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## Full length article

# Improper solid waste management increases potential for COVID-19 spread in developing countries

Christopher Nzediegwu\*, Scott X. Chang

Department of Renewable Resources, University of Alberta, Edmonton, Alberta, Canada



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Since COVID-19 was declared a public health emergency of international concern by the World Health Organization (WHO) on January 30, 2020, more than three million COVID-19 confirmed cases had been reported in 215 countries with more than two hundred thousand confirmed deaths as of May 02, 2020. Although most countries, including Canada and the US, have closed their borders to non-essential travel, confirmed cases and deaths are still increasing likely due to community transmission and increased capacity for testing. To reduce the spread of COVID-19 from human-to-human, the WHO and other national disease control centers (e.g., US Centers for Disease Control and Prevention) have issued various guidelines, including social distancing, frequent handwashing, and practicing proper respiratory etiquette, such as coughing and sneezing into a flexed elbow. The use of personal protective equipment (PPE) such as medical gloves, facemasks, and aprons has been recommended for essential service workers (e.g., doctors, nurses, caregivers, etc.) and other people handling patients infected with COVID-19. More and more countries are recommending that the people wear facemasks when going to public places. Because of these recommendations, millions of PPE are manufactured and used daily during the pandemic. The number of PPE (e.g., facemasks) used daily in Africa is estimated to reach seven hundred million (see Table 1), as several African states (e.g., Ghana, Nigeria, South Africa) with confirmed COVID-19 cases have mandated compulsory facemask use for their citizens.

Millions of contaminated PPEs (e.g., facemasks and gloves) would end up as wastes, which, if improperly managed, can pose environmental and health threats, especially as a recent study (Kampf et al., 2020) finds that the coronavirus can survive on material surfaces (e.g., metals, glass, and plastics) for up to 9 days. Such threats may be

ameliorated in developed countries where green and sustainable waste management strategies, capable of containing such viruses, are practiced. However, the threats would be much higher in developing countries that have poor waste management strategies. In many developing countries, solid wastes are dumped in the open and in poorly managed landfills where waste pickers without wearing proper PPE would scavenge for recyclable materials (World Bank, 2019). Such landfills also serve as a “food bank” for livestock such as dogs and goats, which can roam about in developing countries such as Nigeria. Such acts may expose humans and livestock to diseases (including COVID-19), exacerbating their spread. It was reported that following the interment of a COVID-19 patient at the Gudu Cemetery in Abuja (Nigeria), a Mortician dumped his disposable safety coverall in a public space; the Public Health Department in Nigeria had to intervene to decontaminate the space (Ebeleke, 2020). This is another example where improper management of contaminated PPEs may increase the spread of viral disease.

Improper disposal or disinfection of plastic bottles used for packaging drinks and water sold in many developing countries, including in healthcare facilities and isolation centers, may be another potential source of viral disease spread in those countries. Used bottles may be contaminated with the virus (Butot et al., 2007). However, disposed/used bottles are often sourced and reused to package locally made drinks and herbal medicines that are sold across such countries. Such reuse of contaminated plastic bottles would certainly increase the spread of viral diseases.

Although the governments of many developing countries are taking active measures to contain and reduce the spread of COVID-19, strategies to manage solid wastes, including used PPE, during and after the

\* Corresponding author.

E-mail address: [christopher.nzediegwu@mail.mcgill.ca](mailto:christopher.nzediegwu@mail.mcgill.ca) (C. Nzediegwu).

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**Table 1**  
Estimated daily facemask use in some African states with confirmed COVID-19 cases.

Country	*Population	*COVID-19 Cases	*Urban Population (%)	**Facemasks Acceptance rate (%)	**Average Daily Facemasks per Capita	Total Daily Facemasks
South Africa	59,308,690	5951	67	80	2	63,578,916
Egypt	102,334,404	5895	43	80	2	70,406,070
Morocco	36,910,560	4569	64	80	2	37,796,413
Algeria	43,851,044	4154	73	80	2	51,218,019
Nigeria	206,139,589	2170	52	80	2	171,508,138
Ghana	31,072,940	2074	57	80	2	28,338,521
Cameroon	26,545,863	1832	56	80	2	23,785,093
Guinea	13,132,795	1537	39	80	2	8194,864
Ivory Coast	26,378,274	1333	51	80	2	21,524,672
Djibouti	988,000	1097	79	80	2	1248,832
Senegal	16,743,927	1024	49	80	2	13,127,239
Tunisia	11,818,619	998	70	80	2	13,236,853
Niger	24,206,644	728	17	80	2	6584,207
Burkina Faso	20,903,273	649	31	80	2	10,368,023
DR Congo	89,561,403	604	46	80	2	65,917,193

Total daily facemasks = population x urban population (%) x facemask acceptance rate (%) x average daily facemasks per capita/10,000.

\* Data retrieved on May 02, 2020 from: <https://www.worldometers.info>.

\*\* Arbitrary data.

COVID-19 pandemic, are lacking. The government could adopt the strategies developed by the Lagos State Waste Management Authority, where proactive measures are taken to restrict access of waste pickers to its landfills. Special waste collection buckets to collect disposable PPEs could be provided in buildings (residential, government and hospitals) and in public places. Such waste collection buckets could be emptied, at least daily, by trained personnel who would then decontaminate or dispose the PPE following Nigeria Centre for Disease Control (NCDC) guidelines (NCDC, 2020). Used plastic bottles could be decontaminated with a 70% alcohol solution, as per NCDC guidelines, before reuse in packaging local drinks and herbal medicines.

There are other potential pathways where improper management of used PPEs can pose a significant risk for increasing the transmission of COVID-19. We thus call on the scientific community to voice their concerns to governments at various levels on the need to develop proper strategies for managing solid wastes, such as used PPEs, to curb

the spread of the novel coronavirus.

## References

- Butot, S., Putallaz, T., Croquet, C., Lamothe, G., Meyer, R., Joosten, H., Sánchez, G., 2007. Attachment of Enteric Viruses to Bottles. *Appl. Environ. Microbiol.* 73 (16) 5104 LP – 5110. <https://doi.org/10.1128/AEM.00450-07>.
- Ebeleke E. (2020). COVID 19: we've addressed unprofessional conduct at Gudu cemetery – FG. Retrieved on April 21, 2020 from: <https://www.vanguardngr.com/2020/04/covid-19-weve-addressed-unprofessional-conduct-at-gudu-cemetery-fg/>.
- Kampf, G., Todt, D., Pfaender, S., Steinmann, E., 2020. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J. Hospital Infect.* 104 (3), 246–251. <https://doi.org/10.1016/J.JHIN.2020.01.022>.
- Nigeria Centre for Disease Control (2020). Coronavirus (COVID-19) highlights. Retrieved on April 21, 2020 from: <https://covid19.ncdc.gov.ng>.
- World Bank, World Development Indicators. (2019). Solid waste management. Retrieved on April 23, 2020 from: <https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>.