-leaves-china-mountains-medical-waste (last visited on May 15, 2022).

[11] Reuters Staff, "Discarded coronavirus masks clutter Hong Kong's beaches, trails", *Reuters*, March 12, 2020, *available at:* https://www.reuters.com/article/us-healthcoronavirus-hongkong-environme/discarded-coronavirus-masksclutter-hong-kongs-beaches-trails-idUSKBN20Z0PP (last visited on May 15, 2022).

[12] Safe Waste Treatment for COVID19: Lessons from the Republic of Korea, 2020, UN Economic and Social Commission on Asia and the Pacific, pg. 01, *available at:* https://www.unescap.org/sites/default/d8files/knowledge-products/200514%20waste%20management%20for%20COVID-19%28edited%29%20FINAL_0.pdf (last visited on May 15, 2022).

The situation in India is no different. Indian states like Maharashtra, Uttar Pradesh, Delhi and Kerala were worse affected by the second wave of the COVID-19 pandemic.[13] After compiling the data given in the monthly reports[14] as shown in Table 2 of Central Pollution Control Board (hereinafter referred as "CPCB") established under section 3 of the Water (Prevention and Control of Pollution) Act, 1974, it is seen that India generated 32,996.4 tonnes of BMW between June 2020 to December 2020. As shown below, with 5370 tonnes of waste, Maharashtra became the highest contributor to India's total waste production in the period of June 2020 to December 2020.

S.No	Name of States/UTs	COVID 19 BMW in Tones							TOTAL
		June	July	August	September	October	November	December	
1.	Andaman and Nicobar	0.42	INP	INP	0.42	0.434	0.42	0.43	2.124
2.	Andhra Pradesh	165.48	182.81	118.82	112.35	116.095	317.91	328.51	1341.975
3.	Arunachal Pradesh	3.36	3.36	3.80	3.36	3.472	3.36	3.47	24.182
4.	Assam	28.38	20.68	12.57	62.61	51.739	50.07	23.41	249.459
5.	Bihar	6.84	20.76	41.54	45.36	44.64	28.08	23.31	210.53
6.	Chandigarh	29.85	5.65	55.34	43.02	73.191	70.83	73.19	351.071
7.	Chhattisgarh	11.19	INP	13.39	9.3	9.61	9.3	9.61	62.4
8.	Daman & Diu	0	INP	0.00	0.48	2.387	1.08	1.15	5.097
9.	Delhi	333.42	389.58	296.14	382.5	365.893	385.47	321.32	2474.323
10.	Goa	0.81	0.81	INP	15	7.75	5.43	5.39	35.19
11.	Gujarat	350.79	306.14	360.04	622.89	545.879	423.51	479.57	3088.819
12.	Haryana	75.33	184.18	210.69	278.31	238.452	239.4	209.93	1436.292
13.	Himachal Pradesh	3.81	12.50	4.94	25.2	28.117	30.03	48.24	152.837
14.	Jammu and Kashmir	10.71	9.77	51.77	57.39	59.303	44.82	35.12	268.883
15.	Jharkhand	INP	INP	2.59	4.8	4.96	4.8	11.63	28.78
16.	Karnataka	84	540.28	588.03	168	218.023	210.99	218.02	2027.343
17.	Kerala	141.3	293.32	588.05	494.1	641.979	600.39	542.47	3301.609
18.	Lakshadweep	0.3	INP	INP	0.3	0.31	0.3	0.31	1.52
19.	Madhya Pradesh	224.58	56.40	106.59	339	308.419	208.65	249.49	1493.129
20.	Maharashtra	524.82	1180.00	1359.0	524.82	542.314	609	629.30	5369.254
21.	Manipur	5.13	0.20	2.09	5.13	5.301	5.13	9.27	32.251
22.	Meghalaya	5.1	1.74	6.34	9.9	12.028	7.65	8.56	51.318
23.	Mizoram	4.2	INP	INP	4.2	3.224	3.12	3.22	17.964
24.	Nagaland	3.6	3.40	3.10	2.85	3.317	1.86	2.29	20.417
25.	Odisha	31.86	106.63	109.19	134.01	183.458	222.66	125.58	913.388
26.	Puducherry	18.63	35.82	41.54	63	58.652	28.74	17.11	263.492
27.	Punjab	48	35.59	21.19	234.42	149.606	96.51	86.99	672.306
28.	Rajasthan	177	7.15	50.43	145.08	171.554	141.93	105.93	799.074
29.	Sikkim	6	0.20	0.30	6	4.216	3.69	2.45	22.856
30.	Tamil Nadu	312.3	401.29	481.10	543.78	524.179	300.75	251.22	2814.619
31.	Telangana	12.3	10.50	24.04	188.82	144.801	103.89	68.82	553.171
32.	Tripura	0.45	INP	INP	0.45	0.465	0.45	0.47	2.285
33.	Uttarakhand	0.45	0.82	41.85	21.72	108.996	56.76	76.26	306.856
34.	Uttar Pradesh	210	307.54	408.86	507.15	479.082	316.71	276.46	2505.802
35.	West Bengal	195	136.37	235.12	434.76	486.793	330.84	279.06	2097.943
	TOTAL	3025.41	4253.46	5238.45	5490	5597	4864.53	4527.55	32996.4

Table 2

Source: CPCB Reports from June 2020 to December 2020.

[13] Sujita Kumar Kar, Ramdas Ransing, *et. al.*, "Second wave of COVID-19 pandemic in India: Barriers to effective governmental response", 36 *E Clinical Medicine* 1 (2021).

[14] COVID-19 Biomedical Waste Management Status, CPCB, *available at:* https://cpcb.nic.in/covid-waste-management/ (last visited on May 15, 2022).

This unprecedented production of BMW and the importance of its management becomes the agenda for the discussion in this paper because of the various health hazards and risks to the public health associated with this specific category of waste. The unusual production of BMW both from households (patients with home isolation) and HCFs due to increased usage of gowns, protective clothing and equipment, gloves and masks have created a situation of waste emergency worldwide.[15] According to WHO, out of all the health-care waste generated[16], 85 per cent of the waste is generally not hazardous.[17] However, it is that 15 per cent of the waste which is hazardous and includes infective waste (10%), chemical waste, radioactive waste, cytotoxic, etc which if left untreated without proper disposal can become a potential threat not only to the present generation but also to the generations in the future.[18] The ineffective and inappropriate management of waste can have serious consequences on public health as well as the environment. Unlike general municipal waste, BMW comes with an extra set of precautions and instructions that makes its management different from any other regular waste.

Experts also believe that neglecting the management of COVID-19 waste can potentially cause a threat to the spread of the virus by secondary means.[19] Internal segregation, confinement, and incineration are the most often utilised strategies for its disposal and management. Grinding, shredding, and disinfection (e.g., autoclaving and chemical treatment) are also typical processes, followed by landfilling. All these activities require human interaction with waste which comes with occupational and health safety issues.

Recently, studies have also proved the relationship between air pollution and the spread of the COVID-19 virus.[20] Activities like dumping, incineration or open burning degrade the air

[15] Y. Ma, X. Lin, *et.al*, "Suggested guidelines for emergency treatment of medical waste during COVID-19: Chinese experience. Waste Disposal & Sustainable Energy*",* 2 *Waste Disposal and Sustainable Energy* 84 (2020).
[16] Health-care waste, 2018, WHO, *available at:* https://www.who.int/news-room/fact-sheets/detail/health-care-waste (last visited on May 15, 2022).
[17] *Ibid.*
[18] A. Bruss, E. Giroult, *et. al.* (eds.), *Safe Management of wastes from health-care activities,* World Health Organisation, 1999, *available at:* https://apps.who.int/iris/bitstream/handle/10665/42175/9241545259.pdf (last visited on May 13, 2022).
[19] United nations Environment Programme, "COVID-19 Waste management Factsheets, 2020" (June, 2020) *available at:* https://www.unep.org/resources/factsheet/covid-19-waste-management-factsheets (last visited on May 15, 2022).
[20] Y. Zhu, J Xie, *et.al*, "Association between short-term exposure to air pollution and COVID-19 infection-Evidence from China" 727 *The Science of Total Environment* 1, 5 (2020); H. Li, X L Xu, *et.al*, "Air pollution and temperature are associated with increased COVID-19 incidence: a time series study", 97 *International Journal of Infectious Disease* 278, 280 (2020).

quality and expose humans to toxins by releasing them in the open air.[21] This makes it even more problematic for countries like India, where incineration is considered one of the most common methods of dealing with this waste. In cases where small incinerators operate erroneously or inappropriately, unburned waste, incomplete ash disposal and harmful gases are released. The release of such gases can be up to 4000 times the limit set in the Stockholm Convention.[22] Thus managing an insurmountable amount of waste while avoiding an increase in air pollution, eliminating the chances of secondary transmission and exposure to toxins in a sustainable manner is the biggest challenge of all times.[23] These situations have created real challenges for countries that are not developed and are still struggling in implementing standard waste management policies.[24]

In light of the above discussion, specifically discussing about India, where the health care sector expands at a 22 per cent Compound Annual Growth Rate since 2016[25], only 28 per cent of the hospitals segregate waste[26]. As many as 40 per cent of the total hospital do not segregate the waste according to the local guidelines.[27] India may suffer serious consequences during the COVID-19 pandemic because of a defective BMW management system and shortage of resources.[28]

In 2016, the Central Government issued the Biomedical Waste Management Rules **(**hereinafter referred to as "BMW Rules") in accordance with the authority provided by the Environment Protection Act, 1986[29] (hereinafter referred to as "EPA"). The Ministry of

[21] Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19: interim guidance, 2020, *available at:* https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-WASH-2020.4 (last visited on May 15, 2022).
[22] S. Batterman, *Assessment of Small-Scale Incinerators for Health-Care Waste*, Water, Sanitation and Health Protection of the Human Environment World Health Organization (January 21, 2020), *available at*: https://apps.who.int/iris/bitstream/handle/10665/68775/a85187.pdf?sequence=1&isAllowed=y (last visited on May 16, 2022).
[23] UNEP, COVID-19 Waste management Factsheets, 2020, *available at:* https://www.unep.org/resources/factsheet/covid-19-waste-management-factsheets (last visited on May 16, 2022).
[24] V Chitnis, K Vaidya, *et.al., "*Biomedical Waste in Laboratory Medicine: Audit and Management", 23 (1) *Indian Journal of Medical Microbiology* 6-13 (2005).
[25] NITI Aayog, *Investment Opportunities in India's Healthcare Sector* (NITI Aayog, 2021), *available at:* https://www.niti.gov.in/documents/reports?page=4 (last visited on May 17, 2022).
[26] *Supra* note 9, at 3, pg. 2.; Biomedical Waste Management Rules, MoEFCC, 2016, India, *available at*: https://dhr.gov.in/sites/default/files/Bio-medical_Waste_Management_Rules_2016.pdf (last visited on May 16, 2022).
[27] Overview of technologies for the treatment of infectious and sharp waste from health care facilities by World Health Organisation, *available at:* https://apps.who.int/iris/bitstream/handle/10665/328146/9789241516228-eng.pdf?ua=1 (last visited on May 16, 2022).
[28] M. Anwer and M. Faizan, "Solid waste management in India under COVID19 pandemic: challenges and solutions" 9 (6) *International Journal of Engineering Research and Technology* 368, 369 (2020).
[29] The Environment (Protection) Act, 1986, (Act 29 of 1986).

Environment, Forest & Climate Change (hereinafter referred to as "MoEFCC") issued further amendments in the rules in 2018 and 2019 to govern BMW management operations throughout the country, which was long overdue. CPCB is the apex body in the country that looks after the BMW management activities in the country. The Board works under MoEFCC. Each state has its own State Pollution Control Board[30] (hereinafter referred to as "SPCB") that are responsible for managing BMW handling activities in their state and reporting to the CPCB.

In light of the above discussion, healthcare activities may both recover health and save lives; but they can also generate harmful biological wastes that are harmful to humans and the environment and it is much apparent that the current epidemic has intensified the severity of the issues confronting India's BMW sector. Due to the gravity of the problem, there is considerable literature on BMW in domains like science and technology dealing with various scientific aspects related to BMW disposal and its implication on the environment and public health. The papers published in science and technology journals have sparingly included research on the statutory framework in India with respect to biomedical waste disposal. However, when it comes to the legal backdrop, literature is scarce. The general legal rules with relation to BMW management laws in India have been published in multiple research papers; this research work, on the other hand, addresses contemporary advancements in biomedical waste management in light of the COVID-19 pandemic based on data provided in reports from various organisations and agencies, discusses the laws enforced in India with respect to the subject matter, traces the evolution of the biomedical waste from an International perspective and furthers analyses the implementation of laws and guidelines in India specifically during the pandemic and so differs from prior publications.

The study intends to analyse the nature, scope and precaution laid down under the BMW Rules and the guidelines issued by CPCB for handling and disposing of BMW. The adequacy of the laws and the extent of the efficacy of administrative agencies effectively handling and properly disposing of BMWs is analysed.

It is a doctrinal study based on primary and secondary data and a systematic literature review. Both primary and secondary sources of data are relied upon. For Primary data, various Acts, Statutes, Ordinances, International, National and Regional Instruments, like Conventions, Declarations, Protocols, Treaties and Judgments of various cases and different Reports have

[30] The Water (Prevention and Control of Pollution) Act, 1974 (Act 6 of 1974), s. 4.

been studied. As the Secondary Sources, different Books, Articles, Published and Unpublished thesis and Dissertations have been relied upon and consulted.

The BMW has been a crucial issue in the present time due to its propensity to become a global health hazard affecting both the health and the environment. The scope of the study is confined to the study of the laws in India and analysing the efficacy in its implementation.

Since the area relating to BMW Management is very large, only the problems created by the non-implementation of legal provisions and guidelines are to be investigated. The present study has been focused on BMW management under health care establishments only. Other forms of BMW generated through ways and means unconnected with human healthcare management like originating from research activities, veterinary care and healthcare establishments under Army and Defence, although important in their way, have not been dealt with in the present study.

II. International Agreements and conventions on Biomedical waste management

Prior to the Stockholm Conference, there were no specific Conventions that had any connection with the subject matter, perhaps since such type of waste is of recent origin. Stockholm Conference[31] of 1972 is considered as the first step towards the modern international environmental law by the member countries of the world. This environmental conference led to the forming of the United Nations Environment Programme ("UNEP"). The year after the Stockholm Conference, United Nations Environmental Program identified hazardous waste as one of the key areas in need of global regulation.[32] UNEP led to the adoption of various conventions on the movement of hazardous waste.

The Basel Convention on the Transboundary Movement of Hazardous Wastes[33], adopted in 1989, was created to address the danger of harm to human health and the environment posed by hazardous and other waste disposal and transboundary movement[34]. It attributed liabilities to the member nations for the contravention of provisions that prohibits transboundary movement of hazardous waste illegally[35]. In such cases, the onus lies on the member nation

[31] It is also known as the United Nations Conference on the Human Environment and is considered as the first conference on environment.
[32] Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 1972 and the Rio Declaration on Environment and Development, 1992, *available at:* https://legal.un.org/avl/pdf/ha/dunche/dunche_e.pdf (last visited on May 16, 2022).
[33] Adopted by the Conference of Plenipotentiaries in Basel, Switzerland.
[34] Muthu S. Sundram, "Basel Convention on Transboundary Movement of Hazardous Wastes: Total Ban Amendment" 9(1) *Pace International Law Review* 2 (1997).
[35] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes, 1989, art. 6, 7.

transporting such waste illegally to dispose of the waste safely by reimporting it into the state of generation or otherwise.[36] Clinical wastes from medical treatment in hospitals, medical centres, and clinics, as well as wastes connected to pharmaceuticals and medications, were expressly addressed by the Convention. The technical guideline on the ecologically sound treatment of bio-medical and healthcare waste, released in 2003, is an essential document and a step in the right direction.[37]

Agenda 21[38] was an important document under the United Nations Conference on Environment and Development[39], also known as the Rio Conference or Earth Submit. The Second section[40] of Agenda 21 deals with issues such as radioactive waste, toxic waste hazardous waste etc.

Despite the failure to reach an agreement on a total or partial ban on hazardous waste transboundary movement, the Contracting Parties to the 1989 Convention worked tirelessly to achieve the Basel Ban Amendment in 1995. All hazardous wastes covered by the Convention that are intended for ultimate disposal, reuse, recycling, or recovery from nations specified in annexe VII to the Convention are prohibited from being exported to all other nations.

It was in 1992 when the Basel Convention entered into force. Since then, COP had thought of adopting a mechanism to assign liability and provide compensation for any damages resulting from such activities**.** This finally resulted in The Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal, 1999[41]. This protocol lays down provisions for strict and no-fault liability and has yet not come into force.

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[36] *Id.*, art. 8, 9.

[37] Secretariat of the Basel Convention, UNEP, *Technical guidelines on the environmentally sound management of biomedical and healthcare wastes* (March 19, 2017), *available at*: http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/TechnicalGuidelines/tabid/8025/Default.aspx (last visited on May 25, 2022).

[38] United Nations Sustainable Development, *Agenda 21*, United Nations Conference on Environment & Development, held on Rio de Janerio, Brazil, June 3-14, 1992, *available at:* https://sustainabledevelopment.un.org/content/documents/Agenda21 (last visited on May 25, 2022).

[39] G.A. Res. 44/228, Dec. 22, 1989, cited in Peter P. Rogers, Kazi F. Jalal, *et. al., An Introduction to Sustainable Development* (Earth Scan, 1st Edn., 2008).

[40] It has total of four sections.

[41] *Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal*, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Held on (Basel Switzerland, December 10, 1999), *available at:* http://containeronline.ca/wp-content/uploads/2019/02/1999-Basel-Protocol.pdf (last visited on May 26, 2022).

This was followed by The Stockholm Convention on Persistent Organic Pollutants (POPs)[42] signed in 2001 and adopted in 2004, and Minamata Convention on Mercury,[43] Strategic Approach to International Chemicals Management,[44] among the others.

Soon in 2011, the Cartagena Declaration[45] was adopted at the tenth Conference of Parties (CoP) to *"sets forth a strong commitment by the Parties to the Basel Convention to promote the prevention and minimisation of the generation of hazardous and other wastes."*[46]

Being an active participant, India is under a commitment to interpreting the contents and decision of international gatherings, treaties and agreements into the stream of national law. Article 253[47] of the Constitution explicitly empowers the Parliament to make any law for the entire or any part of India for enforcing any treaty, agreement or convention. The Parliament has made use of this power to enact the EPA of 1986[48], which later on paved paths for the Biomedical Waste (Handling and Management) Rules 1998.

III. Provisions under the Indian Constitution

Our Constitution is a wholesome document if we have to trace out the provisions for the prevention and protection of our environment. Article14[49] has proved to be a potent weapon in the hands of the court while questioning and challenging the government sanctions for projects which possess high environmental impact.[50]

Article 19(1)(a) protects freedom of speech and expression when expressing ideas on environmental issues. Under Article 19(1)(g), all citizens enjoy the right to engage in any

[42] UNEP, *The Stockholm Convention on Persistent Organic Pollutants*, Conference of Plenipotentiaries, Held on Stockholm, Sweden, May 22, 2001, *available at*: http://www.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx (last visited on May 26, 2022).
[43] Entered into force on August 16, 2017.
[44] Adopted by the First International Conference on Chemicals Management (ICCM1) on February 6, 2006 in Dubai.
[45] *Cartagena Declaration on the Prevention, Minimization and Recovery of Hazardous Wastes and Other Wastes*, Basel Convention, Held on (Cartagena, Colombia, October 17-21, 2011), *available at:* http://www.basel.int/Implementation/CartagenaDeclaration/Overview/tabid/5854/Default.aspx (last visited on May 25, 2022).
[46] *Ibid.*
[47] The Constitution of India, art. 253 – "Legislation for giving effect to international agreements. — Notwithstanding anything in the foregoing provisions of this Chapter, Parliament has power to make any law for the whole or any part of the territory of India for implementing any treaty, agreement or convention with any other country or countries or any decision made at any international conference, association or other body."
[48] *Supra* note 29 at 6.
[49] *Supra* note 47, art. 14 – "Equality before law. —The State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India."
[50] *Kinkri Devi* v. *State of Himachal Pradesh,* AIR 1988 HP 4.

profession, trade, or business, subject to reasonable limitations. As a result, a citizen's ability to do business may be prohibited if it poses a health risk to society or the greater public.[51]

Article 21[52] of the Indian Constitution has been interpreted to encompass the right to a healthy environment. In *T. Damodhar Rao* v. *Municipal Corporation of Hyderabad* [53]**,** the apex court held:

> …it would be reasonable to hold that the enjoyment of life and its attainment and fulfilment guaranteed by article 21 of the Constitution embraces the protection and preservation of nature's gifts without which life cannot be enjoyed. There can be no reason why the practice of violent extinguishment of life alone should be regarded as violative of article 21 of the Constitution. The slow poisoning by the polluted atmosphere caused by environmental pollution and spoliation should also be regarded as amounting to a violation of article 21 of the Constitution.

The court has again emphasised on the role of the article 21 when it comes to the enjoyment of a clean and safe environment as a fundamental right in cases like *L.K. Koolwal* v. *State of Rajasthan*[54], *Chhetriya Pardushan Mukti Sangharsh Samiti* v. *State Of U.P*[55] and many more. Article 14, 19 and 21, also known as the Golden Triangle of the Indian Constitution, has been invoked time and again for the protection of the environment.

Important Environmental principles such as Polluter Pays principles[56], Sustainable Development[57] and Precautionary Principles[58] have also guided courts to undo the harm caused and to punish the perpetrator.

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[51] Pooja P. Vardhan, "Environment Protection under Constitutional Framework of India", *Press Information Bureau* (2014), *available at*: https://pib.gov.in/newsite/printrelease.aspx?relid=105411 (last visited on May 16, 2022).

[52] *Supra* note 47 at 10, art. 21 – "Protection of life and personal liberty. —No person shall be deprived of his life or personal liberty except according to procedure established by law."

[53] AIR 1987 AP 171.

[54] AIR 1987 SC 1086.

[55] AIR 1990 SC 2060.

[56] Satish C. Shastri, "The Polluter Pays Principle and the Supreme Court of India", 42 *Journal of the Indian Law Institute* 110 (2000); Polluted Pay Principle as laid down in the 1992 Rio Declaration necessitates polluter to bear the remedial or clean-up costs just as the sum payable to remunerate the survivors of pollution. The principle for the first time was applied and defined in the case of *Indian Council for Enviro-Legal Action* v. *Union of India* (1996) 2 JT (SC) 196.

[57] Rio Earth Summit Declaration, 1992, Principle 8, 23; Sustainable development is defined as development that serves present needs without jeopardising coming generations' capacity to meet their needs.

[58] Rio Declaration, 1992, Principle 15; The precautionary principle states that if there is a high likelihood that a certain practice may have ecologically detrimental implications, it is preferable to take action immediately rather than wait for irrefutable scientific evidence.

Article 48-A[59] also directly talks about the environment. Article 51A(g)[60] obligates every Indian citizen to strive for better levels of effort and performance continuously.

IV. Role of Judiciary

Judiciary also has a huge role to play in the management of BMW. The concerns relating to the management of waste, including waste from HCFs, caught the eye of the judiciary for the first time in the case of *Dr B.L. Wadhera* v.. *Union of India*[61]. Recognising the *"statutory right to live in a clean city",* the court held that the Municipal Authorities must look after the management of waste and *"non-availability of funds inadequacy or inefficiency of the staff, insufficiency of machinery etc. cannot be pleaded as a ground for non-performance of their statutory obligations."* All HCFs with more than 50 beds were directed to arrange for incineration. CPCB and Delhi Pollution Committee were required to regularly visit the premises to ensure directions on generation, collection, management, transportation of the waste generated from these facilities. In fact, the Bio-Medical Wastes (Handling & Management) Rules, 1998,[62] has been considered as the outcome of the Apex Court's concern on the subject.

In *Almitra H. Patel* v. *Union of India*[63], the Supreme Court was compelled to issue directives[64] defining a code for the collection, transportation, and disposal of municipal solid

[59] Inserted by way of Constitutional (Forty-Second Amendment) Act 1976. *Supra* note 47 at 10, art. 48A – "Protection and improvement of environment and safeguarding of forests and wild life. — The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country"

[60] Inserted by way of Constitutional (Forty-Second Amendment) Act 1976. *Supra* note 47 at 10, art. 51A - "Fundamental duties. — It shall be the duty of every citizen of India— to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures"

[61] AIR 1996 SC 2969.

[62] It was notified under the Environment (Protection) Act, 1986 (29 of 1986).

[63] (1998) 2 SCC 416.

[64] "1. The Municipal Corporation of Delhi, NDMC and all other concerned officials to ensure that the relevant provisions of the DMC Act, 1957, Delhi Municipal Council Act, 1994 and the Cantonments Act, 1924 relating to sanitation and public health prohibiting accumulation of any rubbish, filth, garbage or other polluted obnoxious matters in any premises and/or prohibiting any person from depositing the same in any street or public place shall be scrupulously complied.

2. That the streets, public premises such as parks etc. shall be surface cleaned on daily basis, including on Sundays and public holidays.

3.To levy and recover charges and costs from any person littering or violating provisions of the diverse Acts, Bye-laws and Regulations relating to sanitation and health for violating the directions being issued herein.

4. To ensure proper and scientific disposal of waste in a manner so as to subserve the common good.

5. That the sites for landfills will be identified bearing in mind the requirement of Delhi for the next twenty years within a period of four weeks.

6. To take appropriate steps for preventing any fresh encroachment or unauthorised occupation of public land for the purpose of dwelling resulting in creation of a slum. Further appropriate steps be taken to improve the sanitation in the existing slums till they are removed and the land reclaimed.

garbage due to non-compliance with the above-mentioned instruction. MoEFCC notified the Municipal Solid Waste (Management and Handling) Rules, 2000[65], as a result of the above-mentioned decision.

To find the lacunas in the system and to come up with a possible solution, a committee was constituted as a consequence of the judgment given in the case of *Dinanath Waghmare* v. *The District Collector, Nagpur District*[66]. In *Environment Monitoring Forum* v. *Union of India,*[67] the management and handling of the BMW were considered to be the duty of the institution generating such waste. The court in the case of *P. K. Nayyar* v. *Union of India.*[68] recognised the health hazards of BMW generated from hospitals and nursing stations. Lacunas in the management of waste have potentially serious health issues. The court held that positioning if incinerations or lap filling at a distance of 30 to 40 meters is not a safe distance to be unaffected by the ill effects of the waste and hence cause damage to the environment and adversely affect the health of the residents nearby.

V. Present Legal Framework in India

The Biomedical Waste Management Rule of 2016 under rule 3(f) defines Bio-medical waste as:

> any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps, including the categories mentioned in Schedule I appended to these rules.

Thus, Biomedical waste includes waste like human anatomical waste, animal waste, microbiology & biotechnology waste, waste sharps, discarded medicines & cytotoxic drugs, soiled waste, solid waste, liquid waste, incineration ash, chemical wastes. These wastes are potentially hazardous as are infectious in nature and may pose a serious threat to human health.

Today the BMW generated due to treatment of COVID-19 patients in India is regulated by the Solid Waste Management Act of 2016 and the BMW Rules of 2016 enacted by the

7. To identify and make available to the MCD and NDMC within four weeks from today sites for setting up compost plants. Initially considering the extent of solid waste, which is required to be treated by compost plants, the number of sites which should be made available will be eight."

[65] It was notified under the Environment (Protection) Act, 1986 (Act 29 of 1986).

[66] WP (C) 19303/2013.

[67] (2003) MANU/KE/0894.

[68] (2013) 198 DLT 689.

Central Government in the exercise of its powers given under section 6[69], 8[70] and 25[71] of the EPA, 1986[72]. However, this is not the first act that tried to deal with Biomedical waste. The first act that categorically catered to this specific kind of waste was The Hazardous Waste (Management and Handling) Rules 1989, enacted using the same powers under the EPA, 1986[73]. However, this act did not specifically deal with biomedical waste. Only some components of the waste were included in it. Hence there felt a need to enact legislation that particularly deals with BMW. As the result of the need to enact special legislation on BMW along with the direction given by the apex court[74], Bio-Medical Wastes (Handling & Management) Rules, 1998 was enacted. Legal loopholes and lacuna in the 1998 rules led to its amendment in 2000 and 2003. New draft rules were framed in the year 2011[75]. It was recently in the year 2016 when the new Bio-Medical Wastes Management Rules was enacted. As a result, the new Rules will not apply to radioactive wastes, hazardous chemicals, solid wastes, lead batteries, hazardous wastes, e-waste, or hazardous microorganisms, as these wastes are covered by the various Acts/Rules[76] issued to date.

Earlier, the BMW was segregated into ten categories under the Biomedical Waste (Handling and Management) Rules 1998 under Schedule I, as listed below in Table 3.

[69] The Environment (Protection) Act, 1986 (Act 29 of 1986), s. 6 – "Rules to regulate environmental pollution. — (1) The Central Government may, by notification in the Official Gazette, make rules in respect of all or any of the matters referred to in section 3."
[70] *Id.*, s. 8 – "Persons handling hazardous substances to comply with procedural safeguards. — No person shall handle or cause to be handled any hazardous substance except in accordance with such procedure and after complying with such safeguards as may be prescribed."
[71] *Id.*, s. 25 - "Power to make rules. — (1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act."
[72] *Supra* note 29 at 6.
[73] *Ibid*.
[74] *Supra* note 61 at 12.
[75] The Biomedical Waste (Management and Handling) Rules, 2011.
[76] For example, The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, The Batteries (Management and Handling) Rules, 2001, The Atomic Energy Act, 1962 (Act 33 of 1962), The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Municipal Solid Waste (Management and Handling) Rules, 2000, e-Waste (Management and Handling) Rules, 2011 etc.

Type	Category	Includes
1.	Human Anatomical Waste	Pathological waste consists of human tissues, organs, body parts, human fetuses, blood, body fluids.
2.	Animal Waste	This category contains animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses.
3.	Microbiology & Biotechnology Waste	Wastes from laboratory cultures stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from the production of biologicals, toxins, dishes and devices used for transfer of cultures.
4.	Waste Sharps	Sharps are items that could cause cuts or puncture wounds. This category includes needles, hypodermic needles, syringes, scalpels, blades, knives, infusion sets, saws, broken glass and nails. This includes both used and unused sharps. Owing to their property of invading the primary defence barrier of the body i.e. the skin they are the most potent way of transmission of bloodborne pathogens.
5.	Discarded Medicines and Cytotoxic Drugs	Such waste comprised of outdated contaminated and discarded pharmaceutical products, drugs, vaccines and sera. Cytotoxic or antineoplastic drugs, the principal substances in this category, have the ability to kill or stop the growth of certain living cells and are used in the chemotherapy of cancer.
6.	Solid Waste	Wastes generated from disposable items other than the waste sharps‘such as tubings, catheters, intravenous sets etc. Basically these include plastics used in patient care.
7.	Solid Waste	Wastes generated from disposable items other than the waste sharps76such as tubings, catheters, intravenous sets etc. Basically these include plastics used in patient care.
8.	Liquid Waste	Waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities.
9.	Incineration Ash	Incineration ash of any biomedical waste is categorized as hazardous waste under the Hazardous Waste Rules. The ash can have heavy metals and can be contaminated with toxins such as dioxins and furans
10.	Chemical Waste	Chemicals used in the production of biological and chemicals used in disinfection, as insecticides etc.

Table 3

Source: Bio-Medical Waste (Management & Handling) Rules 1998

Under the 2011 rules, Category eight and nine were removed as separate categories thus reducing to only eight categories. Under the present rules, waste has been categorised into four categories[77] mentioned in Table 4.

[77] Bio-Medical Wastes (Management and Handling) Rules, 2016, schedule 1, rules 3 (e), 4(b), 7(1), 7(2), 7(5), 7(6) and 8(2); Bio-Medical Wastes Management Rules, 2016, part 1.

S. No.	Category	Type of Waste	Colour & Type of Container
1.	Yellow Category	-Human Anatomical Waste -Animal Anatomical Waste -Soiled Waste -Discarded or Expired Medicine -Microbiology, Biotechnology and other clinical laboratory waste -Chemical Waste (yellow-e) -Chemical Liquid Waste	Yellow coloured non-chlorinated Plastic Bags Note: (i) Chemical waste (yellow-e) comprising of un-used, residual or date expired liquid chemicals including spent hypo of X-Ray, should be stored in a yellow container
2.	Red Category	Contaminated Waste (Recyclable)	Red Coloured Non-Chlorinated Plastic Bags (having thickness equal to more than 50 μ) and Containers
3.	White Category	Waste Sharps including metals	White Coloured translucent, puncture-proof, leak-proof, Temper Proof containers
4.	Blue Category	-Glassware -Metallic Body Implants	Puncture proof, leak-proof boxes or containers with blue coloured marking

Table 4

Source: Schedule I of the Bio-Medical Waste Management Rules, 2016

The present law[78] provides for more stringent standards of incineration and a bar-code system for bags containing such refuse. This rule is not only applicable to hospitals and nursing centres but also to vaccination camps, blood donations and surgical camps. CPCB issued guidelines for the management of waste generated during diagnostics and treatment of COVID-19 suspected/confirmed patients on March 18, 2020[79]. The guidelines addressing the problem of treatment and management of BMW generated from hospitals and quarantine centres were later revised on March 25, 2020[80]; April 18, 2020[81]; June 10, 2020[82]; July 17

[78] The Biomedical Waste (Management and Handling) Rules, 2016.
[79] Central Pollution Control Board. "Guidelines for Handling, Treating, and Disposing of Waste generated during Treatment/Diagnosis/ Quarantine of COVID-19 patients", (Ministry of Environment, Forest, And Climate Change, 2020).
[80] Central Pollution Control Board. "Revision 1 Guidelines for Handling, Treating, and Disposing of Waste generated during Treatment/Diagnosis/ Quarantine of COVID-19 patients", (Ministry of Environment, Forest, And Climate Change, 2020).
[81] Central Pollution Control Board. "Revision 2 Guidelines for Handling, Treating, and Disposing of Waste generated during Treatment/Diagnosis/ Quarantine of COVID-19 patients", (Ministry of Environment, Forest, And Climate Change, 2020).
[82] Central Pollution Control Board. "Revision 3 Guidelines for Handling, Treating, and Disposing of Waste generated during Treatment/Diagnosis/ Quarantine of COVID-19 patients", (Ministry of Environment, Forest, And Climate Change, 2020).

2020[83]. Stakeholders are required to adopt these principles in addition to current standards under the BMW Rules, 2016.[84]

The guidelines identify and lay down duties of Urban Local Bodies (hereinafter referred to as "ULB"), the methods of collection, management and disposal of waste. The latest guidelines issued on July 17 2020, provided revised guidelines for Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients. It guides on the segregation of BMW from general solid waste generated from quarantine centres and other HCFs and methods of disposing of PPE kits. All the COVID-19 isolation wards, including railway yards and temporary facilities, are to follow these guidelines. A Foot-operated bin with a lid labelled as "COVID-19" shall only be used for the collection and storage of BMW. Such waste shall only be collected by the authorised staff of the Common Biomedical Waste treatment facility (hereinafter referred to as "CBWTF"). Separate colour-coded bins/bags/containers/trolleys keep rubbish separated according to the rules. The bags used to collect BMWs must be double-layered to prevent leaks. Containers, bins, and trolleys, as well as wet and dry solid waste, must be disinfected with a 1 per cent sodium hypochlorite solution. General solid garbage must be collected separately in bags that are not yellow in colour. Opening of any new COVID-19 ward shall be registered to space/pics, and CBWTF and waste generated shall be updated through an application "COVID19BMW". To maintain occupational safety, general solid waste shall be not be segregated from BMW at temporary waste collection and storage centres.

Persons running Quarantine Centres/Camps/Home Quarantine or Home Care facilities have also been assigned duty[85]. The general solid waste generated by these facilities must be kept segregated and sent to the MSW collector specified by ULBs for eventual disposal. Tissues, gloves, masks, and swabs tainted with blood are excluded from the definition of general solid waste. BMW will be collected and kept in specially designated dust bins. It also gives direction to the person taking care of quarantine homes to deposit the BMW in Yellow coloured bags to the authorised collector under ULBs.

[83] Central Pollution Control Board. "Revision 4 Guidelines for Handling, Treating, and Disposing of Waste generated during Treatment/Diagnosis/ Quarantine of COVID-19 patients", (Ministry of Environment, Forest, And Climate Change, 2020).

[84] S. Chand, C.S. Shastry, *et.al.*, "Updates on biomedical waste management during COVID-19: The Indian scenario" 11 *Clinical Epidemiology and Global Health* 3 (2021).

[85] Waste Management during the COVID-19 Pandemic from Response to Recovery, UNEP, (August, 2020), *available at*: https://reliefweb.int/sites/reliefweb.int/files/resources/WMC-19.pdf (last visited on May 16, 2022).

Masks worn by people who aren't COVID-9 patients must be disposed of after 72 hours of storage in a paper bag and cut into pieces to avoid reuse.[86] PPE such as three-layer masks, splash-proof aprons/gowns, nitrile gloves, gumboots, and safety goggles must be provided to CBWTF workers. SPCBs/PCCs will be responsible for ensuring correct BMW segregation, collection, and disposal in accordance with BMW Rules, 2016 and CPCB standards. Rural or distant regions without access to CBWTFs may utilise deep burial pits to dispose of yellow category trash as per the guidelines set out in Schedule II of the BMW Rules, 2016.

ULBs must hire approved garbage collectors to collect BMW from residents' doorsteps and transport it to collection locations where it will be picked up by the CBWTF. If there are fewer quarantined homes/homecare units, ULBs may hire CBWTFs to collect garbage straight from residents' doorsteps.

The waste collected by segregation shall be stored in well-ventilated areas and later on transported in designated closed vehicles with Global Positioning System tracker to the waste disposal facility for proper treatment and disposal.[87] According to the updated guidelines, treatment or storage of waste on the site of generation is prohibited. Once the waste reaches the CBMWFs, it is then treated, sterilised. According to the category of waste, the waste undergoes the process of incineration, landfilling or dumping. The facilitates generating BMW and governed by the BMW Rule 2016 shall maintain qualitative and quantitative data on the amount and the process of waste generated and disposed of.

VI. Analysis

According to the latest CPCB Annual Report on Biomedical waste for the year 2019[88], India generated 619 TPD of Biomedical waste from 3,22,425 HCFs out of which a total of 544 TPD of waste were treated.[89] This is only 5 TPD more than that generated in the year 2018[90] with 534 T of BMW treated every day. Similarly, a total of 559 TPD of waste was generated

[86] Amended in Rev. 2 of guidelines dated 18.04.2020 and Rev. 4 dated 17.07.2020; Criteria for 72 hours is as per CDC guidelines for Decontamination and Reuse of Filtering Facepiece Respirators.
[87] Central Pollution Control Board, *available at:* https://cpcb.nic.in/ (last visited on May 16, 2022).
[88] Central Pollution Control Board, "Annual Report on Biomedical Waste Management as per Biomedical Waste Management Rules, 2016- For the year 2019" 1 (Ministry of Environment Forest & Climate Change, 2019).
[89] *Ibid.,* pg. 2.
[90] Central Pollution Control Board, "Annual Report on Biomedical Waste Management as per Biomedical Waste Management Rules, 2016- For the year 2018" 2 (Ministry of Environment Forest & Climate Change, 2018).

in the year 2017 with 518 T of BMW waste treated daily.[91] Around 13 per cent of waste remain untreated in the year 2019 and 2018 which is 6 per cent higher than that remained untreated in the year 2107. This data is before the presence of BMW emergency due to COVID-19.

Today, 710 tons of BMW waste are generated in India, out of which 101 tonnes of waste is COVID-19 generated[92]. The country's infrastructure and human resources are insufficient to accommodate this massive influx of BMW. The country's 198 CBMWFs and 225 captive incinerators are insufficient to actively control the flood of BMWs. This additional BMW wreaked havoc on BMW's disposal. Only 1.1 lakh of the 2.7 lakh HCFs identified are currently permitted under the BMW Rules, 2016.[93]

According to the CPCB research, 25 per cent of the HCFs examined had not obtained a licence from their respective State PCBs, preventing BMW monitoring. COVID-19 waste is generated by 2,907 hospitals, 20,707 quarantine centres, 1,539 sample collecting centres, and 264 testing laboratories.[94] COVID-19 biomedical waste is collected, transported, and disposed of by around 198 CBWTFs from hospitals, isolation wards, quarantine centres, home quarantines, homecare, sample collecting centres, and testing laboratories.[95]

Implementation of 'COVID19 BWM' Tracking Application

Out of 198 CBWTFs, 184 CBWTFs are registered however there are 18 CBWTFs, yet to be registered with the "COVID19BWM" application to track and record the data.[96] The reports of the SPCB and the data collected on the COVID-19 BMW waste tracking APP reflects an average of 203 tons per day (hereinafter referred to as "TDP") of COVID-19 BWM generated

[91] Central Pollution Control Board, "Annual Report on Biomedical Waste Management as per Biomedical Waste Management Rules, 2016- For the year 2017" 2,3 (Ministry of Environment Forest & Climate Change, 2017).
[92] Report by CPCB in O.A No. 72 of 2020, *available at*: https://greentribunal.gov.in/sites/default/files/news_updates/Status%20Report%20in%20O.A%20No.%2072%20of%202020.pdf (last visited on May 16, 2022).; Mashura Shammi, Arvind Behal *et al.*, "The Escalating Biomedical Waste Management To Control the Environmental Transmission of COVID-19 Pandemic: A Perspective from Two South Asian Countries" 7 *Environ. Sci. Technol.* 4091 E (2021).
[93] *Id.*, at 10.
[94] *In re: Scientific Disposal of Bio-Medical Waste arising out of Covid-19 treatment- Compliance of BMW Rules 2016*, O.A. No. 72/2020, pg. 03, 06, *available at*: http://www.indiaenvironmentportal.org.in/files/file/COVID-19-waste-NGT-order.pdf (last visited on May 23, 2022).
[95] Generation of COVID19 related Biomedical Waste in States/UTs generated by Central Pollution Control Board, Delhi, August, 2020, *available at:* https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/COVID19_Waste_Management_status_August2020.pdf (last visited on May 16, 2022).
[96] *Supra* note 94 at 19, pg. 10.

until May 10, 2021.[97] As presented in Table 5, the peak reached on May 10, 2021, where the BMW generated was about 250 TDP. In 2020, the peak was generated between 180- 220 TDP. In May 2021, around 5,048 generators of COVID-19 waste have registered on the said App. Out of 198 CBWTFs, 168 reported the COVID-19 BWM generation on the Tracking App.

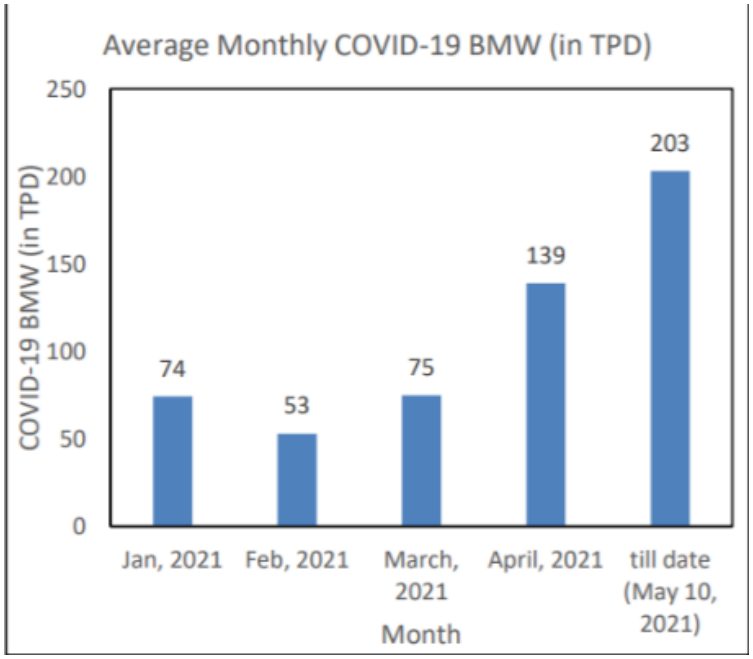

Table 5

Source: Central Pollution Control Board

Waste generation and treatment facility

Table 6 shows the data on the total amount of BMW generated and the no of CBWTFs engaged in each state and Union Territories.

[97] Generation of COVID19 related Biomedical Waste in States/UTs generated by Central Pollution Control Board, Delhi, May, 2021 *available at:* https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/COVID19_Waste_Management_status_Jan_May_2021.pdf (last visited on May 16, 2022).

S.No.	State	Total quantity of BMW generated	Number of CBWTFs engaged
1.	Andaman and Nicobar Islands	0.2	No CBWTF
2.	Andhra Pradesh	25.7	11
3.	Arunachal Pradesh	1.0	No CBWTF
4.	Assam	8.6	1
5.	Bihar	35.6	4
6.	Chandigarh	5.6	1
7.	Chhattisgarh	16.4	2
8.	Dadar Nagar Haveli	0.3	1
9.	Delhi	37.2	2
10.	Goa	2.0	No CBWTF
11.	Gujarat	50.5	20
12.	Haryana	21.0	11
13.	Himachal Pradesh	4.2	2
14.	Jammu and Kashmir	13.9	2
15.	Jharkhand	4.9	2
16.	Karnataka	72.6	25
17.	Kerala	89.5	1
18.	Lakshadweep	72.0	No CBWTF
19.	Madhya Pradesh	23.8	14
20.	Maharashtra	82.7	29
21.	Manipur	1.4	1
22.	Meghalaya	1.7	2
23.	Mizoram	0.9	No CBWTF
24.	Nagaland	0.2	No CBWTF
25.	Odisha	18.7	4
26.	Puducherry	4.9	3
27.	Punjab	18.8	5
28.	Rajasthan	25.7	8
29.	Sikkim	0.5	No CBWTF
30.	Tamil Nadu	55.3	9
31.	Telengana	18.4	11
32.	Tripura	1.4	1
33.	Uttarakhand	6.6	2
34.	Uttar Pradesh	61.4	18
35.	West Bengal	43.1	6

Table 6

Source: CPCB Report

The method of deep burial pits is still used in states like Himachal Pradesh, Kerala, Manipur, Odisha, Rajasthan, Uttarakhand, Assam, Jharkhand, Madhya Pradesh, Meghalaya, Puducherry and Tamil Nadu as the CBWTF facility is insufficient.

The incineration facility, along with CBWTF, are insufficient to deal with waste generated by COVID alone in states like Bihar, Kerala, Odisha, Jammu and Kashmir, Meghalaya and Uttarakhand. There is a need to set up new CBWTFs in these states.

There is also a need to increase the capacity of the incinerators in cities like Pune and Thane, where the generation of such waste is beyond the capacity of the facilities.

Another problem that needs immediate attention is the overburden on the incinerators. The available capacity of incineration of BMW is 840 tons/day (hereinafter referred to as "TPD")[98] which is sufficient to treat 710 TPD of BMW. However, owing to an increase in the output of biomedical waste, there may be a capacity constraint in some places or cities where the existing capacity of CBWTFs in a 150-kilometre coverage area is insufficient. In such cases, stand-by facilities such as incinerators, industry captive incinerators, and the like should be made available, and deep burial should be used only as a last option. Heavy metals, such as mercury and lead, can cause significant soil contamination if they are present in the trash that is buried or if they are not buried according to the required standards.[99]

BMW is required to be segregated separately and treated differently than other domestic waste. Apart from creating severe health hazards as discussed above, disposal of BMWs in the general garbage bin used for disposing of municipal waste increases the load on CBWTF since they are not designed for domestic waste. Domestic garbage that is not segregated can result in the incineration of plastic garbage that should otherwise be disposed of in a red bin for sterilisation and recycling. Incineration of plastic materials with even a trace of chlorine in their composition might result in the creation of dioxin[100] which is an unintentional by-product of waste combustion. The burning of Polyvinyl Chloride (PVC) which is a common ingredient in medical equipment is a primary source of Dioxin production. With a half-life of being 7-11 years[101], Dioxins are highly stable compounds that get stored in human fatty

[98] *Supra* note 94 at 19, pg. 07.
[99] Jessica Briffa, Emmanuel Sinagra, *et.al.*, "Heavy metal pollution in the environment and their toxicological effects on humans" 6(9) *Heliyon 6, e04691* (2020).
[100] Alfons Buekens and Kefa Cen, "Waste incineration, PVC, and dioxins" 13 *Journal of Material Cycles and Waste Management* 190 (2011).
[101] Dioxins and their effects on human health, WHO, *available at:* https://www.who.int/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health (last visited on May 16, 2022).

tissues.[102] Exposure to dioxins has an adverse impact on reproductive and developmental health as well as the immune system, endocrine mechanisms, nervous system.[103]

In addition to proper management and disposal of BMW, there is a need to spread awareness of the precaution and the guidelines to be followed while handling such waste by both professional workers of the general public. A model plan should be created at all levels of government, including the Panchayat, Subdivision, District, and State, and it should be revised as needed. In addition to providing them with suitable safety gear, there is a requirement for online orientation/training of personnel accountable for compliance in the Local Bodies and Health Department.

With challenges revolving around proper waste segregation, categorisation protocols and disinfection of gloves, PPE kits, masks etc, India not only struggles with the problem of inefficiency in pre-treatment and proper waste disposal but also lack of awareness among those who are actually handling the waste.

VII. Conclusion and Suggestions

The outbreak of the novel coronavirus has not only exposed the poor healthcare infrastructure in countries and the lack of preparedness to battle a pandemic but also loopholes in their waste management process. It has forced us to reflect on the gaps in BMW Rule compliance in terms of capabilities to appropriately dispose of waste generated and non-compliance with procedural and monitoring components.

This article examines India's overall role in the handling of BMW during the COVID-19 pandemic. The whole BMW management infrastructure must be evaluated, and appropriate expenditures in expansion to boost capacity and coverage must be undertaken. Such an investment will be worthwhile, as it will assure safe and sound BMW management with the capability to prepare the country for any future calamity.

The author comes up with suggestions that could be implemented to deal with the waste generated in this fight with the COVID-19 virus in the long run.

1. Campaigns on both print and online media, social media, pamphlets etc., shall be used to educate the general masses, workers and waste handlers about the precautions and

[102] *Ibid.*
[103] Mrinalini Goswami, Pranjal J. Goswami *et al.*, "Challenges and actions to the environmental management of Bio-Medical Waste during COVID-19 pandemic in India" 7 *Heliyon* 10 (2021).

guidelines for handling and disposal of waste. This fight can't be won without including the participation of the general public in it.

2. Any HCFs or CBMWFs violating the provision of the BMW Rule 2016 shall be liable for strict penalties. Despite stringent rules, there have been cases of violation of the provisions. According to the statistics given by the CPCB in their 2018/2019 Annual Report[104], 23,942 HCFs breached the BMW Rules 2016, suggesting a significant level of non-compliance with these recommendations. For their violations, 18,210 HCFs received a warning. These data show that a large volume of BMW is produced; however, 13 per cent of HCFs have broken BMW guidelines. This brings to a close BMW's terrible management and handling.

3. Other critical features that demand ongoing emphasis from the necessary authorities to ensure safe and appropriate disposal of the BMW include a strict monitoring mechanism, operational and functional effectiveness of CBWTFs and transparency considerations.

4. For the safe collection, treatment, and disposal of BMW, there is a need to give more attention to the innovation of environmentally friendly technology and capacity training of healthcare staff and waste-handlers. India should design technology to generate clean fuel by the use of BMW on the lines of the Welsh Government.[105] Start-ups and small industries shall be promoted to come forward to convert BMW into construction brick or other eco-friendly construction material. Research shall be done on the aspect of converting BMW for the construction of roads and partial replacement of cement in concrete.

5. The experience of BMW management throughout this worldwide catastrophe can help authorities establish a well-equipped system for safe disposal in the post-COVID-19 situation, as well as give insights for future catastrophe preparations.

[104] *Supra* note 90 at 19; *Supra* note 91 at 19.

[105] Kevin Sullivan, "Sunlight Could Turn Covid Waste into Clean Fuel – Funding for New Swansea-Led Project" *Swansea University Press*, Nov. 12, 2020, *available at:* https://www.swansea.ac.uk/press-office/news-events/news/2020/11/sunlight-could-turn-covid-waste-into-clean-fuel--funding-for-new-swansea-led-project.php (last visited on May 24, 2022); A team led by the Swansea University has developed a novel process known as the "photo reforming" wherein sunlight is used to simultaneously kill the virus and convert the non-recyclable medical waste like mask and PPE kits into clean hydrogen fuel. The process does not create greenhouse gases and can also generate organic feedstock for chemical industry. The team also includes epidemiology experts from India and has received £47,000 from the Welsh Government for the project

The proper statutory framework to regulate BMW helps battle the situation that requires urgent and immediate preparedness, readiness and response. The laws should develop a holistic system of master management starting from generation and segregation until final disposal. Reports from time and again have shown that even implementing legislation, there has been mismanagement. They are frequent instances of violation of the provisions. Although the government has made efforts to improve the situation effectively and efficiently, it's difficult to conclude if the laws are fulfilling the objective with which they're were implemented.

"Let the wastes of the sick not contaminate the lives of the healthy."