

Review Article*Open Access, Volume 2***Impact of COVID-19 pandemic on the current status of solid waste management in India****Debishree Khan, Shailendra Yadav; Atya Kapley****Director's Research Cell, CSIR-National Environmental Engineering Research Institute (NEERI), India.****Corresponding Authors: Atya Kapley**

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Abstract

Managing Solid Waste is always a challenge for any developing nations due to poor infrastructure and awareness. The emergency situation due to COVID-19 pandemic has shifted the dynamics of solid waste generation globally. However, its impact varies from developed world to developing nation. Multiple knowledge gaps exist regarding the containment of waste during pandemic situation in developing nation. For overcoming health crisis, a multifaceted coordinated approach between civic authorities, policymakers and scientific community is required. Therefore, present review article highlights the challenges associated with solid waste management and role of policymakers in combating pandemic strategically.

Keywords: COVID-19; biomedical waste; solid waste management; environment

Introduction

The novel strain of coronavirus COVID-19 case was first reported in India on 30th January, 2020 and ever since the daily reported cases has continued to increase. The latest health care emergency due to outbreak of COVID-19 has impacted the lifestyle and altered the consumption and generation of solid waste [1]. Due to high transmission rate and severity of COVID-19, lockdown was imposed in whole country. The lockdown reduced various anthropogenic activities (industrial, transportation and routine activities which boosted environmental health by improving surface water and air quality, quality, climate change and reduction in the solid waste generation. Moreover, second wave of COVID-19 mediated by evolution of novel strains of corona virus is further worsening the situation. The infectious rate is rising at much higher pace in second wave in comparison to first wave. Total number of COVID-19 cases observed, along with active cases, patients recovered and death has been given in Table 1, (Source: MoHFW; <https://www.covid19india.org>) [2].

Solid Waste Management (SWM) is still a pressing problem in most of the parts of the world especially in the developing countries. SWM is a public health service which is yet to acquire high importance and must be considered as an essential service like health care service. During the lockdown the quantity of solid waste has reduced but an unexpected change in waste composition has been observed. The composition of biomedical and plastic waste has increased significantly posing risk to human and environment health [3]. Usage of face masks and Personal Protective Equipment (PPE) has resulted in the accumulation of plastic waste [4]. Solid waste plays critical role in the transmission of diseases and hence its waste management services acts as an important sanitary barrier [5]. It has been found that the coronavirus may survive 2 hours to 9 days on the diverse components of solid waste which increases the chances of environmental dissemination of COVID-19 [6]. The present scenario of piles of uncollected waste and random disposal of waste into the barren land and rivers may drive rapid transmission of coronavirus.

Table 1: State wise COVID 19 cases, death and recovery rate.

State	Confirmed	Deaths	Recovered
Maharashtra	3010597	55878	2522823
Haryana	298133	3191	282368
Jammu and Kashmir	37163	694	28510
Punjab	251460	7083	219063
Tamil Nadu	899807	12778	865071
Uttar Pradesh	630059	8881	601440
West Bengal	593615	10344	573118
Bihar	268377	1583	263233
Delhi	676414	11081	651351
Gujarat	318438	4566	298737
Karnataka	1015155	12625	963419
Kerala	1135233	4668	1102359
Madhya Pradesh	306851	4040	281476
Andhra Pradesh	907676	7239	890137
Rajasthan	339325	2829	323618
Telangana	313237	1723	302768
Assam	218670	1109	215597
Jharkhand	127246	1130	120872
Odisha	342695	1922	337935
Goa	59068	835	56156
Chhattisgarh	369046	4319	326277
Uttarakhand	102264	1727	97520
Himachal Pradesh	65242	1070	60595
Puducherry	42359	684	40083
Arunachal Pradesh	16849	56	16785
Manipur	29423	374	28988
Tripura	33540	392	33085
Meghalaya	14122	150	13870
Sikkim	6257		
Nagaland	12363	92	12138
Ladakh	2638	34	1757
Chandigarh	28194	383	24661
Mizoram	4491	11	4439
Andaman and Nicobar Islands	5109	62	4990
Dadra and Nagar Haveli and Daman and Diu	3744	2	3538
Lakshadweep	741	1	704

Unfortunately, a significant fraction of under privileged urban population in many developing cities make their living from the dumpsite and from the unregulated SWM system [7]. The waste collection and transportation are essential and was active at most of the places during pandemic. But, people working in the informal waste management sectors were more vulnerable to COVID-19 risk and may be adversely affected by transition during lockdown period [8].

The advent of COVID-19 has stressed both health and waste sector with existing infrastructure and inadequate safety equipment [9]. Considerable attention has been paid for combating COVID-19 transmission in the health sector but only limited attention was given to the SWM sector during the pandemic. Though, there is direct association exists between both the sectors [10]. During this period, rise in amount of biomedical waste derived from healthcare sector (mainly comprises of PPE, facemask and single use plastics) have been observed especially at outskirts of urban areas. Hence, proper strategies for the management of these waste is necessary for controlling environmental transmission of coronavirus [11]. Random disposal of biomedical waste may increase the frequency of transmission of coronavirus among rag pickers and scavengers. Guidelines should be imposed by civic authorities for the proper segregation and safe disposal of biomedical waste. Therefore, governments have recommended to treat biomedical waste, household waste, and other hazardous waste as a crucial and essential public service to reduce the likelihoods of secondary impacts on health and environment [3].

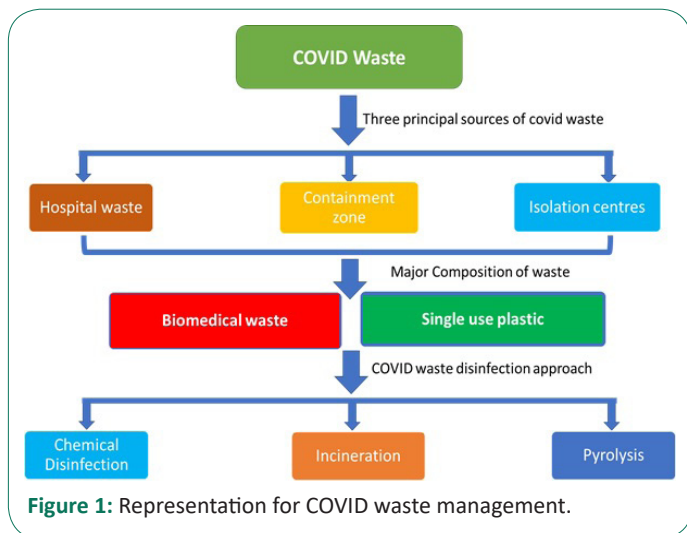
Impact of COVID-19 emergency on MSWM

With total lockdown during the last few months, it has been expected that the household organic waste generation was comparatively lesser than the other times as people have the tendency to store less perishable goods at their places due to the uncertainty of the lockdown duration. On the other hand, it has been also noticed that due to the closure of many eateries around the cities and the imposed social distancing, people developed a tendency of buying things online more frequent. The pandemic has affected the food supply chain massively. This change in habit pattern has led to increase in more of packaging waste mainly consisting of plastics and cardboards. Moreover, an increase in packaging waste is also identified in the medical sector to meet the excess demand.

Meanwhile, the recycling services across the city has also interrupted due to the lockdown due to the inhibition among the recyclers about the contaminated waste at centers, lack of demand of recyclables and also due to lack of identification of the recycling industries in many parts of the country [12]. Some European countries have pushed back their solid waste disposal options by strictly prohibiting the collection of waste from infected residents [12].

According to the Biomedical waste rules and Central Pollution Control Board (CPCB) guidelines, it has been stated that waste collection from the treatment of infected patient at hospital should be collected by using double layered bags to avoid leakages [13]. The waste generated during the treatment should be strictly treated as the biomedical waste. Similar precautions and instructions should be followed in case of household waste also to avoid risk to the sanitation workers. Solid waste at household level like discarded masks, gloves, tissues etc. might be the potential source of contamination and transmit the disease and should be considered as a special waste. No proper demarcation of waste generated from an infected person is done at most of the places leading to the mixing with the other household waste. The people who are not yet aware of the seriousness of this disease and its route of transmission are having a casual approach and practicing normal system as pre COVID-19 pandem-

ic are more in menace and also putting others in danger. Most of the hospitals are following the rules of disposing biomedical waste but few small clinics and nursing homes are reported to dispose their waste unscientifically. Hence, it is very critical to manage the solid waste related to COVID-19 and keeping track of it. The severity arises when the mixed waste ended up in the landfill imposing a threat to the environment and to the public health. Recent experiences and situation due to this pandemic highlights the need of safe disposal of biomedical waste and its management to prevent further infection and control [9]. Practicing only spraying sanitizer on the waste after collection will not serve the problem (Figure 1).



Strategy for managing coronavirus during lockdown

Roles and responsibilities of policy maker

As described in the previous section that the quantity of solid waste, particularly plastic and biomedical waste is rising and there is need for the adaptation of efficient SWM practices [4]. Indian civic authorities and SWM infrastructures are under immense pressure due to coronavirus pandemic. Keeping fact in mind that SWM may act as sanitary barrier and limit dissemination of COVID-19, Impact and Policy Research Institute (IMPRI) New Delhi organized a panel discussion on “Waste Management during COVID-19: Challenges and the way forward”. It was concluded that periodic assessment and monitoring of solid waste management approaches used by municipal agencies is required [14]. Various sources of COVID-19 waste includes containment zones; COVID care centres; home quarantine; and hospitals and labs. However, major challenge is the collection, segregation and decontamination of hazardous and biological (COVID) waste. The concept of home isolation for asymptomatic COVID patients has further exacerbated the magnitude of pressure on COVID waste management practices. As per Common Bio-medical Waste Management and Treatment Facility (CBW-MTF), Delhi, the generation of biomedical waste in hospitals has increased upto 2.5 to 4 kg per bed in post COVID situation. Earlier it was only 500gram per bed [9,15]. There is no separate facility available for the treatment of biomedical/hazardous wastes at local scale and the shortage of skilled workers for the SWM during lockdown situation is worsening the situation.

Imbalance between the quantity of waste generation and collection due to social distancing and lockdown is a critical factor which is adversely affecting SWM practices [16]. Although, guidelines have been put forward by CPCB, its implementation at the ground level is still remains a potential challenge [17]. The coordinated and multifaceted approach is required for the

containment of COVID-19 infections through suitable waste management practices. Role of policymakers may play very critical role in the overcoming pandemic situation. They must ensure the regulation of guidelines imposed by CPCB and local civic authorities at the ground level.

Also, they may play key role in increasing the public awareness about safety measures and the need of segregation of waste (biomedical waste) for the containment of COVID-19 in local languages. They must also advocate the use the recycled products to limit the generation of plastic wastes. Awareness should be increased among public on the usage of plastic as environmental health hazard by designing and implementation of policies. Specific coloured bins can be provided for the segregation and disposal of biomedical wastes like PPE kit, face masks and single use plastics. Policy should also be designed to promote local startups which will reduce the usage of plastics in the form of packaging. The consumption of local products can be promoted by low cost which requires tax reduction and other exemptions. They may also collaborate with international organizations or private sector to reduce the burden of SWM practices on local authorities and adoption of sustainable technology/skills for the proper disposal of biomedical/solid wastes. As per PM Narendra Modi “Vocal for Local”, policy should promote startups associated with the recycling of waste to reduce the bulk of waste entering ecosystem and their consequences [18].

Public participation

India is second most populous country of world and therefore even lakhs of workforce associated with SWM is insufficient for handling huge amounts of waste (both solid & biomedical) generated during COVID pandemic. Presently, India is generating around 101 million tons biomedical waste per day [13]. Public participation both at individual and community level is very essential for the proper segregation and management of waste. People can be made aware with the waste generation and their consequences on environment and human health by organizing awareness camps at local scale of program at school, colleges in urban settings. Educating students with waste management basics such as application of biodegradable food waste as compost and need of segregation of waste will help in reducing the quantum of waste generation. In rural area, organizing awareness program at gram panchayat level and demonstration of green technologies will help in reducing the bulk of solid waste. Usually, in developing countries (both urban & rural settings) waste are not properly segregated (contains both solid, food and biomedical waste) which pose risk to the environment and hinders SWM practices. Although, central organization like Ministry of Environment and Climate change (MOEF) and CPCB, government of India under “Swachh Bharat mission” has taken several initiatives to raise awareness regarding clean India. “National Environmental Engineering Research Institute-CSIR” is actively working in the area for SWM practices, clean technologies and raising awareness among common peoples addressing water crisis by “Jagruti Program”. It was launched by Shri M. Venkaiah Naidu, Hon'ble Vice-President of India. Several other steps are being taken to raise social awareness at local scale which will help in combating COVID waste management crisis.

Disinfection approaches for COVID waste

Most of the tools being used for disinfection of COVID-19 biomedical waste relies on the high temperature combustion. Incineration techniques are currently being used for COVID

waste management in various parts of India. In addition, techniques like high temperature pyrolysis, medium temperature microwave technique and chemical disinfection techniques can be used for the COVID waste management. The advantage of high temperature combustion techniques is that it ensures almost complete degradation of organic waste (90 to 100 %) with minimal byproduct. The disadvantages of higher temperature combustion techniques include high temperature and maintenance cost [19]. Some of the techniques used are described in brief

Incineration

Incineration or thermal treatment techniques are commonly used for the treatment of raw municipal solid waste. Temperature used for the combustion ranges between 800 to 1200°C. Currently it is used by various civic authorities for the treatment of COVID-19 medicated biomedical waste like Mumbai, Jharkhand and Delhi. In Jharkhand, a common incinerator of Jharkhand pollution control Board is operating at 1100°C for the treatment of COVID-19 biomedical waste. Mumbai is currently generating approx. 12,065 kg COVID-19 biomedical waste since 25th July 2020. These biomedical wastes are being treated using incineration at Deonar CBWMTF facility which has capacity of 24,000 kg waste per day. But the quantity of biomedical waste is expanding due to COVID-19 pandemic and it will not be surprising that Mumbai will need another incineration facility [20]. Similarly, Delhi biomedical waste management facility are under immense pressure due to rising COVID waste. Currently, Delhi is generating 372 tons COVID biomedical waste per day. These biomedical wastes are being treated at three waste to energy plants situated at Ghazipur, Okhla, and Sukhdev Vihar. These plants are treating approx. 13 tons of COVID-19 biomedical wastes [21].

Chemical disinfection technique

Chemical disinfection techniques is essential for the pretreatment of COVID-19 biomedical waste to ensure safe collection and disposal. After collection and segregation, biomedical waste is sanitized using appropriate concentration of disinfectants such as sodium hypochlorite, hydrogen peroxide. The chemical disinfectants can be divided into two categories: chlorine and nonchlorine based. In chlorine-based disinfection, sodium hypochlorite or chlorine dioxide are used for the disinfection. In non-chlorine-based disinfections: disinfectants like hydrogen peroxide, formaldehyde (>0.7%) isopropanol (>70%) and isopropanol (>70%) and ethanol (>75%) are used for the pretreatment of COVID-19 biomedical waste. Pretreatment allows neutralization of various pathogens and zoonotic organisms associated with the biomedical waste [19].

Conclusion & future perspectives

It is evident that the emergency led due to COVID-19 has altered the lifestyle and the pattern of the solid waste generation. The lockdown imposed due to the COVID-19 pandemic has severely damaged the societal and economical aspect of life especially in the developing countries. The small-scale industries and the supply chains are yet to revive completely. Despite of lockdown, the incidences of COVID-19 is increasing constantly. In India active cases of corona has crossed over 59 lakhs, which is serious concern for both civilians and the policymakers. Therefore, countermeasures must be adopted to limit the dissemination of coronavirus. Enhancement of solid waste management facility and introduction of new facility for

the treatment of biomedical (COVID-19) waste may play crucial role in limiting the environmental transmission of the COVID-19 virus. Further, implementation of guidelines for effective waste management system at the ground level is necessary.

Inadequate collection and handling of municipal solid waste is still an issue in many Indian cities. There is a scope to learn from the situation and build a resilient supply chains to prepare the system for any future pandemic. Enforcement of regulation and the meeting the standards of managing waste should be the utmost priority for the administrative authority or the regulating body. Segregating waste at source and awareness about it is not only necessary but also a need of an hour. Simultaneously managing the solid waste as per the area wise generation rate has to be taken into consideration. Hospitals and COVID related health centers should keep a record of their waste production as there is a sudden rise in the sanitary products, PPE and other healthcare products. Artificial intelligence can thrive at this present scenario of managing COVID related waste generation. The system can keep a track of all the infected household and other quarantine centers and hospitals and accordingly should connect to the biomedical waste centers.

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