

# Single-Use Plastics and COVID-19: Scientific Evidence and Environmental Regulations

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Waste plastics are a serious and growing environmental problem. Less than 10% of plastics are recycled, with most discarded in landfills, incinerated, or simply abandoned.<sup>1</sup> Single-use plastics constitute about half of plastic waste. While most plastics are used and initially disposed of on land, much eventually enters aquatic ecosystems.<sup>2</sup> Wildlife mortalities result from encounters (e.g., ingestion and entanglement) with large debris, including plastic bags. Such bags are excluded from many recycling programs, as they can entangle machinery. Most plastics do not readily biodegrade in the environment. However, they can be embrittled by UV exposure and fragment into microplastics (<5 mm) and nanoplastics (<1 μm) by abrasion. Minute particles can be ingested by biota at all levels of the food chain. Associated ecosystem and human health repercussions are growing concerns.<sup>2</sup> In terms of waste minimization and sustainability, direct reuse of plastic products followed by recycling are preferred solutions.

The US has no federal regulations limiting single-use plastics. Several states and numerous localities have enacted restrictions, but these have been under pressure by plastic manufacturers and allied interests. Recently, these interests have built upon concerns regarding the Severe Acute

Respiratory Syndrome Coronavirus 2 (SARS-CoV-2, also known as COVID-19) pandemic to push back on reusable bag usage and restrictions on single-use plastics. For example, the “Bag the Ban” campaign (<https://www.bagtheban.com>) includes a letter from the Plastics Industry Association (PIA) to the U.S. Department of Health and Human Services (HHS) (<https://www.politico.com/states/f/?id=00000171-0d87-d270-a773-6fdfcc4d0000>). The letter stated: “Study after study after study have shown that reusable bags can carry viruses and bacteria, spread them throughout a grocery store, and live on surfaces for up to 3 days”. The PIA then requested that the HHS “...speak out against bans on these products (single-use plastics) as a public safety risk”. In the wake of this campaign, a growing number of state and local governments and businesses have retreated from single-use plastic packaging restrictions and banned use of reusable bags and beverage containers.

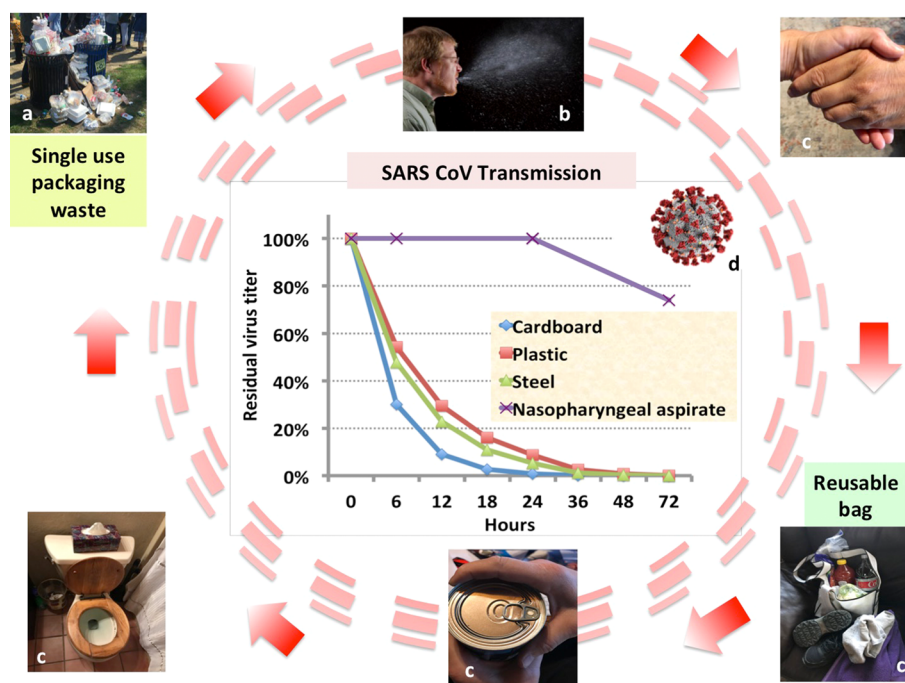
Human contact with contaminated surfaces (formites) is one exposure route in the spread of infectious diseases, including SARS-CoV-2. Single-use plastics (e.g., gowns, syringes, and gloves) provide critical protection from infection in medical facilities. However, the three scientific studies cited in the PIA letter to support the premise that SARS-CoV-2 transmission can be facilitated by incidental contact with reusable bags in grocery stores merit scrutiny.

Importantly, none of the three studies investigated the presence, survival, or infectivity of any coronavirus family members (e.g., SARS-CoV-1, SARS-CoV-2, and Middle East Respiratory Syndrome (MERS)). Instead, they focused primarily on alimentary versus respiratory system-centered pathogens, which have different primary paths of transmission and environmental persistence. The Repp and Keene study was a retrospective investigation of a nine-person, norovirus outbreak in the US.<sup>3</sup> Here, a reusable plastic bag (and packaged food items therein) had been stored in the hotel bathroom of the initial patient identified. This individual suffered from vomiting and diarrhea but did not have subsequent contact with the individuals who later became ill.

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**Figure 1.** SARS-CoV survival is the longest in naso-pharyngeal aspirate, substantially shorter on dry impervious surfaces (e.g., plastic and steel), and shortest on porous cardboard, paper, or cloth.<sup>5–8</sup> Reusable grocery bags are thus likely minor vectors of SARS-CoV-2 compared to direct person-to-person contact, aerosolized human fluids, or handling contaminated surfaces such as food packaging, grocery carts/baskets, check-out kiosks, or door handles. Photo credits: <sup>a</sup> National Oceanographic & Atmospheric Agency; <sup>b</sup> Centers for Disease Control and Prevention (CDC); Brian Judd; <sup>c</sup> R. Hale, VIMS; <sup>d</sup> CDC: Alicia Eckert, MS and Dan Higgins, MAMS.

The study authors postulated that aerosol deposition of norovirus from the initial patient onto the bag and contents (while it resided in the patient's bathroom) was the initial pathogen transmission step. The bag and contents were later removed, and the packaged food therein eaten. The journal editor's synopsis of the paper stated: "Unfortunately, the authors were unable to differentiate between handling of the food packaging versus consumption of the foods they contained. Additionally, there was no assessment of handling of the grocery bag as a stand-alone risk factor".<sup>4</sup> Norovirus survives up to 2 weeks on surfaces at room temperature, compared to 1 to 3 days for SARS-CoV.<sup>4–8</sup>

The Barbosa et al. study<sup>9</sup> cited by the PIA examined food-borne bacteria (e.g., *Enterobacteriaceae* sp. and *Listeria* sp.) and coliforms, but not coronaviruses, on the inside of reusable plastic bags obtained from Portuguese shoppers. The authors focused on potential cross-contamination of food from repeated bag use, not exposure of grocery workers or customers due to handling the bag exterior. They postulated that the pathogens detected "...are probably concentrated in zones such as the bottom of the bags where the probability of cross-contamination to foods is higher". Pathogens were low or not detectable in most bags examined. They emphasized the need to wash bags, to not use them for multiple purposes, and to separate raw and ready-to-eat foods.

The third study (Williams et al.) proffered by the PIA also focused on the likelihood of cross-contamination of food by enteric bacteria (e.g., *E. coli*) inside reusable plastic bags,<sup>10</sup> not a coronavirus on the exterior. Bags were obtained from US consumers entering grocery stores. The authors noted that soiled clothes had on occasion been stored inside some bags and could be pathogen sources. They cautioned against this

practice and indicated bag laundering eliminated 99.9% of bacterial load.

Coronaviruses are lipid-enveloped viruses, which are vulnerable to UV exposure and desiccation.<sup>5–8</sup> SARS-CoV-2 on the exterior of a reusable bag (consistent with contamination by aerosol deposition) likely results in its reduced survival, compared to the nonenveloped pathogens inside of bags described in the three PIA-highlighted studies. Frequency of reusable bag usage is another consideration. The 2011 Williams et al. study noted that 49% of the reusable bags were used once a week and 22% and 18%, respectively, used twice and three times a week.<sup>10</sup> Reduced frequency of store visitation, following recent COVID-19 social distancing guidance, would likely extend bag usage intervals. A comparison of these intervals and the reported 3-day SARS-CoV survivability on plastic surfaces<sup>5,6</sup> suggest that virus carryover from the previous bag use will be diminished further. Importantly, SARS-CoV die-off on dry surfaces is rapid over time (Figure 1), with about a 90% loss over the first 24 h.

In grocery stores, we postulate that human-to-human contact (e.g., respiratory aerosols or skin to skin contact) or contact with recently contaminated surfaces (e.g., door handles, bathrooms fixtures, packaging, grocery cart/baskets, currency, and payment keypads) would be more dominant SARS-CoV-2 vectors than infrequently handled reusable grocery bags. If single-use options are desired, paper bags at the checkout may be incrementally safer than plastic due to shorter SARS-CoV half-lives on these porous materials.<sup>5–8</sup>

In summary, we submit that the three scientific studies highlighted in the PIA letter to the HHS (therein described as "Study after study after study...") to support their premise that reusable grocery bags place people at substantial risk to SARS-CoV-2 infection are of questionable applicability. Further, the

U.S. Food and Drug Administration recently stated: “Currently there is no evidence of food, food containers, or food packaging being associated with transmission of COVID-19” (<https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/coronavirus-disease-2019-covid-19-frequently-asked-questions>).

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### Notes

The authors declare no competing financial interest.

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