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The Bio-Medical Waste Management Concerning Covid-19 Waste: A Case Study Of Bathinda, Punjab

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Abstract

The increase in COVID-19-associated waste (CAW) in the environment might result in their easy approach to other organisms, possibly increasing the potential risk of contaminating the food chain (in ecosystems like freshwater, marine, and terrestrial). Hence, an increase in the quantity of COVID-19-associated waste might lead to a waste disaster when not managed properly. The need of the hour is to create a more efficient, automatic, mechanized, and well-modified waste management system for handling the present situation and delaying the projected waste disaster in the aftermath of COVID-19. The present study incorporates the issues originating to waste discharges, their potential sources, the possible sustainable solutions towards environmental sustainability, and on-site strategies. Proper management of COVID-19 waste is essential for the survival of humankind. It is also kept of equal importance for the environment and animals. The researchers have observed that the the Bio-medical Waste Management Rules, 2016 have not been adequately implemented by the HCFs regarding COVID-19 waste in Bathinda, Punjab.

Keywords: Covid 19, Biomedical Waste, Laws and Policies, health

Introduction

Humans live in an era of development based on overall progress, including economic and social perspectives. Countries of the world are divided into three groups: developed, developing, and least developed. Among the other developmental indices, the socio-economic aspect is the most significant constraint in deciding the vulnerability level of a country towards human health problems.[i] The human-to-human transmission and higher contagious properties of this pandemic created a major concern among the lower-income countries (least developed and developing). Because of the higher population and proportion of people having below or poor socio-economic conditions, these countries are at major risk of current public health emergencies.[ii] Before the COVID-19 pandemic, biomedical waste sources were limited to hospitals, nursing homes, biomedical research centers, etc.[iii] But in the meantime, biomedical waste quantity and sources have increased significantly. Nowadays, on a global scale, every solid waste parcel generated per person contains certain proportions of biomedical waste, including used masks, air respirators, hand gloves, gowns, aprons, face shields, and other protective gear. An enormous amount of solid waste

is dumped pointless without proper treatment in the outskirts of the urban area, along the roadsides in the open areas. This leads to an increased vulnerability towards this disease (COVID-19) among people living in those areas, from frontline sanitation workers to rag-pickers and those living in the nearby slum areas.[iv] Due to unawareness of the people about the hazardous nature of biomedical wastes associated with contagious diseases, wastes are not dumped accordingly and get mixed up with other types of wastes (like municipal solid waste and industrial wastes) deliberately. It creates a big challenge for the waste management system, as the system is not well planned to manage such situations. There is a major but un-noticeable role of rag-pickers in waste management.[v] The studies have shown that about 60% of rag-pickers are non-native migrant workers that come to the cities for their livelihood.[vi] Many studies showed the persistence and infectivity of different human coronaviruses on certain inanimate surfaces like metal, plastic, glass, clothes, and papers for up to 9 days at room temperature.[vii] The longer persistence of viruses on the wastes surface and infectivity of viruses adhered to such wastes pose a high rise of contamination in the ecosystem when thrown carelessly. The increase in COVID-19 associated waste (CAW) in the environment might result in their easy approach to other organisms, possibly increasing the potential risk of contaminating the food chain (in ecosystems like freshwater, marine, and terrestrial). Hence, an increase in the quantity of COVID-19 associated waste might lead to a waste disaster when not managed properly. Some countries have already started to make backup plans and are struggling to overcome such type of projected waste disaster.[viii] The need of the hour is to create a more efficient, automatic, mechanized, and well-modified waste management system for handling the present situation and delaying the projected waste disaster in the aftermath of COVID-19. Transmission and persistence of COVID-19 by various mediums, sources (point and non-point) of COVID-19-associated waste generation. The impacts of COVID-19-associated waste on components of the biosphere, the anticipated waste disaster of COVID-19, possible solutions toward solid and liquid waste management, and possible innovative solutions of COVID-19-related issues are the main objectives that are illustrated in the present study. Although the literature is available on COVID-19-related issues, there is a need to address the issues with a holistic approach. The present study incorporates the issues originating to waste discharges, their potential sources, the possible sustainable solutions towards environmental sustainability, and on-site strategies.[ix]

Guiding Principles for the Disposal of COVID-19 Waste[x]

Five guiding principles are recognized worldwide for waste management. These principles are also helpful to developing countries when enacting legislation, rules, regulations, and policies.

- The “Polluter pays” principle implies that all waste producers are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce. This principle also attempts to assign liability to the party that causes damage.[xi]
- The “Precautionary” principle is a persuasive principle governing health and safety protection. It was defined and adopted under the Rio Declaration on Environment and Development (UNEP, 1972) as Principle 15: “Where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation”.[xii]
- The “Duty of care” principle stipulates that any person handling or managing hazardous substances, wastes, or related equipment is ethically responsible for using the utmost care in that task. This principle is best achieved when all parties involved in the production, storage, transport, treatment, and final disposal of hazardous wastes (including healthcare waste) are appropriately registered or licensed to produce, receive and handle named categories ofwaste.[17]

- The "Proximity" principle recommends that treatment and disposal of hazardous waste occur at the closest possible location to its source to minimize the risks involved in its transport. Similarly, every community should be encouraged to recycle or dispose of the waste it produces within its territorial limits unless it is unsafe.[xiii]
- The "Prior informed consent principle" embodied in various international treaties is designed to protect public health and the environment from hazardous waste.[xiv] It requires that affected communities and other stakeholders be apprised of the hazards and risks and that their consent be obtained. In the context of healthcare waste, the principle could apply to the transport of waste and the siting and operation of waste treatment and disposal facilities.

The Bio-Medical Waste Management (Amendment) Rules, 2018[xv]

The Biomedical Waste Management Rules, 2016, have been amended and updated to improve compliance and strengthen the implementation for a better environment. In 2018, the Government of India published the Bio-Medical Waste Management (Amendment) Rules 2018.[xvi] Some of the significant reforms in the 2018 rules are:

I. Complete phasing out of chlorinated plastic items such as bags and gloves from the bio-medical waste generators including hospitals, dispensaries, animal houses, clinics, nursing homes, blood banks, etc.[xvii]
II. Within two years of these rules' publication, all institutions must publish an annual report on their site.[xviii]
III. The guidelines issued by the Central Pollution Control Board, all the operators of common bio-medical waste treatment and disposal facilities, have to establish a global positioning system and a barcoding system for handling bio-medical waste.[xix]
IV. The State Pollution Control Board has to compile, review and analyze the information received by the operators and send these reports to the Central Pollution Control Board, which keeps detailed information regarding district-wise waste generation.[xx]

One of the major challenges that will be faced by the healthcare facilities and hospitals in implementing these rules and guidelines is the lack of funds as to phase out chlorinated plastic bags and establish a global positioning and a barcode system for biomedical waste, a huge cost will be incurred and the period for the same is concise, i.e., two years.[xxi] Another major challenge is the use of incinerators and the hazards it causes. After implementing the first rules in 1998, India saw a boom in the installation of incinerators. Based on the high temperature, the system kills the pathogen, and in the process, it also destroys the material in which the microbes reside. However the limitation of this system is that it produces several toxins during the process, such as products of incomplete combustion and dioxins.[xxii] These products of incomplete combustion are the particles formed during the incineration and dissociation of waste components. By this method, metals are not destroyed but dispersed into the environment causing severe health problems. These toxins accumulate in fatty acids and travel up the food chain. It damages the immune and endocrine systems of human beings. In foreign countries like the Philippines and Denmark, incinerators are banned, and the Government of India should take similar steps to mitigate these toxins from the environment.[xxiii]

The major technology used to dispose of biomedical waste is incineration, microwaving, autoclaving, and chemical treatment. Apart from these, some new technologies have also been developed or are still under research, such as thermal and biological, irradiative, and chemical processes.[xxiv]Most waste, including cultures, soft waste (gauze, bandages, and gowns), human waste, laboratory waste, and sharp medical instruments, are sterilized in the thermal processes.[xxv] These thermal processes

are divided into three groups- low heat technologies (operating between 93 C and 177 C), which include microwaves and autoclaves; medium heat technologies(operating between 177 C and 540 C), which include reverse polymerization and thermal depolymerization, and high heat technologies (operating between 540C and 8300C) which include plasma, induction, lase oxidation based pyrolysis.[xxvi] In biological processes, bio converters and biodegradable plastic systems are used to dispose of biomedical waste.[xxvii] The Central Government vide notification G.S.R. 129(E) on 19th March 2019 has published in the e-gazette, the Bio-Medical Waste Management (Amendment) Rules, 2019, to amend the Bio-Medical Waste Management Rules, 2016. The key highlights of the amended Rules are as follows:

I. The occupier of all bedded health care facilities shall maintain and update the bio-medical waste management register on a day-to-day basis.[xxviii]
II. All bedded HCFs shall display the monthly record of waste disposal management on their website.[xxix]
III. Such HCFs (irrespective of any number of beds) shall make the annual report available on their website before 19 March 2021.[xxx]
IV. HCFs with less than ten beds shall comply with the output discharge standard for liquid waste by 31st December 2019.[xxxi]

The World Health Organization issued guidelines related to COVID-19 waste management on March 23, 2020. The guidelines have been updated many times. Here, the researchers have discussed the third edition of the guidelines. This third edition gives additional details on COVID-19 waste management. The guidelines have been given in two paragraphs. the first paragraph discussed the human and technical resources that are necessary to segregate, recycle, and dispose of the waste safely. This paragraph also discussed there is no evidence of the transmission of COVID-19 from the handling of healthcare waste. this para has also defined the COVID-19 waste. according to this para, there is no difference between general waste and COVID-19 waste. therefore, there is no necessary for additional treatment for COVID-19 waste without providing any guidelines by the institute. [xxxii] Para second of the guidelines discusses most of the health care waste is non-infectious. Non-infectious waste should be segregated from the infectious waste in clearly marked bins, bagged and tied, and disposed of as general municipal waste. para second of these guidelines also discuss how the COVID-19 waste is managed and disposed of. The COVID-19 waste should be collected safely in clearly marked lined containers and sharp boxes. This waste should be treated, preferably on-site, and then safely disposed of. Preferred treatment should be used for the disposal of the COVID-19 waste. High temperature, dual chamber incineration, and autoclaving should be used for the disposal of COVID-19 waste. These guidelines discuss the healthcare workers who handle the COVID-19 waste. All those who handle COVID-19 waste should wear appropriate PPE (long-sleeved gown, heavy-duty gloves, boots, mask, and goggles of a face shield) and workers perform hand hygiene after removing it.[xxxiii] Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19: Interim guidance - Many cities report a significant increase (5 times greater than before the Pandemic) of medical waste generated in hospitals, primarily through the use of PPE. Therefore, increasing the capacity to handle and treat this healthcare waste is essential without delay. Additional waste treatment capacity, preferably through alternative treatment technologies, such as autoclaving or high-temperature burn incinerators, may need to be procured, and systems may need to be put in place to ensure sustained operation. Ideally, safe waste disposal is linked to purchasing and investments in PPE. As an interim measure, safely burying health care waste may be done until more sustainable measures can be implemented. Manual chemical disinfection of Waste is not recommended, as it is not regarded as reliable and

efficient. In addition, countries should work to establish sustainable waste management chains, including addressing logistics, recycling, treatment technologies, and policies.[xxxiv]

Taken measurements	Implications	Impacts
Safety	PPE and hand sanitizer for workers.	Protects workers from being infected.
Disinfectant	Disinfecting waste prior to sorting.	Prevents workers from contracting the virus and spreading it to others.
Storage	Temporary storage for 9 days.	Helps to handle excess waste and prevent it from spreading the virus, which can persist for up to 9 days.
Treating location	On-site treatment.	Suitable for handling extra waste.
Treating technique	Sterilwave (an ultra-compact mobile treatment system), autoclave, burn incinerator, SF-CO2 sterilization, microwave or radio-wave treatment.	Kills the virus.
Handling	Sorting waste and putting it in different bags based on type of waste.	Easier to handle and dispose of.
Social distancing	1.5 m among workers and public during waste handling	Prevents infection and spread.
Training	Using PPE and sanitization.	Use of these will help protect from infection
Advertisement of guidelines	Social media and display in workplaces.	People will become more aware of health measures.

Table 1: Analysis of the guidelines of the WHO

Name of the Institute	Polluter Pays	Precautionary	Proximity	Prior Informed Consent	Duty of Care
WHO	X	✓	✓	X	✓
UNEP	X	✓	NO	X	✓
MoH&FW	N/A	N/A	N/A	N/A	N/A
MoEFCC	N/A	N/A	N/A	N/A	N/A
ICMR	N/A	N/A	N/A	N/A	N/A
CDC	N/A	N/A	N/A	N/A	N/A
CPCB	X	✓	✓	X	✓
SPCB/PCC	X	✓	✓	X	✓

Table 2: Relation between Guiding Principles and Guidelines of the Institutions

The interim guidelines of the WHO on COVID-19 waste have not followed the Polluter Pays principle. According to the polluter pays principle, those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment. Any guidelines have not described the polluter pays principle. Interim guidelines have followed the precautionary principle because one of the guidelines discussed enhancing the COVID-19 waste management infrastructure chain to prevent future environmental degradation. The COVID-19 waste should be segregated from the general waste because COVID-19 waste is infectious waste. COVID-19 disease may occur from infectious waste. so, the guidelines has followed the Precautionary principle. Interim guidelines have followed the proximity principle. One of the guidelines of these guidelines revealed that the COVID-19 waste disposed of in the nearest CBWTFs. It is the purpose of this guideline that is less harm to the environment due to transportation of the COVID-19 waste. the Prior Consent Information principle has not been followed by guidelines of the WHO on COVID-19 waste. The interim guidelines of the WHO has followed the Duty of Care principle. One guideline says those who manage or handle COVID-19 waste wear a PPEs kit before managing or handling it.

The COVID-19 Waste Management Factsheet of the UNEP have not followed the Polluter Pays principle. The guidelines have followed the Precautionary principle because one of the guideline has discussed infrastructure development. To combat COVID-19 waste, developing countries should build better infrastructure for COVID-19 waste management. The guidelines of the UNEP have not

followed the Proximity principle. The guidelines of the UNEP have not followed the Prior Consent Informed principle. The Duty of Care principle has been observed in the guidelines. One of the guidelines has discussed that healthcare workers must wear PPEs kit when they will manage and handle the COVID-19 waste. MoH&FW, MoEFCC, ICMR, and CDC have not given any guidelines on COVID-19 waste management because these institutes were established for different specific purposes, and no institute has any purpose related to the management of COVID-19 waste.

- The Central Pollution Control Board has given guidelines on COVID-19 waste management that are "Guidelines for Handling, Treatment, and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients". The guidelines of the CPCB has not followed the Polluter Pays principle because no guideline has been discussed about it. The Precautionary principle has been observed in these guidelines. One guideline has discussed that as a precaution double-layered bags should be used for the collection of waste from isolation wards to ensure adequate strength and no leaks. the guidelines of the Central Pollution Control Board have followed the Proximity principle. One of the guidelines has discussed the COVID-19 waste disposed of in the nearest CBWTFs. The Prior Informed Consent principle has not been observed in the guidelines of the CPCB. The Duty of Care principle has been followed in the guidelines. One of the guidelines has discussed not managing and handling COVID-19 waste without wearing a PPE kit for the healthcare workers. The Punjab State Pollution Control Board has not issued its own guidelines. The Board has shared the guidelines of the CPCB. So the PPCB guidelines follow the same principles followed by the guidelines of the CPCB.

Bibliometric Analysis of Bio-medical Waste Policy at the International Level

To know the current scenario of available biomedical waste policy at the international level. a bibliometric has been carried out in the 'Scopus database using the search key (TITLE-ABS-KEY Biomedical waste policy).' The timeline considered for this research is ten years (from 2012 to 2021). Based on the study, the following findings are obtained. This data has been demonstrated graphically as below.

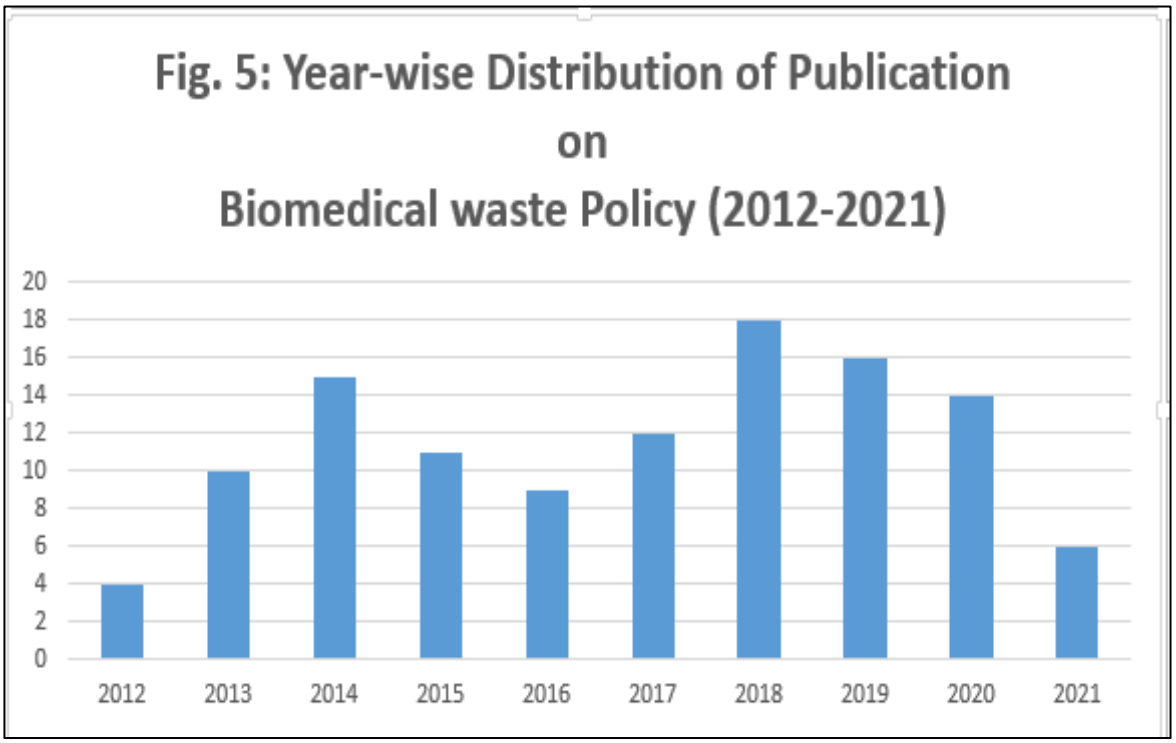

Fig. No. 3: Year-wise Distribution of Publication on Biomedical Waste Policy

The search resulted in 115 research documents published during ten years from 2012 to 2021. In 2012 only four research papers were published, and research on bio-medical waste policy has accelerated since 2013, with more than eight research papers and publications each year since 2012. The interest in the study of biomedical waste policy significantly growing in 2018 observed 18 research documents published on the topic of biomedical waste policy in a year. The result of the bibliometric analysis reflects that in recent years the inclination of researchers and academicians toward biomedical waste policy has increased.

Research Design

The study explores and analyses the status of implementing the Biomedical Waste Management Rules, 2016 Concerning COVID-19 Waste in Bathinda District. The researchers have used empirical methods. In empirical research, the researchers have relied on primary sources of data. The primary source of data has been collected through field visits.

Population

The present study aims to explore and analyze the status of implementation of Bio-medical Waste Management Rules, 2016 Concerning COVID-19 Waste in Bathinda, district of Punjab. Hence, the population of the present study consists of all the healthcare facilities that generate COVID-19 waste in the Bathinda district of Punjab. There are 69 HCFs available in the district which generates COVID-19 waste.

Sample

The investigator has selected the Health Care Facilities of Bathinda District of Punjab as the participants of the present study under investigation. The data was collected from the Health Care Facilities regarding COVID-19 waste management from March 2020 to December 2021. The researchers have collected data from 12 HCFs and 1 from CBWTF of Bathinda district chosen through purposive sampling.

Tools of Data Collection and Analysis

The researchers have applied a passive participant observation method. The researchers observed and recorded the behaviors of the stakeholders in their environment without conversing or interacting with them in any way. The researchers have collected the data from the common biomedical waste treatment facility and from the District Medical Commissioner's office, Bathinda. The data has been collected from the CBWTFs by the researchers through the semi-structured interview. The executive officer of the CBWTF fixed the interview schedule. The data has been gathered through semi-structured interviews. The researchers collected the data from the office of the District Medical Commissioner through informal interviews.

The researchers have used Critical Discourse Analysis for the analysis of the secondary data available in the form of the statutes, rules, guidelines, and Acts. The researchers have analyzed primary data received from CBWTF and DMC's office on the basis of three laws; the BMW Rules, 2016, Guidelines on BMW Rules, 2016, and Guidelines of the CPCB on COVID-19 Waste Management. Furthermore, the researchers applied the Content Analysis technique to interpret data collected through a field survey to carry out the result of the hypothesis.

Analysis and Interpretation of Data Related to COVID-19 Waste in Bathinda

In 2018, the biomedical waste was generated 591 kg/day, in Bathinda. The biomedical waste was increased by 7% in 2019, and BMW generation reached to 645 kg/day in 2019. However during the COVID-19 Pandemic, due to the increase of COVID-19 waste, biomedical waste was exponentially increased by 20% and reached 830 kg/day. 69 HCFs available in Bathinda, which has generated COVID-19 waste during first and second waves of the COVID-19 pandemic. These data have been taken from the CBWTFs facility by the researchers.

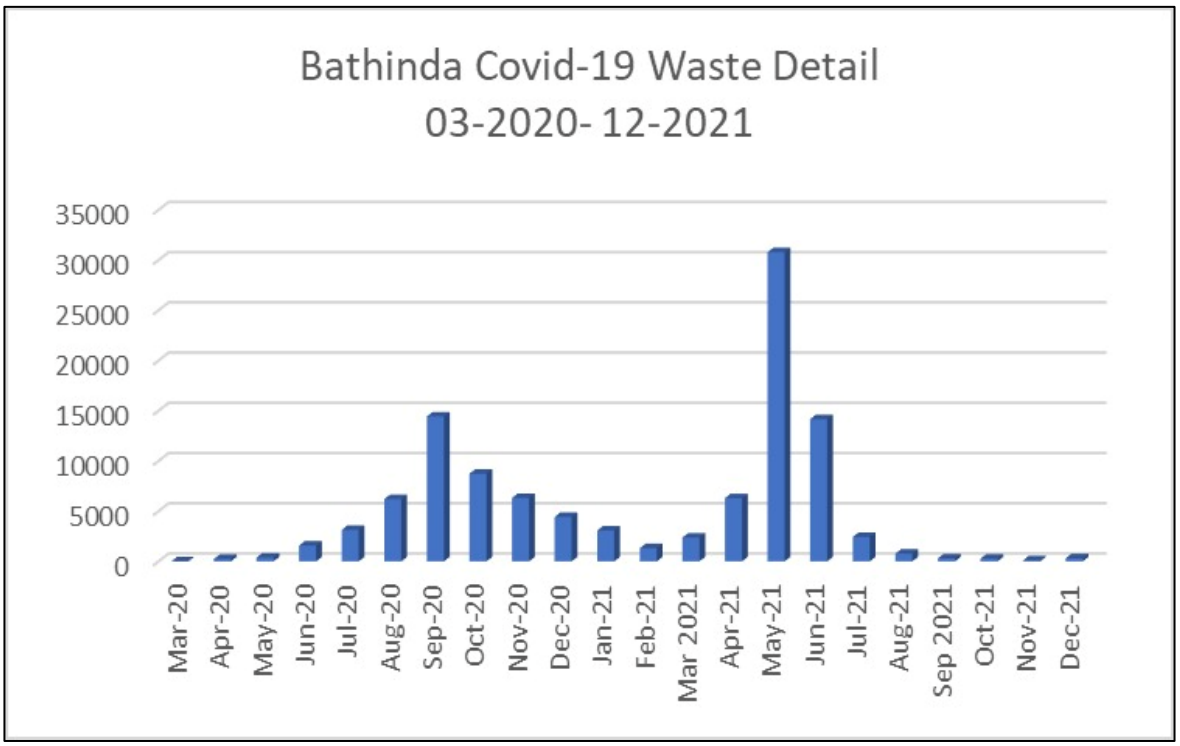

FIG.NO. 4: COVID-19 waste details of Bathinda

The data shown in figure no six has been taken from the Common Biomedical Waste Treatment Facility. All biomedical waste of Bathinda is disposed of by that CBWTFs. Data shown that September 2020 is the month in which the highest COVID-19 waste was generated in the first wave of the pandemic. A total of 14435 kg of COVID-19 waste was generated. The maximum COVID-19 waste was generated in the month of may in 2021 during the entire pandemic. The total COVID-19 waste generated in May month was 30793 kg. If we see the quarterly result COVID-19 waste generation from August to October, these three months were generated highest COVID-19 waste during first wave of the pandemic in 2020. the data of fig no six showed that, April, may, and June months of 2021 was generated the maximum COVID-19 waste during the second wave of the pandemic.

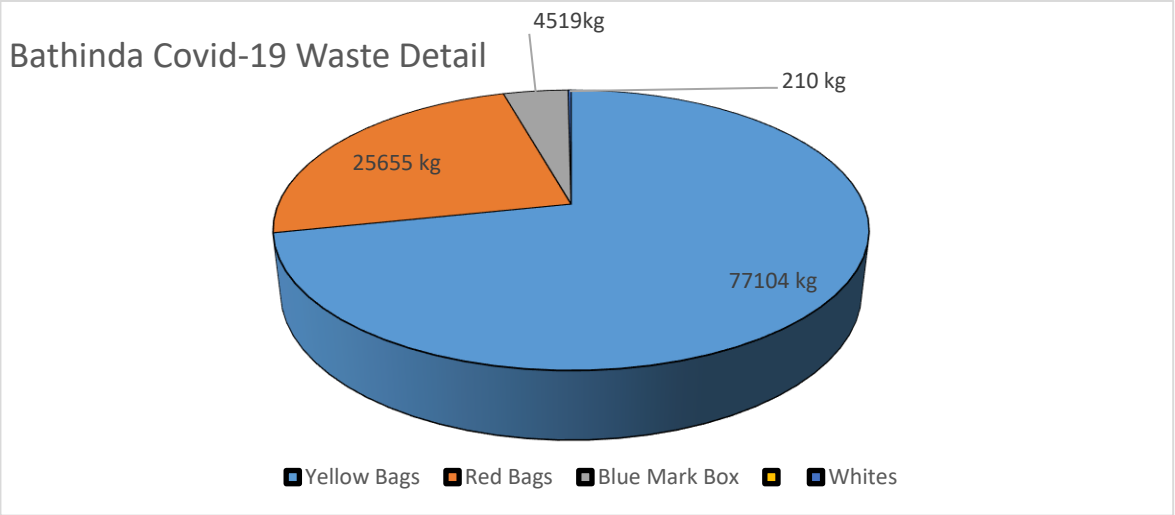

FIG. NO.5: types of COVID-19 waste details

Data from figure no 7 shown that four types of waste have been generated as COVID-19 waste. the Yellow color waste has been the highest generated by HCFs which is 77104.17 kg during 2020-2021. The total weight of Red color waste is 25655.44 kg which is the second-highest waste that the HCFs have generated during the COVID-19 period. The total weight of the white color is 210 kg. White color waste is the lowest generated waste by the HCFs during 2020-2021.

Sr.no.	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	If a daily report is sent on App. (yes/no)
1	DH Bathinda	300	5	20	No	Yes	Yes	1	No	No
2	SDH Rampura Phul	50	2	10	No	No	Yes	No	Yes	No
3	SDH Talwandi Sabo	50	2	50	10	No	Yes	3	No	No
4	SDH Ghuda	10	3	23	No	Yes	Yes	2	No	No
5	CHC Gonlana	30	2	All	No	Yes	Yes	2	No	No
6	CHC Nathana	30	1	15	No	Yes	Yes	1	Yes	No
7	CHC Bhagta	30	Yes	All	No	No	Yes	Yes	No	No
8	CHC Sangat	30	Yes	All	Nil	Yes	Yes	12	Yes	No
9	CHC Ballianwali	30	1	7	O	Yes	Yes	1	Yes	No
10	CHC Maur	18	2	All	No	Yes	Yes	Yes	Yes	No
11	CHC Raman	30	1	No	No	No	No	No	No	No
12	CHC Bhucho	7	1	16	3	No	Yes	1	Yes	No

Table 6: Data related to COVID-19 waste management of August, 2020.

Sr.no.	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	If a daily report is sent on App. (yes/no)
1	DH Bathinda	300	3	15	No	Yes	Yes	1	No	No
2	SDH RampuraPhul	50	2	10	No	No	Yes	No	Yes	No
3	SDH Talwandi Sabo	50	2	50	10	No	Yes	3	No	No
4	SDH Ghuda	50	No	No	No	Yes	Yes	2	No	No

5	CHC Gonlana	30	3	All	No	Yes	Yes	21	Yes	No
6	CHC Nathana	30	1	15	No	Yes	Yes	Yes	Yes	No
7	CHC Bhagta	30	Yes	All	Nil	Yes	Yes	12	No	No
8	CHC Sangat	30	Yes	All	No	No	Yes	Yes	Yes	No
9	CHC Ballianwali	30	1	6	0	Yes	Yes	1	Yes	No
10	CHC Maur	25	2	All	No	Yes	Yes	Yes	Yes	No
11	CHC Raman	10	2	Nol	No	No	No	No	No	No
12	CHC Bhu Cho	4	1	16	3	No	Yes	Yes	Yes	No

Table 7: Data related to COVID-19 waste management of September, 2020.

Sr.no.	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	if a daily report is sent on App. (yes/no)
1	DH Bathinda	300	3	15	No	Yes	Yes	1	No	No
2	SDH RampuraPhul	50	2	2	No	No	Yes	No	Yes	No
3	SDH Talwandi Sabo	50	2	50	10	No	Yes	3	No	No
4	SDH Ghuda	50	0	0	No	Yes	Yes	2	No	No
5	CHC Gonlana	30	3	All	No	Yes	Yes	2	Yes	No
6	CHC Nathana	30	1	15	No	Yes	Yes	1	Yes	No
7	CHC Bhagta	18	Yes	All	No	No	Yes	12	Yes	No
8	CHC Sangat	18	Yes	All	Nil	Yes	Yes	Yes	No	No
9	CHC Ballianwali	30	1	6	O	Yes	Yes	1	Yes	No
10	CHC Maur	28	2	All	No	Yes	Yes	Yes	Yes	No
11	CHC Raman	10	2	All	No	No	No	No	No	No
12	CHC BhuCho	4	1	16	3	No	Yes	1	Yes	No

Table 8: Data related to COVID-19 waste management of October, 2020.

Data related to COVID-19 waste of three months has been taken for analysis and interpretation by the researchers. The data of these three months (August, September, and October 2020) have been taken because, in these three months the maximum number of COVID-19 waste was generated by HCFs. These three months have been taken from the first wave of COVID-19. Because in these three months, HCFs need utmost care of COVID-19 waste. The researchers have taken data from the twelve government HCFs in the Bathinda district of Punjab that function as Isolation centers. So, there is a need for better management of COVID-19 waste in these months. The researchers analyzed these data and then tried to interpret the data to prove the hypothesis.

The researchers have analyzed the data on eight parameters that have been given in tables (3, 4, and 5). Then researchers interpreted the data on Bio-Medical Waste Management Rules, 2016, Guidelines for Implementation of Bio-medical Waste Management Rules, 2016 by CPCB, and Guidelines for Handling, Treatment, and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients, which was issued on July 17, 2020.

The first parameter on which data has been analyzed is whether any training of healthcare workers was conducted or not during 2020 by HCfs in Bathinda. According to Guidelines for Management of Bio-medical Waste as per BMW Rules, 2016, a minimum of one training should be organized for the healthcare worker in a year. According to these data, all HCFs have organized a minimum of three and a maximum of eleven training which is more than the minimum requirement of the rules.

The second parameter on which data has been analyzed is a no of a person who has not gone any training so far. According to the received information, two HCFs have not trained persons of twelve

HCFs. According to the Guidelines for Management of Bio-medical Waste as per BMW Rules, 2016, no person should be left without training in HCFs.

The third parameter on which data has been analyzed is whether SOPs of BMW is available in facilities or not. Five out of twelve HCFs do not have SOPs of BMW in their facility. According to Guidelines for Management of Bio-medical Waste as per BMW Rules, 2016, there should be SOPs available in the HCFs.

The fourth parameter on which data has been analyzed is whether the rule book of BMW Management 2016 is available or not in the facilities. Eleven out of twelve HCFs have a rule book of BMW management 2016. According to Bio-Medical Waste Management Rules, 2016, a rule book should be available in the facilities.

The fifth parameter on which data has been analyzed is how many internal committee meetings have been conducted by the HCFs. According to BMW guidelines, a minimum two internal meetings should be held by HCFs within six months. Here, two HCFs have not held any internal meetings out of twelve HCFs.

The sixth parameter on which data has been analyzed is whether minutes of the meeting have been prepared or not by HCFs. Five out of twelve HCFs do not prepare minutes of the meeting. According to Guidelines for Management of Bio-medical Waste as per the BMW Rules, 2016, they must have prepared minutes of the meeting when the meeting will be conducted.

The seventh parameter on which data has been analyzed and interpreted is that HCFs update daily reports of COVID-19 Waste on COVID-19BMW App or not. None of the facilities has updated the data on the COVID-19BMW app. According to guidelines on COVID-19 waste, HCFs should update daily reports of COVID-19 waste on the COVID-19BMW App. However, none of the HCFs have implemented this rule.

The eighth parameter on which data has been analyzed and interpreted is that, have all HCFs made their own websites and updated monthly data related to COVID-19 waste on that website. The researchers have observed through the interpretation of data that no HCFs have made their own website and updated the data on COVID-19 waste. according to the BMW Rules, 2016, all the HCFs must make their own websites within two years of the enforcement of the BMW Rules, 2016.

SN	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	If a daily report is sent on App. (yes/no)
1	DH Bathinda	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
2	SDH RampuraPhul	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
3	SDH Talwandi Sabo	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
4	SDH Ghuda	10	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
5	CHC Gonlana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
6	CHC Nathana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
7	CHC Bhagta	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
8	CHC Sangat	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
9	CHC Ballianwali	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
10	CHC Maur	18	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
11	CHC Raman	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
12	CHC Bhu Cho	7	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No

Table 9: Data reletated to COVID-19 waste management of April, 2021.

SN	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	If a daily report is sent on App. (yes/no)
1	DH Bathinda	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
2	SDH RampuraPhul	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
3	SDHTalwandi Sabo	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
4	SDH Ghuda	10	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
5	CHC Gonlana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
6	CHC Nathana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
7	CHC Bhagta	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
8	CHC Sangat	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
9	CHC Ballianwali	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
10	CHC Maur	18	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
11	CHC Raman	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
12	CHC Bhu Cho	7	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No

Table 7: Data related to COVID-19 waste management of May, 2021.

SN	Name of the Facility	No. of Functional Weds	NO. of Training on BMW	NO. of Personal Trained	NO. of Person Not go any training so far	SOP of BMW available (yes/no)	Is BMW management 2016 Rule Book available (yes/no)	NO. of BMW Committee Meetings held	If Minutes of the Meeting Done (yes/no)	If a daily report is sent on App. (yes/no)
1	DH Bathinda	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
2	SDH RampuraPhul	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
3	SDH Talwandi Sabo	50	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
4	SDH Ghuda	10	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
5	CHC Gonlana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
6	CHC Nathana	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
7	CHC Bhagta	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
8	CHC Sangat	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
9	CHC Ballianwali	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
10	CHC Maur	18	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Yes
11	CHC Raman	30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No
12	CHC Bhu Cho	7	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No

Table 9: Data reletated to COVID-19 waste management of June, 2021.

The researchers have taken data of the three months (April, May, and June) of 2021 from the second wave of the COVID-19 pandemic. The reason for taking data from these three months is that, the maximum COVID-19 waste in 2021 has been generated in these months. The researchers analyzed the data and then interpreted the data to prove the hypothesis and achieve the research objectives. The researchers have analyzed the data on eight parameters that have been given in tables (6, 7, and 8). Then researchers interpreted the data on Bio-Medical Waste Management Rules, 2016, Guidelines for Management of Bio-medical Waste as per the BMW Rules, 2016 and Guidelines for Handling, Treatment, and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients, which was issued on July 17, 2020.

The researchers analyzed the data of these three months (April, May, and June) of the second wave of the COVID-19 pandemic and then interpreted the data. The researchers observed that HCFs did not give any information on these seven parameters. The HCFs have only provided information on parameter eight: whether HCFs update data related to COVID-19 waste on the COVID-19BMW app daily or not. The researchers have analyzed the data on that parameter and then interpreted that, five out of twelve HCFs have not updated daily data of COVID-19 waste on the COVID-19BMW

Conclusion

Approximately 5.2 million people die every year due to infection of biomedical waste. HIV, Hepatitis B, Cancer, and many other diseases occur due to the mismanagement of biomedical waste. In today's world, biomedical waste management is a serious concern. The Biomedical comes under hazardous waste, which means waste that has substantial potential to harm public health or the environment. Before COVID-19, India generated approximately 614 tonnes of biomedical waste per/day. During COVID-19, lump-sum 750 tonnes of bio-medical waste was generated per day, 25% more than before COVID-19. This 25% increase due to a new type of waste being included in the biomedical waste. COVID-19 waste is a type of biomedical waste. The difference between COVID-19 waste and biomedical waste is that, all biomedical waste is not hazardous, only 15% of biomedical waste is hazardous, but all COVID-19 waste is hazardous. It is generated during the treatment, testing, and diagnosis of COVID-19 patients by healthcare facilities. These types of waste are very infectious. It spreads the disease very quickly. So, the prime concern of the stakeholders are to manage and dispose of COVID-19 waste properly. COVID-19 waste is a danger to society and the environment. If the COVID-19 waste is not managed and disposed of, it will spread into the atmosphere. COVID-19 waste is made of Poly Propylene and Poly polyvinyl carbon. Poly Propylene and Poly polyvinyl carbon are plastic. If it is thrown into the water, then water will get contaminated. If any animal drinks the contaminated water, then it will also be at risk of getting COVID-19 disease. It also affects the soil. Therefore, proper management of COVID-19 waste is essential for the survival of humankind. It is also kept of equal importance for the environment and animals. The researchers have observed that the the Bio-medical Waste Management Rules, 2016 has not been adequately implemented by the HCFs regarding COVID-19 waste in Bathinda. The following are a few suggestions for implementation:

1. The State and UT need to create an awareness campaign to provide accurate information concerning the relative risk posed by COVID-19 waste.
2. The Bio-medical Waste Management Rules, 2106. should be implemented in the true sense.
3. The state should implement an effective mechanism for better management of COVID-19 waste.
4. The HCFs should try to train all the healthcare workers.
5. All HCFs should update all the information related to biomedical waste on their website.
6. State should implement bar code system as soon as possible.
7. CBMWTFs should be installed more in a State.
8. Every State should submit the annual report to the Central Pollution Control Board before the deadline.

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