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Rinnie Mahajan
Department of Economics, University of Jammu, Jammu, India

Annie Mahajan
Department of Economics, University of Jammu, Jammu, India

Corresponding Author:
Rinnie Mahajan
Department of Economics, University of Jammu, Jammu, India

Covid 19 and Integrated Biomedical waste management: An Indian Perspective

Rinnie Mahajan and Annie Mahajan

Abstract
The pandemic of COVID-19 has led to socio-economic-environmental crisis at a global level. Such emergencies have affected the generation and disposal of bio medical wastes both in quantitative and qualitative terms. These scenarios have posed serious challenges to the decision and policy makers to ensure sustainability of environment. The present study attempts to address the challenges faced by the existing biomedical waste management charter to combat huge amount of waste generation. Developing country particularly India stands second among the reported number of COVID positive cases across the world. This has led to enormous hike in the generation of biomedical waste. Thus, the present study tries to highlight the various COVID driven problems and the necessary chalking out strategies thereby integrating traditional and modern techniques of waste management from cradle to crest alongside assessing various government policies and guidelines. The study further recommends improvements in Biomedical waste management sector to subjugate ongoing and future challenges of pandemic.

Keywords: Biomedical waste, COVID 19, integrated biomedical waste management

1. Introduction

The whole world has been moved by a mere particle of SARS-CoV2 virus. This invisible particle has led to more than 2 million deaths with more than 96 million cases still active across the world. These figures are more critical for the top five infected countries such as USA (24.5 million), India, (10.6 million), Brazil (8.57 million), Russia (3.57 million) and United Kingdom (3.47million) (Johns Hopkins University Corona Virus Resource Centre, 2020). To overcome this phenomenal emergency, the government authorities should assure support to human health with the existing medical fraternity. Although, the entire world has experienced revival of pure and pristine environment yet the situation is in sharp contrast to the generation and management of bio medical waste. The profound effect of this global pandemic has been the alteration of quantitative and qualitative aspect of biomedical waste and its management which poses serious threats to those engaged directly in sanitation purpose. As a consequence, there is a sharp rise in hazardous and clinical waste such as personal protection equipment (PPE), masks, infected needles, gloves etc. which when mixes with the stream of unsegregated waste increases the risk of virus transmission. Thus, proper collection, transportation and disposal of biomedical waste will be an effective contribution in battling the global pandemic. Various government institutions have stressed over the treatment of biomedical waste as an essential public service.

World Health Organization has put forward that biocidal and heat treatment of biomedical waste will be powerful in remediation of the virus (Kampf et al., 2020) [9]. SWANA (Solid Waste Association of North America) has reported a drastic change in the quantity and volume of waste owing to imposition of lockdown (SWANA, 2020). WHO has particularly given set of rules for handling different types of biomedical waste during COVID era? The present study discusses several pathways to deal with waste, decentralization of administration and existing framework. Along with the understanding of worldwide management of bio medical waste, the study reflects a deep concern in understanding of appropriate waste management practices. It also attempts at evaluating the current status of infrastructure in combating the current crisis and thereby proposing suitable alterations. Further, it provides suggestions to policymakers and other administrative bodies for effectual management of waste.

1.1. Response of the Government towards Waste Management

The COVID crisis has given rise to unprecedented changes in qualitative and quantitative nature of solid waste. The amount of various types of waste: biomedical waste, food waste and plastic waste has increased considerably which has consequently changed the physio-chemical nature of solid waste. For example; food makers in US have undergone unusual adversity because of closure of cafes, hotels, restaurants and schools etc. The US ecological protection agency (USEPA) proposed rules for sustainable management of waste during the pandemic. In India, abrupt country wide lockdown has led to generation of enormous amount of food waste alongside creating economic loss to poor farmers.

The State authorities in worldwide countries realized the significance of categorizing different waste executives and further attempted several measures to handle the evolving circumstances. For example, Australian inhabitants were requested to lessen the generation of waste to evade problem of waste administration. Prior to this, they were made aware of segregation and reusing techniques. Tokyo has reported massive upsurge in ignitable waste by 3.10% because of the changing patterns of eating and drinking while at home (The Japan Times, 2020) [15]. Government of India also stressed on the importance of composting to COVID free households. The Britain Government has also announced COVID monitoring declarations for waste hoarders and locals which emphasis on proper segregation, storage of waste and scientific treatment (Defra Department for Environment Food & Rural Affairs, 2020). Several nations including Finland, Denmark, and Norway burnt 50% of their waste within energy recovery guidelines. Australia is handling municipal waste through composting (32%), incineration (40%) and landfilling (9%) (Istrate et al., 2020). Significant amount of generated waste is dispose (d via landfilling in Indonesia, China, Brazil and India. An investigation in Indonesia revealed that 60-70% of the waste is landfilled while the rest winds up in air or oversaw by the authorities (Kyriakis et al., 2019) [11]. A similar study in India also reported that 70% of the urban solid waste is landfilled posing serious threat to environment.

It is a challenging task for the densely populated countries like India to develop proper waste management system as well as to restrict the COVID Sars transmission. Over the period of last seven months, India is reported to produce more than 33000 tons of waste and 146 tons per day of COVID waste. The hike in COVID waste generation is attributed to 1) generation of biomedical wastes like cotton swabs, syringes, PPE etc. 2) majority of the waste coming from COVID affected households became a COVID waste. The CPCB (Centre Pollution Control Board), India has declared certain guidelines to handle the medical waste efficiently. All the subordinate bodies like SPCB (State Pollution Control Board) and Urban Local Bodies (ULBs) are under strict obligation to follow the prescribed guidelines. Further, the MoEFCC (Ministry of Environment, Forest and Climate Change) has also provided guidelines for management of biomedical waste. These guidelines include two major dimensions: 1) Dumping of waste in specified colored dustbins 2) Fast disposal of biomedical waste according to Bio Medical Waste Management Rules, 2016. The disposal of medical waste in designated dustbins prevent the mixing with the general solid waste. CPCB has also developed an application on mobile to keep a track of BMW from all the COVID centers.

Table 1: Different guidelines given by different agencies:

Name of Agency	Guidelines to handle COVID waste
Occupational Safety and Health Administration (OSHA), US	Sanitation workers should use Personal Protection Equipment (PPE) while managing COVID waste. Medical waste from COVID wards should be treated similar to regular medical muck.
World Health Organization, (WHO)	There should be proper segregation of biomedical waste in designated bins. Infectious waste should be treated through incineration, autoclaving etc. If proper disposal and treatment facilities are not available, controlled burning of waste should be adopted in such cases.
Central Pollution Control Board (CPCB), India	Segregate waste with the use of different colored bins/containers/ bags. Before handing the medical waste to CBWTF, it should be collected and stored in a room temporarily. Non-hazardous waste should be managed as per the Solid Waste Management Rules, 2016.
European Union (EU)	There should a separate waste bag for each patient which is to be sealed properly before disposing.
National System for Environmental Protection	There are two categories of Municipal Solid Waste (MSW). 1) MSW from COVID affected households and 2) MSW from non COVID affected households.

2. Problems in Handling of Biomedical Waste (BMW)

The transmission of COVID 19 virus is very usual via droplet and contact pathways (WHO, 2020) [18]. The droplets from an infected person can settle on surfaces where the alive virus can again cause infection. Comparative study of SARS CoV -1 and SARS CoV-2 with context to survival time on solid surfaces and aerosols revealed that virus survived for 7 days and 3 hours respectively (Doremalen et al., 2020) [4]. Further, it validated that virus can remain active and infective for 9 days on inanimate objects (Kampf, 2020) [9]. Biomedical COVID waste as well is made up of various types of inanimate objects such as rubber, cardboards and plastics etc.

Despite the biological aspect of COVID virus, there are several other reasons which can stimulate the transmission of virus among different rural and urban regions (Li et al., 2020) [12]. Special guidelines have been stated for handling different types of solid waste as the survival time of virus fluctuates according to the nature of materials in waste. This situation demands adopting disinfecting and precautionary measures while handling of waste. CPCB has issued guidelines stating differential treatment for different types of waste. The COVID waste obtained from different health centers, hospitals and quarantine centers poses severe threat to workers involved in managing this kind of waste. Thus, there is an urgent requirement of automatic disposal and disinfection techniques with no involvement of any labour.

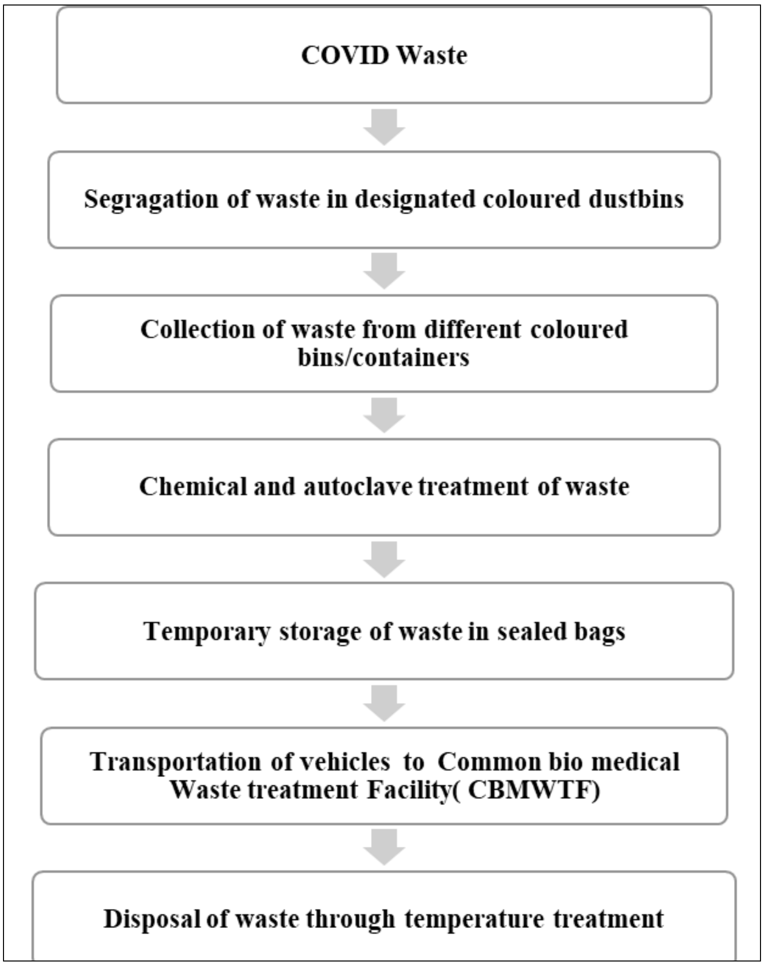

Fig 1: Overview of COVID waste management

3. Techniques Adopted for Treatment of Waste

There exists different disposal technologies for different types of waste. During the COVID era special emphasis has been given to disposal and treatment of COVID waste. Although many countries across the world usually apply common waste disposal techniques and focuses on proper segregation of waste. However, disposal and treatment techniques of different types of waste differ from country to country.

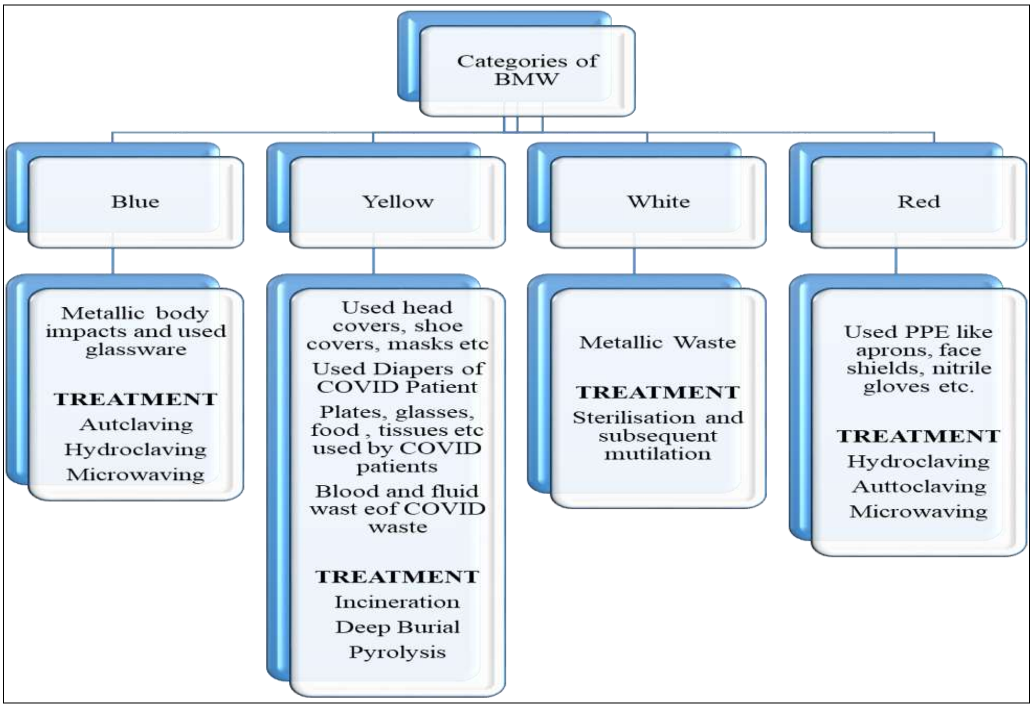

Fig 2: Segregation of different types of BMW

3.1. Disinfection using incineration

The process of incineration involves combustion at a very high temperature. It can be assessed that pathogen can only be slayed with a high temperature between 800 -1200 degree Celsius (Datta et al., 2018) [2]. According to BGL Pvt Ltd. (BMW treatment center approved by PCB of Jharkhand) COVID waste is incinerated at temperature greater than 1100 degree Celsius. The residual is further subject to incineration. As per BGL, this process is highly contagious to the environment and public health due to the release of large number of dioxins and furans. There are several other techniques also available for the treatment of biomedical Covid waste: medium temperature microwave techniques and high temperature pyrolysis.

In the context to India having large and dense population, there are around 198 BMW treatment centers and 225 medical centers having well developed bio waste management facilities. Simple statistics revealed that infrastructure is insufficient to handle such large amount of COVID waste. Thus, this calls for proper waste segregation on one hand and development of mobile incinerators on the second hand.

3.2. Disinfection using pyrolysis

Pyrolysis is a more comprehensive practice scientifically than incineration. It is performed at a temperature range of 550- 800 degree Celsius. There are different forms of pyrolysis depending upon the degradation procedure: oxidation pyrolysis, plasma pyrolysis and laser pyrolysis etc. In case of plasma pyrolysis, inflammable gaseous vapor is used for combustion at a high temperature range of 900-1000 degree Celsius which is highly effective in the destruction of dioxins. Therefore, this technique of pyrolysis is highly recommended in the disposal of COVID waste which will curb the further transmission (Wang et al., 2019) [17].

3.3. Disinfection using medium temperature microwave technique

This procedure functions under a temperature range of 177-540 degree Celsius. It is based on the process of converse polymerization underneath which high energy microwaves are used for the breakdown of complex organics in the presence of inert atmosphere. Nitrogen produces inert atmosphere which hinders the incineration of oxygen to divulge the elevated temperature sterilization. Use of low burning temperature, less energy usage, restricted heat loss and minimal residue greatly benefits environment in the time of crisis. Under restricted system, these microwaves can defuse the virus. According to the Chinese Ministry of Ecology and Environment, this technique is the most efficient one in disinfecting COVID waste.

3.4. Disinfection using chemicals

The chemical disinfection procedure is extensively used in the pretreatment of COVID waste. Power driven crushing usually precedes this procedure. The air is passed through particulate absorbance filter which further prevents formation of aerosol during the crushing. Subsequently, the chemicals are allowed to mix with the degraded waste under negative pressure for decomposition of organic substance and inactivation of the viruses and bacteria. The above mentioned treatment is considered to be efficient as it includes broad spectrum sterilization, highly stable performance and does not leave any hazardous residue.

The procedure works upon non chlorine ($NaOCl$ and ClO_2) and chlorine-based frameworks. The sodium hypochlorite results in the formation of toxic compounds such as chlorine substituted aromatic compounds, dioxins etc. while the chlorine dioxide results in ammonia or alcohol formation. In non-chlorine procedures, peroxides (H2O2) causes oxidation of lipid and protein constituents of the membrane which results into disintegration of viral membrane. Formaldehyde, Ethyl alcohol and Povidine iodine are various chemicals used in decontamination of unanimated objects (Duarte & Santana, 2020) [5].

3.5. Disinfection for reprocessing personal protective

The use of sterilization technology is not only restricted to a protection measure but has much more significance. The study revealed that N95 masks undergone hot air smoke with 5 cycles do not worsen the fitting of masks while treatment of similar masks under ultraviolet germicidal irradiation with 10 cycles worsen in fitting and thus, got failed in occupational safety and health administration (OSHA) testing protocols. Therefore, there is no evidence that whether the improvement takes place through all the deposits of restricted virus in the essential part. The reframed guidelines are helpful in prevention of transmissions and minimization of health issues. Overlooking clinical waste from several health centers is a challenge as leftover microorganisms must be demolished before removal. The wastes from medical center is 5 % chemical, 10% infectious and 85% non-infectious (Wang et al., 2020) [17]. The COVID waste treatment plants have well equipped technology which is consistent with the social, economic and sustainable environment. Massive expansion in the volume of waste has disturbed the existing framework. However, the standard procedure of waste management states the removal of nonhazardous waste from medical facilities. Many countries including India recommends disposal of medical waste and waste from COVID affected households in a prevalent local way. Thus, this poses a problem to the existing framework and thereby increasing the risk of secondary infection.

4. Recommendations

The global pandemic has led to massive upsurge in the use of PPE kits, sanitary good and other health care products which has consequently increased the generation of contagious and hazardous waste. The quarantine centers, wards, hospitals and health institutions are required to dispose the medical waste in double sealed bags or bins under the government guidelines. The role of Urban Local bodies in managing the BMW stands significant despite facing the shortage of manpower. Incineration comes out to be the best disposal ways in the regions where the COVID outbreak is maximum. Sanitary landfilling of infected waste should be adopted only in the areas which suffers from lack of disposal facilities. The direct involvement of unskilled labour should be avoided in view of high risk and infection. Unsegregated waste in developing countries further aggravates the problem for manual scavenging. Waste pickers suffer from high morbidity of diseases like tuberculosis, HIV, eye infections etc. Thus, mass awareness should be created highlighting the importance of segregation of waste and minimization of waste production.

In addition to this, the vehicles carrying the COVID waste should be sanitized by spraying sodium hypochlorite. The health and sanitation workers should strictly use 90% alcohol based sanitizers. Women workers are more vulnerable to ill effects of waste picking. Thus, provision of insurance cover and social security are major issues for waste pickers in the time of global crisis. For example in UK, government has given the workers a status of "key workers" and assured them with the provision of social benefits.

To handle huge waste generation, the government should adopt better waste to energy techniques. Previous studies shows that thermal treatment of waste reduces 90% of the waste (Mayer, 2019) [13]. However, these techniques demand huge amount of financial resources. Developing countries like India are unable to meet the requirements and hence rely on landfilling methods (Kulkarni & Anantharama, 2020). For the decomposition of organic waste composting, anaerobic digestion, aerobic digestion and biological treatments should be adopted.

5. Conclusion

The present study highlighted different waste processing and treatment technologies suitable during the COVID crisis. This study might pave way for improvement in waste management strategies. Further, there is an urgent need of solid waste management frameworks which are economically, socially and environmentally feasible. For the developed as well as developing countries, the pandemic has highlighted the weaknesses of the waste management system. Therefore, the present study reflects the need to restructure the waste management framework by training the unskilled labour, adopting suitable disposal techniques and educating people about the waste management strategies from cradle to crest in order to overcome any future crisis.

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