



Environmental Catastrophe of COVID-19: Disposal and Management of PPE in Bangladesh

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Abstract

As COVID-19 spreads quickly across the whole of Bangladesh, the increased uses of Personal Protective Equipment (PPE) could lead to secondary environmental catastrophes. It is urgent for respective authority to maintain a safe waste disposal system to save the environment and protect public health from impending health threats.

Keywords COVID-19 · PPE · Medical waste · Bangladesh · Environmental pollution

One of the major negative aspects of COVID-19 pandemic is the overlooking of the environmental aspects and the evoking catastrophes of increased plastic pollution all over the world. Bangladesh is one of the most polluted developing countries in the world (Haque et al. 2020). Despite that, it improved its position substantially from 179th to 162nd according to the Environmental Performance Index (EPI 2020), out of 180 countries in terms of handling environmental pollution. However, the substantially increased use of single-use-plastic polymers during the COVID-19 pandemic will surely affect the poor waste management of the country and the environmental performances. Moreover, COVID-19 has disrupted the fragile healthcare system along with the socio-economic and mental wellbeing in Bangladesh, a developing country of 165 million (Shammi et al. 2020). As of today, 8 August 2020, with 252,502 confirmed cases and 3333 deaths (IEDCR 2020), Bangladesh is now positioned among the top 15 affected countries in terms of new infections with an increasing trend of both infection and death.

COVID-19 is generating substantial amounts of hazardous waste worldwide (Yu et al. 2020) with the rise of personal protective equipment (PPE) used in hospitals, and other professions are being the main component. PPE comprises gloves, medical masks, goggles or a face shields, gowns, as well as respirator for specific procedures (i.e. N95 or FFP2 standard or equivalent) and aprons. According to the World

Health Organization (WHO), standard PPEs are single use, and after the use, it becomes a hazardous medical waste (WHO 2020). The goggles and face shields could be reused maintaining standard disinfecting procedure. However, the other components of PPE have no capacity for reuse. In South Korea, China, Japan, and other countries have given instructions to wear masks in public (Feng et al. 2020). Recently, the Government of Bangladesh (GoB) also imposed public to use masks (The Daily Star 2020). In response to protecting the frontline doctors and healthcare workers, the GoB keeps distributing different PPE commodities in the government hospitals treating COVID-19 patients (Table 1). Subsequently, it is speculated that as the number of patients increases, the requirement of PPE kits, masks, and gloves also increases, which in turn will increase the generation of medical and personal PPE wastes.

The Environment and Social Development Organization (ESDO), a Bangladeshi NGO, reported 14,500 t of hazardous plastic waste from the disposal of single-use surgical face masks, hand gloves, hand sanitizers, and polythene bags in communities, hospitals, and other healthcare facilities in March–April 2020 alone (ESDO 2020). On average, 206–250 t of COVID-19 wastes are produced per day in Dhaka city alone (The Business Standard 2020). However, the legislative guideline of “Bangladesh Medical Waste Management and Processing Rules 2008” remained as paperwork even after 11 years (DGHS-MFHW/GOB 2011). Moreover, the National Preparedness and Response Plan for COVID-19 also failed to address the issues of the hospital and residential PPE waste management based on standard colour coding (DGHS-MFHW/IEDCR/, 2020).

The PPE after use should be discarded according to standard procedures ensuring the safety of hospital doctors,

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Table 1 PPE commodities used and distributed in the hospitals during the COVID-19 treatments (DGHS 2020)

PPE commodities	Quantity used (9 June 2020)	Quantity used (8 August 2020)
Apron and gowns	76,540	76,653
Gloves for examination	317,901	506,431
Gloves surgical	569,482	618,026
Head/face/eye shields	992,770	1,201,127
Masks	2,524,863	6,787,300
PPE kit	1,432,206	1,104,674
Sanitizer	185,417	189,232
Shoe protector	87,414	46,351
Others	5,378,710	5,001,499

nurses, and healthcare workers in the doffing room ensuring disinfection followed by removal and storing in a sealed box or biosafety bags. These bags of waste generated from COVID-19 treatments are then transferred to in-house storage. From the in-house storage, the PPE along with the other medical wastes are collected in open drums by an NGO PRISM Bangladesh Foundation and transported for final disposal in Matuail Landfill station at Dhaka South City Corporation (DSCC). This is the only option for Dhaka city's hospital waste management (PRISM Bangladesh Foundation n.d.). However, uncapped collection and transportation of COVID-19 wastes over such a long distance are certainly dangerous for public health.

Before COVID-19, there were approximately 40,000 informal waste collectors across the country. During COVID-19, 50% of the informal waste collectors were reduced due to the fear of infection (ESDO 2020). Unfortunately, in many rural, urban, and semi-urban hospitals, this disposal facilities are absent. Many hospitals and clinics burn medical wastes in their backyards or mix them with the regular city corporation bins.

In the residential areas, the used PPE, masks, and gloves and other COVID-19 wastes were discarded among the household bins putting the waste collectors' health and life at risks. The used PPE wastes can be equally health hazardous and infectious, and these wastes were not labelled. The occupational health and safety issues of the waste collectors are completely overlooked. Moreover, the unplanned environmental disposal of medical wastes can risk the biodiversity of the riverine ecosystems of Bangladesh and may also hamper the marine ecosystem of the Bay of Bengal (Dhaka Tribune 2020; The Guardian 2020). As the PPE, disposable masks and latex gloves are all plastic polymers; these will contribute to the microplastic pollution and irreversibly damage the ecosystem health (Fig. 1).

Ideally, medical wastes must be incinerated at 700 °C scrubbing and filtering particulate matter. In Wuhan, China, the biomedical hospital wastes were incinerated in a specialized facility, and several new mobile incinerators were established promptly in different locations of Wuhan to reduce further environmental transmissions (Yu et al. 2020). During the pandemic, Wuhan produced more than

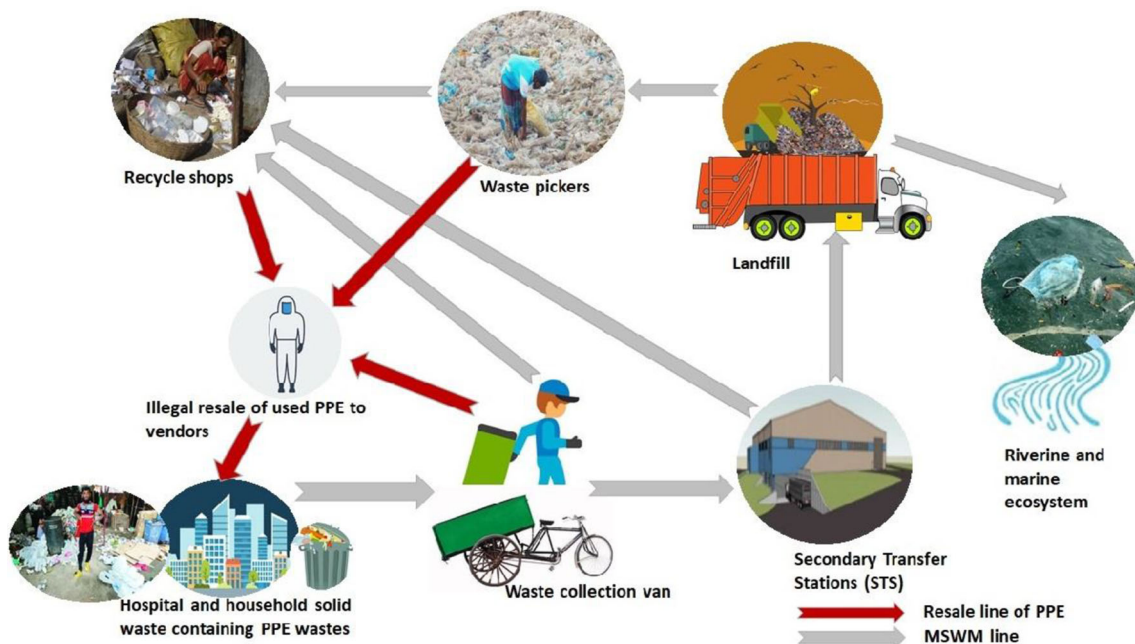


Fig. 1 The mismanagement of in-house storage of hospital waste and household COVID-19 PPE waste. The disposable masks, PPE, and other COVID-19 wastes find their ways into resale and reuse. Moreover, from

the landfill sites, it also finds its way and accumulates in the rivers and ocean debris and damage the ecosystem

240 t of biomedical wastes/day forcing the city authorities to implement mobile treatment facilities which were upgraded from 50 t/day to over 263 t/day (South China Morning Post 2020). However, some hospitals in Dhaka and other cities were found to burn their medical wastes in their backyards without proper treatment facilities emitting different flue gases and harmful particles in the atmosphere.

It is important to consider that PPE waste management during an infectious pandemic should be considered an emergency and managed without undue delay. But since in Bangladesh, we do not have good incineration facilities, PPE waste from the hospitals and residential areas remains a tremendous challenge. Moreover, due to the reduction of oil prices and the demands for personal protection, the single-use plastics rose significantly in the world. This has furthermore reduced the possibility of recycling and increased plastic waste generation (Zambrano-Monserrate et al. 2020). Besides, there is a risky and unhealthy practice of collecting used masks and PPE by the rag-pickers and waste collectors who resale it in the local market illegally. This unhealthy practice should be stopped and taken care of by the law enforcement offices (Fig. 1).

Lastly, we must equip our medical waste management system and overcome the obstacles mentioned. It is high time that we should implement and update Bangladesh Medical Waste Management and Processing Rules 2008 in entire Bangladesh. The disparity of rural and urban residential and hospital PPE waste management must be focused on the updated guidelines. COVID-19 pandemic can be taken as an opportunity to improve the capacity building of PPE waste management. The waste management operators and collectors can be given special training on occupational health and safety protocols on safe waste collection and management. Awareness-raising program can be planned for the rural and urban residential PPE users to safely dispose of their used PPE and masks following proper safety protocols in a labelled bag. The concerned ministry and authority can think about installing good capacity incineration facilities for medical PPE waste and residential PPE waste management in different divisions of the country. City corporations, waste management authority, Ministry of Health and Family Welfare, and Department of Environment should work together to improve the capacity of hazardous PPE waste management.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with animals performed by any of the authors.

References

- Directorate General of Health Services (DGHS), Ministry of Health & Family Welfare of Bangladesh (MFHW), The Government of Peoples' Republic of Bangladesh (GOB). (2011). Environmental assessment and action plan for the health, Population and Nutrition Sector Development Program (HPNSDP) 2011–2016. http://www.mohfw.gov.bd/index.php?option=com_docman&task=doc_download&gid=359&Itemid=&lang=en. Accessed 8 Aug 2020
- Directorate General of Health Services (DGHS), Institute of Epidemiology, Disease Control and Research (IEDCR), Ministry of Health & Family Welfare of Bangladesh (MFHW), The Government of Peoples' Republic of Bangladesh (GOB). (2020). National preparedness and response plan for COVID-19, Bangladesh.
- Dhaka Tribune. (2020). World environment day: medical waste prolonging COVID-19, threatening biodiversity. <https://www.dhakatribune.com/bangladesh/environment/2020/06/04/world-environment-day-friday-medical-waste-prolonging-covid-19-and-threatening-biodiversity> accessed 9 June 2020.
- Environmental Performance Index (EPI). (2020). Bangladesh. <https://epi.yale.edu/eipi-results/2020/country/bgd>. Accessed 9 June 2020.
- Environment and Social Development Organization (ESDO). (2020). COVID-19 pandemic pushes single use plastic waste outbreak: no management, No protection: high health and environmental risk unveiled. https://esdo.org/wp-content/uploads/Summery_Report_on_COVID-19-Pandemic-Pushes-Single-Use-Plastic-Waste-Outbreak_by_ESDO_2020-1.pdf Accessed 9 June 2020.
- Feng, S., Shen, C., Xia, N., Song, W., Fan, M., & Cowling, B. J. (2020). Rational use of face masks in the COVID-19 pandemic. *The Lancet Respiratory Medicine*, 8(5), 434–436.
- Haque, M. M., Niloy, N. M., Nayna, O. K., Fatema, K. J., Quraishi, S. B., Park, J.-H., Kim, K.-W., & Tareq, S. M. (2020). *Variability of water quality and metal pollution index in the Ganges River*. Bangladesh: Environmental Science and Pollution Research (In press).
- Institute of Epidemiology, Disease Control and Research (IEDCR). (2020). IEDCR COVID-19 update. <https://www.iedcr.gov.bd/> Accessed 9 June 9, 2020. Accessed 7 August 2020.
- PRISM Bangladesh Foundation (n.d.). Medical waste management. https://pbf.org.bd/?page_id=717. Accessed 8 Aug 2020
- Shammi, M., Bodrud-Doza, M., Islam, A.R.M.T., & Rahman, M.M. (2020). COVID-19 pandemic, socioeconomic crisis and human stress in resource-limited settings: a case from Bangladesh. *Heliyon*, e04063.
- South China Morning Post. (2020, March 12). Coronavirus leaves China with mountains of medical waste. <https://www.scmp.com/news/china/society/article/3074722/coronavirus-leaves-china-mountains-medical-waste> Accessed 9 June 2020.
- The Business Standard. (2020). 206.2 tonnes of COVID-19 wastes produced in Dhaka a day: Study. <https://tbsnews.net/coronavirus-chronicle/covid-19-bangladesh/206218-tonnes-covid-19-wastes-produced-dhaka-day-study> accessed 7 August 2020.
- The Daily Star. (2020). Not wearing a mask in public now illegal: DGHS. <https://www.thedailystar.net/country/news/not-wearing-mask-public-now-illegal-dghs-1906840> accessed 10 June 2020.
- The Guardian. (2020). 'More masks than jellyfish': coronavirus waste ends up in ocean. https://www.theguardian.com/environment/2020/jun/08/more-masks-than-jellyfish-coronavirus-waste-ends-up-in-ocean?CMP=share_btn_fb&fbclid=IwAR0sdZK8692far9Z1dsqsgGQKO-tMoX5oR2jbT1kPYRhc0QKTUPd0asSIpg accessed 9 June 2020.
- World Health Organization (WHO). (2020). Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19). Interim guidance 19 March 2020. <https://apps.who.int/iris/>

bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf Accessed 9 June 2020.

- Zambrano-Monserrate, M. A., Ruano, M. A., & Sanchez-Alcalde, L. (2020). Indirect effects of COVID-19 on the environment. *Science of the Total Environment*, 728, 138813. <https://doi.org/10.1016/j.scitotenv.2020.138813>.
- Yu, H., Sun, X., Solvang, W. D., & Zhao, X. (2020). Reverse logistics network design for effective management of medical waste in

epidemic outbreaks: insights from the coronavirus disease 2019 (COVID-19) outbreak in Wuhan (China). *International Journal of Environmental Research & Public Health*, 17 (5), doi:<https://doi.org/10.3390/ijerph17051770>.

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