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Challenges, opportunities and progress in solid waste management during COVID-19 pandemic

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ABSTRACT

At the end of December 2019, Wuhan City became the epicenter of the highly contagious virus known as the novel coronavirus. Now that mid-2020 has already passed, almost every country is adversely affected by Corona Virus Disease (COVID-19). The routine activities of people of all ages are overturned, which has led to a shift in the trends of waste created by households, streets, and most importantly, medical facilities and quarantine centers. Compulsive use of personal protection equipment such as masks, gloves, sanitizers, etcetera by the frontline workers from the medical sector, banks, daily need stores, waste collection industries, etc. and the use of masks by every common man stepping out has skewed the trend of waste generation to a different direction. Recently, the replacement of single-use plastic was accepted by the masses, and the pandemic suddenly rebounded to the previous situation, it is expected to be worse in the long run. Another secondary outcome is reduced waste collection and recycling due to lockdown, leading to a pile-up of wastes. But several nations are adopting strategies to break the transmission chain of the virus by trying to minimize human contact. The study discusses the effect of COVID-19 on the generation, recycling, and disposal of solid waste. A brief collection of different countries’ efforts to restrict the transmission of virus through solid waste is also discussed.

1. Introduction

In Urban systems, solid waste is generated on a day-to-day basis and needs to be administered daily. Solid waste management is an essential practice adopted by the local authorities to maintain hygienic surroundings in residential areas [1]. The role of these local bodies becomes much more critical in natural disasters such as hurricanes, earthquakes, floods, pandemics, etc. Due to the accumulation of waste or water stagnation, the risk associated with the prevalence of pathogens in drinking water supply and waste disposal may amplify many folds [2]. Ragpickers, sweepers, and healthcare staff are directly exposed to such waste and may become infected, ultimately impeding the area’s cleanliness. In early December 2019, a sudden surge in pneumonia cases was observed in the city of Wuhan, Hubei province, China, it was reported to World Health Organization (WHO) Headquarter, China, on December 31, 2019. The COVID-19 was announced as a pandemic by WHO on March 11, 2020 [3]. As the symptoms posed by this novel coronavirus is similar to Severe Acute Respiratory Syndrome (SARS), it is officially named SARS-CoV-2 [3,4]. It is a beta coronavirus originated from mammals (particularly bats) and declared as HG3 (Hazardous Group 3) pathogen like Human Immunodeficiency Virus (HIV) and Tuberculosis (TB) [5,6]. After SARS (2002–03) and MERS (Middle East Respiratory Syndrome) (2012), COVID-19 is the third zoonotic outbreak of the 21st century. This pandemic particularly has a global impact on various sectors that resulted in economic breakdown [7]. The primary source of human to human transmission is the respiratory droplets [8] from the infected person, but secondary sources are indirect contact, e.g., transmission of the virus from an inert metallic surface touched by an infected person [9].

SARS-CoV-2 has infected a vast population and also led to copious fatalities across the world. The cemetery and cremation centers have observed a sudden jump in the inflow of dead bodies that have to be handled by only trained personals properly equipped with PPE. International Committee of the Red Cross (ICRC) has given guidelines to manage the dead by maintaining staff safety and the dignity of the deceased [5].

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During the pandemic, there is a drastic change in the nature of waste generated. PPE, masks, hand sanitizers are now part of daily lives, and the waste generated from them has added a voluminous load to the waste generated. PPE, masks, hand sanitizers are now part of daily lives, and the capacity of existing facilities [10]. The use of single-use plastics, PPE and work from home by most of the population to avoid disease transmission associated with the household, quarantine centers, hospitals, infected patients, etc. due to the COVID-19 pandemic. Moreover, the poor solid waste handling of properly, each mask weighing 4 g will weigh up to 40,000 kg plastic, environment within a month. If only 1% of total masks are not disposed of properly, each mask weighing 4 g will weigh up to 40,000 kg plastic, poses a very dreadful picture [18]. Improper disposal of biomedical waste is responsible for soil and groundwater pollution and adversely affects the biota [17]. Table 1 summarizes the quantum of mask usage across the globe.

Due to the different waste management practices, the developing nations face a higher risk of contamination via waste and wastewater than developed countries. Since developed countries have greener and more secure methods to manage the waste. In contrast, in developing countries, the waste is mostly disposed to insecure landfills and dumping ground are often visited by the ragpickers without any safety gear. It may spread the virus and make contact tracing complicated [17,22,23].

WHO has classified the “health care waste” into several categories that include infectious waste consisting of blood, body fluids, and contagious waste from patients; pathological waste consists of human tissues, body parts, etc.; sharp metallic debris like surgical blades, needles, etc.; chemical waste consist of disinfectants, sterilant, mercury, etc.; and pharmaceutical waste having expired and contaminated drugs; cytotoxic drugs and their unorganized disposal of masks and PPE that end up into the water bodies have led to plastic waste pollution explosion [19]. The hydrophobic protective layer used on the mask to prevent the body fluid droplets consists of polypropylene (PP), while other expensive masks consist of polyurethane (PUR) or polyacrylonitrile (PAN) [20]. The plastic-based masks, surgical masks, tissue papers, and used sanitizer plastic bottles add load to the landfills. Not only that, but improper disposal also contributes to riverain and marine pollution. Such contaminants interfere with the natural habitat of the animals and disturb them [6]. The virus may be present on the surface of the masks and enter the water bodies, threatening those in contact with it [21]. World Wide Fund for Nature (WWF) Italy has stated that 10 million masks will be dispersed in the environment within a month. If only 1% of total masks are not disposed of properly, each mask weighing 4 g will weigh up to 40,000 kg plastic, poses a very dreadful picture [18]. Improper disposal of biomedical waste is responsible for soil and groundwater pollution and adversely affects the biota [17]. Table 1 summarizes the quantum of mask usage across the globe.

2. Waste generation scenario

Due to pandemic, there is a paradigm shift in the form of waste generated, e.g., a sudden increase in the number and amount of plastic wastes used in food packaging or one-time use personal protective equipment (PPE) such as masks, gloves, respirators, syringes, etc. The reduction in fossil fuel cost [12] and suspicion over the purity of recyclables [10] are other factors responsible for the plunge in use of single-use plastics. Currently, the demand for PPE has reached crisis mode, where the reuse of masks is not recommended due to the high chances of viral retention. To prevent the aerial transmission of the virus, every individual has to wear a face mask that has added to the waste load [13]. To minimize the spread of the virus, restaurants and café are not allowing personal or reusable containers instead using the one-time-use packaging materials [14,15]. On the other hand, during lockdown due to restricted travel, work from home, increased online shopping, and higher food consumption at home have contributed tremendously to household waste. In contrast, the waste generated from several kinds of mass gatherings is prevented [16,17]. Politecnico di Torino (Italy) has predicted that during phase 2, when the public activities resume, the monthly demand for masks and gloves will increase to 1 billion and half a billion, respectively [18].

Several organizations like Opération Mer Propre (France), Thames21 (London), OceansAsia (Hong Kong) have expressed concern about the

| Table 1 The Estimated quantity of masks to be used during a pandemic [22]. |
|-----------------|-----------------|-----------------|
| Continents      | Total Daily facemask (million) | Weight of total daily facemask used (tonnes) |
| Asia            | 3716.20          | 1486.48          |
| Africa          | 922.22           | 368.89           |
| Europe          | 884.71           | 353.88           |
| North           | 489.05           | 195.62           |
| America         |                  |                  |
| Oceania         | 45.43            | 18.17            |
| South           | 544.39           | 217.75           |
| America         |                  |                  |

Note: (i) Total daily facemasks = (#population * #urban population (%) * #Facemask acceptance rate (%) * #average daily facemasks per capita)/10,000 [18] (ii) # Data extracted from https://www.worldometers.info/coronavirus on Aug, 16 2020. (iii) ## values for facemask acceptance rate and average daily face mask per capita is assumed 80% and 2, respectively. (iv) Weight of masks (tonnes) is calculated based on each mask weighing 4 g [14].
metabolites; Radioactive waste and general waste [24]. In general, biomedical waste contains items that are highly infectious and hazardous for the staff handling them. During the pandemic, the number of patients admitted in the hospitals is much more than usual, testing of COVID-19, etc. has increased the hospital and lab wastes many folds (Table 2). The waste generated is very hazardous due to high transmissivity and needs to be administered daily to prevent stacking.

3. Effect on waste receiving and recycling

According to the world bank classification, the low-income countries mostly generate wet waste dumped openly, and only 20% of total waste goes for recycling. In comparison, this fraction is 51% for high-income countries, as most of the waste is recyclable and has better waste management [25]. At the moment of the pandemic, all the nations suffer from the lack of returns and proper functioning of recycling facilities due to employees’ lean attendance at work.

European recycling companies are facing a severe crisis due to COVID-19. As the production and use of virgin plastic have lower cost and safe compared to recycled plastic; thus, the recycling facilities are going through a socio-economic crisis. It will eventually encourage the incineration of recyclable waste and lead to adverse environmental impacts and reduce resource recovery (recyclable plastic) [27]. In the USA, due to staying at home orders in Oregon, the Oregon Beverage Recycling Cooperative (OBRC) has received 45% lesser returns to be recycled compared to last year in April. Initially, the services were suspended, but later, even if the redemption centers are opened, the number of returns is reduced. California and Michigan recycling facilities are facing similar challenges due to a drop in the collection of recyclables [28]. Vienna has experienced a 10–15% drop in recyclable material collection with nearly 500 visitors per day. Thus only four out of 16 recycling units are operational [29]. In the Netherlands, the demand for recycled products obtained from sorted textile and plastic packaging is suffering. Citizens are requested by collection and sorting companies not to donate the products, few of them are collecting at higher prices. Only 40% of thrift shops are opening due to a drop in demand for recycled textiles, piles up the stores [30].

During the pandemic, the Hong Kong government introduced two bonus schemes to encourage waste recycling [31]: (i) One-off Rental Support Scheme (ORSS), which allows recycling facilities to pay 50% of their rent (or up to HKD$25,000). (ii) One-off Recycling Industry Anti-Epidemic Scheme (ORIAS) supports the operational costs of recycling facilities at a rate of HKD$20,000 per month. More than 580 applications have been accepted for funds and provided over HKD$90 million to recyclers recently.

Table 2

| City, Country       | Population (World Population Review), (number) | Additional Medical Waste (Kg per day) | Total Waste Production Over 60 Days (Kg) |
|---------------------|-----------------------------------------------|-------------------------------------|-----------------------------------------|
| Manila, Philippines | 14 *10⁶                                        | 280 *10³                             | 16.8 *10⁹                              |
| Jakarta, Indonesia  | 10.6 *10⁶                                      | 212 *10³                             | 12.75 *10⁹                            |
| Kuala Lumpur, Malaysia | 7.7 *10⁶                               | 154 *10³                             | 9.24 *10⁹                            |
| Bangkok, Thailand   | 10.5 *10⁶                                      | 210 *10³                             | 12.6 *10⁹                            |
| Hanoi, Vietnam      | 8 *10⁶                                        | 160 *10³                             | 9.6 *10⁹                            |

Note: The increase in medical waste (kg) is estimated at 3.4 times of the number of infected persons.

4. Waste management plan

To handle the waste generated from household, streets, quarantine centers or hospitals, it is necessary to understand the lifecycle of virus, transmission, and control pathways. A total of 3497 respiratory, stool, serum, and urine samples from patients were tested to study the lifespans of SARS-CoV-2 RNA. The virus sustained for 17–31 days (55 samples) in stool, i.e., much longer duration compared to its period in respiratory samples (13–29 days) and serum (11–21 days) (39 samples) [32]. The lifespan of the virus also varies for different surfaces, known as fomites (objects or materials that are likely to carry infection, such as clothes, utensils, and furniture etc) and mostly, the virus stays on the smooth surfaces for a longer duration (Fig. 1).

The main pathway of transmission of the virus in the waste collection system is from the generator to the collector if the instructions for keeping the waste untouched for a prescribed duration of at least 72 h are not followed before disposal, as the virus can live on a rigid surface for up to a few days [7,34]. The waste collection systems with a compaction system may also release aerosols with the virus if the household waste is collected from the residence of home quarantined patients [35]. Biomedical waste has a range of waste such as human and animal anatomical waste, contaminated blood, swabs, expired medicines, syringes, glassware, discarded mattresses, etc. that may contain various infections virus and hazardous materials [36].

Several disinfectants are used to eliminate the vector of disease while handling the waste. Some of the commonly used disinfectants are alcohol, chlorine, hydrogen peroxide, iodophors, phenolics, etc. [37]. The viruses such as SARS CoV, MERS CoV or endemic human coronavirus-rusts (HCoV) tend to linger on inert surfaces like metals, plastic, or glass, i.e., up to 9 days (temperature higher than 30 °C) reduce the persistence of these viruses, can be disinfected within 1 min by 62–71% ethanol, 0.5% H₂O₂ or 0.1% sodium hypochlorite [38]. The SARS-CoV-2 virus is very resistant to variation of pH between 3 and 10, and it is highly dependent on the temperature. At 4 °C, it is highly stable (by day 14, only 0.7 log-unit reduction found), while it sustained only for 5 min at 70 °C [33]. The two disinfection formulations recommended by WHO, namely, 80% ethanol or 75% 2-propanol, are suitable during viral outbreaks [39]. SARS-CoV-2 can also be deactivated by Households bleach (dilution 1:49 and 1:99), 70% Ethanol, 7.5% Povidone-iodine, 0.1% Benalkonium chloride, 0.05% Chloroxylenol, and Chlorhexidine within 5 min of application, while 1:49 hand soap solution is effective within 15 min [33].

The Association of Cities and Regions for Sustainable Resource Management (ACR+) has given separate protocols for waste collection for frontline waste workers’ safety to collect waste from houses with COVID-19 patient and quarantine facilities. This waste is source segregated and sent directly to the incinerators or landfills [7]. The Public Health of England (PHE) has given similar guidelines for self-quarantine patients; the used disposables like paper tissues and cleaning cloths should be disposed of in the rubbish bags and doubly secured within another disposable bag. It should be kept for 72 h and not in the recycling bins but in residual bin [40]. The Central pollution control board (CPCB), India, has altered the waste disposal rules for biomedical waste during COVID-19 for infected debris. The waste from isolation wards needs to be labeled as “COVID-19 waste” such that the Common Biomedical Waste Treatment Facility (CBWTF) can handle it separately. Whatever container stores the COVID-19 waste has to be disinfected by the 1% sodium hypochlorite solution [7]. According to Schedule II of Bio-medical Waste Management Rules, 2016, the yellow category waste can be allowed for deep burial in the pits in case of the absence of CBWTFs in the area [41]. Ministry of Environment of the Czech Republic has instructed that the drapes from the quarantine center or household of an infected person should be appropriately sealed in a 0.2 mm thick plastic bag and should be doubly packed in case of thinner plastic bags. The waste should be disposed of in black dustbins (for mixed municipal waste containers) to avoid littering and thoroughly wash hands after
Due to the low availability of waste management staff (<70%), it is necessary to adopt a degraded mode of waste collection. Instead of stopping at every house to collect the waste, it can be collected from several complexes to a common place. It will minimize close contact during waste collection [43].

Norwegian environmental agency has stated that due to increased work pressure amid pandemic, the waste management employees are at high risk of infection while handling waste and hazardous waste. Thus, several municipalities have kept an unattended counter for the reception of hazardous waste [44]. Vienna waste management services (municipality) has taken some strict measures for the safety of the employees. The street sweeping employees are reduced to 50% and are divert the staff to urgent services like waste collection, and to minimize the staff in the office, the office personals are allowed to work from home as much as possible. Employees on-site are instructed to be well equipped with masks, gloves, etc. and follow the protocol of regular hand wash and maintain a distance of 1 m while working [29]. Similar measures are adopted by the European Union [45], RECYC-QuéBEC, Canada [46], France [47], etc. The life cycle analysis (LCA) states that incineration of biomedical waste can minimize the environmental impacts if the energy recovery is maximized even when the chemical disinfectants are used. But even the trace emissions of dioxins and furans are objectionable [10].

Plastic waste footprint (PWF) translates the footprints that plastic imposes throughout its life. It shows that Chemical recycling (depolymerization), primary and mechanical recycling, and energy recovery can be used to reduce the footprints by recovering energy from plastic and avoid the energy-consuming pathways (extraction to polymerization) to produce virgin plastic [10].

International Solid Waste Association (ISWA) has covered three overall goals to manage the waste during COVID-19 pandemic [34]: (1) The waste management practices should not be compromised anywhere in the world. The health of waste management workers should not suffer and be well equipped with protective gear to ensure safety. (2) The recycling activity needs to be re-iterated to avoid infection or cross-contamination. (3) The biomedical waste should be safely disposed of such that it ‘doesn’t generate secondary pollutants or infection. It has also provided guidelines (temporary) for the municipal waste service provider; generators-the citizens, COVID positive patients, and recycling companies and operators [34]. For municipal waste service provider: The collection of mixed recyclables should be discontinued, and manual handling should replace mixed mechanical-manual handling systems. The expansion of storage facilities can help maintain a safe waiting period before handling the recyclables by the professionals to avoid the layoff of services. For generators-the Citizens: The recyclables can be stored in paper bags (residence time of virus on paper: 24 h) as the plastic packaging retains the virus for a longer duration (Fig. 1). The package can be stored for a minimum of three days before giving it for collection. If a plastic bag is used for storage, it should be in other plastic containers with the date of mentioning it to the recycling center. For COVID positive patients: The waste should be doubly packed in disposable plastic bags and disinfected. For Recycling companies and operators: Increase the capacity of waste storage facility such that the storage duration can be increased before manual handling of waste.

Table 3 summarizes the procedure, which can be followed for sustainable waste disposal during the COVID-19 pandemic.

5. Case studies of waste management

Governing bodies of few nations have laid some efficient strategies to manage the waste during the pandemic. Since the situation is somewhat different from the outbreaks previously experienced, it is conceivable that an out-of-box solution might make a difference and set a precedent for other nations. The Welsh Government has given non-statutory guidelines to prioritize the waste collection and recycling of household waste, street cleansing/litter bins/fly-tipped waste, and commercial waste [42]. Due to the low availability of waste management staff (<70%), it is necessary to adopt a degraded mode of waste collection. Instead of stopping at every house to collect the waste, it can be collected from several complexes to a common place. It will minimize close contact during waste collection [43]. Norwegian environmental agency has stated that due to increased work pressure amid pandemic, the waste management employees are at high risk of infection while handling waste and hazardous waste. Thus, several municipalities have kept an unattended counter for the reception of hazardous waste [44]. Vienna waste management services (municipality) has taken some strict measures for the safety of the employees. The street sweeping employees are reduced to 50% and are divert the staff to urgent services like waste collection, and to minimize the staff in the office, the office personals are allowed to work from home as much as possible. Employees on-site are instructed to be well equipped with masks, gloves, etc. and follow the protocol of regular hand wash and maintain a distance of 1 m while working [29]. Similar measures are adopted by the European Union [45], RECYC-QuéBEC, Canada [46], France [47], etc. The life cycle analysis (LCA) states that incineration of biomedical waste can minimize the environmental impacts if the energy recovery is maximized even when the chemical disinfectants are used. But even the trace emissions of dioxins and furans are objectionable [10].

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Table 3
Procedures that can be followed for sustainable waste disposal during COVID-19 pandemic.

| Source of waste/ Procedure followed during disposal | Source segregation | Packaging | Labeling | Resting time | Disinfection | Remarks |
|-----------------------------------------------------|--------------------|-----------|----------|--------------|--------------|---------|
| Household waste                                     | Recyclable waste   | Regular packaging or paper bags can be used as packaging material. | NA       | 72 h         | The resting time will disinfect the waste | Incineration |
|                                                     | Residual waste     | The life span of the virus is shorter (a few hours) compared to the ones on plastics (up to 7 days) |          |              |                               | Proper disposal will block the transmission of the virus. |
| COVID-19                                            | Residual Waste     | Double packaging of the waste in disposable bags. |          |              |                               | All the waste is treated as residual waste. |
| Hospital waste                                      | Biohazard waste    | Anti-puncture packaging is recommended for biohazard waste. |          |              |                               | |
|                                                     |                    | labeled as “COVID-19 waste” | NA       |              |                               | |
|                                                     |                    | 72 h |          | Use of disinfectants such as 80% ethanol, 75% 2-propanol, etc. | Autoclave |
|                                                     |                    | |          | Resting time is provided as long as possible to make sure the disinfection occurs naturally. | |
|                                                     |                    | |          | • Use of disinfectant such as 80% ethanol, 75% 2-propanol, etc | |
|                                                     |                    | |          | • Use of disinfectant such as 80% ethanol, 75% 2-propanol, etc | |
|                                                     |                    | |          | • Use of disinfectant such as 80% ethanol, 75% 2-propanol, etc | |
|                                                     |                    | |          | • Use of disinfectant such as 80% ethanol, 75% 2-propanol, etc | |

waste. The waste generated by different sectors are categorized into low, medium, and high priority, its mitigation and the possible consequences upon cessation of services are listed. The waste collection service is essential to maintain hygienic conditions and recycle to reduce the environmental impacts and aid the economy [48]. Donatella Bianchi, the president of WWF Italy, has appealed to the concerned institutions to install the PPE and protective device collectors at the workplaces, parks, supermarkets, and several public locations [18]. In Upper Austria, the residents are advised to reduce waste generation and proper separation to avoid overloading of waste management facilities. The appropriate protective gear should be used during waste disposal to minimize contact [49]. All the waste collected from household contained infected persons under treatment is subjected to incineration at 1000 °C to assure disinfection. The glass waste can be disposed of separately [50]. In Vienna, none of the waste directly ends up in landfills, as all the waste treatment plants are working to its maximum capacity, and all the residual waste is first treated into waste to energy plants. This practice settles the COVID-19 infected masks and PPE kits as citizens are instructed to collect it with the residual waste [29]. Zagreb City Holding Ltd. (Waste management company, Subsidiary Cistoča) started the disinfection and washing of the residual waste bins since March 23, 2020 [51]. In the Netherlands, the waste collection operates normally. Still, the plan is to scale down the operations by prioritizing the residual and organic waste according to the demand for situations like a drop in sales, reduction in staff, etc. [30]. The Norwegian government has stated the need for intermediate waste storage to manage the processing and sorting plants if the waste increases beyond handling capacity. The change in landfill permits and waste transportation to a different place is allowed temporarily [52].

The Lagos state government has strictly implemented guidelines to prohibit the rag pickers from entering the dumpsites as it might be a potential route to community transmission, and the frontline workers in this sector will be given PPE kits [16]. According to Nigeria Centre for Disease Control (NCDC) guidelines, the disposable PPE is collected in separate bins placed in buildings, hospitals, and public places are disinfected and discarded by trained personnel daily [22].

6. Future perspective and conclusions

According to the current situation, the pandemic is expected to prevail beyond the year 2025 [53]; thus, developing a long-term plan for solid waste management is necessary. Instead of single-use masks, reusable ones can be sterilized and used. The staff can be employed in the waste recycling facility on a rotation basis to work at 50% capacity at a time. Still, it should be operated on a routine basis to avoid the accumulation of waste. The most critical requirement is a general awareness among the citizens to cope with the current situation wisely. The COVID-19 pandemic erupted as a very sudden occurrence in millions of lives. To keep a check on the number of patients, the lockdown and interruption of international travel were imposed by different countries. The high transmissivity of the virus increased the number of patients at unprecedented rates. Industrial and daily activities faced abrupt termination, affected product manufacturing that led to the layoff of several employees and changed the waste generation and collection trends. The isolation facilities and hospitals are overflowing with patients and
generate a large amount of infectious waste. The requirement for PPE kits, masks, hand sanitizers, gloves, etc. has expanded to an unexpected rate, from health care to domestic levels, resulting in colossal waste generation. Several countries have adopted preventive measures to prevent the spread of the virus. The study concludes that:

- The key point to be adhered to is that waste management is not only the responsibility of the collector, but citizens do need to be vigilant about the safety of the frontline staff. Thus, the instruction to minimize waste generation, i.e., rest the waste for at least 72 h before final disposal, disinfection of disposal bag, etc. should be followed.

- We need to make sure that disposed PPE is adequately managed at the source and does not add to the riparian pollution. Instead, energy recovery from plastic waste can reduce plastic waste footprints.

- Reliance on bioplastics over fossil fuel-based plastic can be a sustainable switch even though it will incur additional costs.

- As the prevailing conditions have influenced the collection and disposal of waste, stringent and flexible waste disposal policies have been adopted by nations to prevent the transmission of viruses through solid waste produced from households, self-isolated patients with COVID, and hospitals.

CRediT authorship contribution statement

Abhilasha Tripathi: Conceptualization, Visualization, Data curation, Writing - review & editing. Vinay Kumar Tyagi: Conceptualization, Visualization, Resources, Writing - review & editing. Supriya Vivekanand Vivekanand: Writing - review & editing. Purnehdu Bose: Writing - review & editing. Surindra Suthar: Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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