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1 **Existence of SARS-CoV-2 in wastewater: Implications for its environmental**
2 **transmission in developing communities**

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21 The ongoing pandemic of coronavirus disease 2019 (COVID-19) is a public health
22 emergency of international concern. The disease, caused by severe acute respiratory
23 syndrome coronavirus 2 (SARS-CoV-2), emerged in China in December 2019 and was
24 declared a pandemic by the World Health Organization (WHO) on March 11th, 2020
25 due to its world-wide spread. This disease has now been reported in over 213
26 counties/territories, with more than 5.5 million confirmed cases and over 0.35 million
27 deaths globally.

28 SARS-CoV-2 is transmitted person-to-person via the inhalation of aerosol/droplets or
29 through contact with contaminated surfaces. Since the detection of SARS-CoV-2 in
30 faecal samples, it has also become clear that coronavirus is also present in human

31 wastewater. SARS-CoV-2 has been identified in sewage in the Netherlands,¹
32 Australia,² Italy,³ USA,⁴ and France.⁵ The first report of SARS-CoV-2 detection in
33 sewage came from the Netherlands suggesting its technical feasibility.¹ A study in the
34 Paris area of France reported the existence of SARS-CoV-2 in all raw wastewater
35 samples, and in 6 out of 8 treated wastewater samples.⁵ Similarly, 6 out of 12 untreated
36 wastewater samples in Italy were positive for SARS-CoV-2.³ A study in the USA
37 reported higher levels of SARS-CoV-2 in wastewater than would have been expected
38 from clinically-confirmed cases.⁴ They estimated that roughly 5% of all faecal samples
39 were positive for SARS-CoV-2 in the testing period whereas the number of clinically-
40 confirmed cases was 0.026%. In Australia, the number of infected individuals,
41 estimated from untreated wastewater, were in reasonable agreement with clinical
42 observations.² Analysing wastewater for SARS-CoV-2 has therefore been proposed
43 as a warning tool and complimentary approach to track the prevalence of infection.¹⁻⁵
44 According to Reuters news (April 16, 2020), Australia's Government is already
45 planning to monitor its sewage for the presence of coronavirus. Wastewater
46 surveillance for SARS-CoV-2 could provide an unbiased opportunity to track its
47 epidemiology in countries having limited resources for clinical diagnosis.

48 The presence of SARS-CoV-2 in wastewater may also have consequences for public
49 health in developing countries with poor water and sewage infrastructure, inadequate
50 institutional and technical disinfection capabilities, and lack of financing. According to
51 2017's World Water Development Report by United Nations, 80% of wastewater
52 worldwide (>95% in some developing countries) is released to the environment without
53 adequate treatment. Wastewater-related exposure to SARS-CoV-2 remains a
54 significant possibility in such vulnerable communities. For example, it is a common
55 practice to dump wastewater without adequate treatment into surface water bodies
56 (e.g. rivers, canals etc.) which downstream are being used for drinking water or
57 irrigation. Cases of accidental contamination of drinking water with raw sewage is
58 commonplace in developing countries, and even reported in the developed world.⁶

59 Additionally, sprinkler irrigation in cities of urban green spaces using treated
60 wastewater could potentially aerosolize the virus if present. Although there is currently
61 no evidence of SARS-CoV-2 transmission via exposure to aerosolized wastewater,
62 this transmission route was identified during the SARS outbreak in 2003. Wastewater
63 aerosols, created by a defective wastewater plumbing system, were identified as a
64 potential transmission route within a housing block in Hong Kong.⁷ Finally, the use of
65 wastewater as irrigation water has the potential to impact on soil quality and potential
66 uptake in crops or the contamination of groundwater resources by the virus if present.
67 In the developing world, an additional transmission route may be via faecal-oral
68 contact. Although hypothetical at this stage, the faecal-oral transmission has been
69 reported for many viral diseases such as Ebola Haemorrhagic fever, Hepatitis A,
70 Hepatitis E.⁸ It becomes a crucial consideration when over half of the global population
71 (4.2 billion) lacks access to safely-managed sanitation.⁹
72 This highlights the need to consider the potential risks to developing communities from
73 environmental transmissions differently than those who are served by adequate
74 disinfection. We, therefore, call governments to integrate safety of wastewater
75 management, drinking water supply and recreational water environments in their fight
76 against the virus. Investments into wastewater infrastructure would be essential to
77 contribute in controlling outbreaks of waterborne diseases. Effective wastewater
78 disinfection to treat and minimize onward environmental transmission of infected
79 wastewater is also essential. A final disinfection step should be imposed urgently if
80 existing wastewater treatment plants are not optimized to remove viruses. There is
81 also an urgent need to provide clear information about the efficiency of the current
82 water disinfection treatments to stop the viral spread. The health of sanitation workers
83 should also be protected by following best safety practices.
84 In summary, a significant knowledge gap exists regarding transmission, persistence,
85 and fate of SARS-CoV-2 in wastewater and the environment requiring greater
86 understanding of the environmental dynamics, persistence and transmission of this

87 virus. Research is needed to investigate interactions of the virus with environmental
88 surfaces and its persistence, mobility and fate in soils and the aquatic environment,
89 and potentially the food chain.

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