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Perspective

Emerging challenges in urban waste management in Tehran, Iran during the COVID-19 pandemic

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COVID-19 may pose different direct and indirect effects on the environment (Zambrano-Monserrate et al., 2020). Among the various environmental issues, municipal solid waste (MSW) management is the most challenging environmental problem in Tehran during COVID-19 pandemic. Non-sustainable handling of wastes in many developing countries makes them more vulnerable to the possibility of Coronavirus propagation through waste management practices. The effects of COVID-19 pandemic on solid waste management systems is still not known well. Available researches have mainly focused on direct health issues associated with COVID-19 rather than environmental aspects. Emerging challenges in MSW management during the COVID-19 pandemic has rarely been addressed.

Tehran, the capital and the most urbanized city of Iran with a population of 8,693,706 is one of the largest cities in West Asia and the 21st largest city in the world. The average municipal solid waste (MSW) generation rate is 0.745 kg/capita/day in Iran, with the highest rate of up to 1000–1200 kg/capita/day in Tehran. The quantity of the solid waste generated in Tehran is estimated to be more than 7,500 tonnes per day. COVID-19 outbreak has changed the quantity and composition of solid wastes in Tehran City. In Iran, the use of personal protective equipments (PPE) such as facemasks has been recommended by the Iran's National Headquarters for Managing Coronavirus (INHMC) for all people. The INHMC was formed by the Ministry of Health and Medical Education to prevent or control the outbreak of Coronavirus in Iran. A large amount of these PPE is daily used in Tehran during the COVID-19 pandemic as a result of such recommendations. On average ca. 32% of the residents of Tehran have accepted to use PPEs during the pandemic that is pretty low in the context of the spread of the viral disease. The estimated figures of facemasks and single-use plastic gloves discarded daily in Tehran based on the two scenarios (i.e. according to the legislation situation) are presented in Table 1. The highest amount of the facemask wastes were generated during March 2020 (10.78 million per day). Table 1 indicates that legislation will considerably increase discarded facemasks. Discarded materials including contaminated PPEs can exacerbate environmental and health problems, if not managed properly. Such threats would be much higher in developing nations with poor waste management strategies. For instance, garbage trucks in Tehran are mainly equipped with compactors which enable them to collect more wastes. Compaction of wastes is economically attractive for waste collection contractors; however, high moisture content of the collected wastes mostly result in overflow of the leachate from garbage trucks that is a very common in Tehran. Viruses may persist in landfill leachates for days to months (EPA, 2016).

Legal separation and recycling of MSW has been completely ceased after the COVID-19 outbreak, while illegal separation and recycling of wastes is still ongoing. Suspension of waste separation and recycling programs in Tehran was due to the risk of spreading the new Coronavirus at solid waste transfer stations and recycling facilities. However, it is believed that waste separation is more important than ever during the outbreak of COVID-19, and only households with infected or suspicious persons should be exempted. For instance, Italy has banned source separation of wastes by only the infected residents (Zambrano-Monserrate et al., 2020). Previously around 4,900 tonnes of the collected wastes were daily landfilled in Tehran. In addition, daily around 200 tonnes of the general urban wastes were incinerated at Aradkouh disposal site. Composting facility of Aradkouh was also

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Based on these concerns, six urgent research and development challenges for devising and implementing strict regulations on management of MSW wastes have been highlighted as a national priority. Scientific communities especially in developing nations are required to devise proper urban waste management strategies during the COVID-19 pandemic. Safe separation, handling and disposal of MSW including medical wastes from hospital and non-hospital sources should be identified:

- Decision-making under socioeconomic uncertainties based on the financial recovery path and changes in people habits.
- Devising applicable approaches for sustainable MSW management in low-income countries during the COVID-19 pandemic.
- Providing urgent training programs as well as robust legislation to enhance people knowledge, attitudes and practices towards proper solid waste management during the COVID-19 pandemic.
- Developing separate waste storage and collection services for suspicious individuals who receive care at home or small healthcare centers.
- Provision of enforceable and observable plans in developing countries for collection, processing, transfer and final disposal of the infectious and non-infectious hospital wastes during the pandemic.
- Life-cycle sustainability assessment for different urban waste disposal and management scenarios during the pandemic.

Substantial structural modification in waste management in Tehran is required, from the separation and storage guidelines at homes and hospitals to the safety protocols for waste collection teams during the pandemic. Safe separation, handling and disposal of MSW including medical wastes from hospital and non-hospital sources should be highlighted as a national priority. Scientific communities especially in developing nations are required to devise proper urban waste management strategies during the COVID-19 pandemic. Neglecting the effects of the COVID-19 pandemic on people behavior and solid waste management systems would pose more challenging and long-lasting environmental and health outcomes worldwide.

### 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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