Editorial

SARS-CoV-2 in water

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Editorial: SARS-CoV-2 in water

We are delighted to share with you our special issue on SARS-CoV-2 in water, specifically targeted towards our Journal readership. Cutting-edge studies and reviews on the water-related health aspects of SARS-CoV-2 have been contributed by our research community related to the potential risk of waterborne COVID-19 transmission, household water uses, and hygiene during the pandemic, and surveillance of SARS-CoV-2 RNA in wastewater.

RISK OF WATERBORNE TRANSMISSION

In the early days of the pandemic, when shedding of virus with faeces was identified, the most critical question that needed to be addressed was: Does SARS-CoV-2 in water and wastewater present a risk to human health? Could water-based exposures, for example to plumbing workers and wastewater treatment plant operators, present a transmission pathway that needs to be managed?

While several lines of evidence emerged, indicating that there is likely minimal risk via waterborne exposure (including the lack of epidemiological signal of cases amongst wastewater workers, the lack of evidence of infectious virus in wastewater, and the lack of evidence of SARS-CoV-2 persistence in water or wastewater), this topic is still frequently raised for discussion from various sectors of the community. Included in this special issue is an invited review by Professor Mark Sobsey on the risk of COVID19 via faecal waste, wastewater, and water exposures (Sobsey 2022). We would like to express our gratitude to Mark for taking the time to undertake this important review and document his perspective on the available evidence for the benefit of our readership.

Of course, scientific evidence grows rapidly with ongoing research efforts and there is a need to stay alert and open-minded should there be a need to revisit. With that in mind, we commend to you a study from Dey *et al.* (2022) investigating the potential role of amoebae in the environmental persistence of SARS-CoV-2 virus. Understanding the microbial ecology of water systems and the interaction between different microorganisms is of great value and is important for managing the waterborne risk of several pathogens (from SARS-CoV-2 or other RNA viruses) in the future.

HOUSEHOLD WATER USE AND COMPLIANCE WITH PUBLIC HEALTH ADVICE

Public health interventions to limit person-to-person transmission including stay-at-home orders, social distancing, and handwashing were implemented swiftly and globally at the start of the COVID-19 pandemic, with varying degrees of success. As a result of these interventions, water usage patterns changed both due to stay-at-home orders and an increase in water demand for hand washing. The interaction between water availability and compliance with public health orders became the focus of interesting research.

Kumpel *et al.* (2022) investigated household water usage patterns in Hubballi-Dharwad, India during 2020–2021. One-quarter of all households reported insufficient water for handwashing, suggesting that the increased demand for water was not being met. Their results showed that water insecurity negatively affected a household's ability to adhere to protective public health measures during the COVID-19 pandemic and highlighted the importance of access to uninterrupted, on-premises water during public health emergencies.

When a household water supply is insufficient or interrupted, there is a need to leave the household to obtain an essential water supply. Leaving the home increases person-to-person interactions in the community, and this is exacerbated when needing to visit public water and sanitation facilities where physical distancing is often not possible. Denpetkul *et al.* (2021) report a quantitative risk assessment highlighting the risks of person-to-person spread within public toilet facilities.

Handwashing is a simple and effective hygiene measure. Biswas & Karmakar (2022) analysed data from a recent National Sample Survey for India to assess trends in handwashing across the country. They considered a very broad range of factors including caste, class, monthly expenditure, religion, together with water and sanitation access criteria. They showed clearly that handwashing throughout India is far from universal, and sections of the population with poor handwashing practices are

relatively more vulnerable during the COVID-19 pandemic. Identification of these vulnerable sections of the population is of great value for intervention.

WASTEWATER SURVEILLANCE

While disease surveillance via analysis of wastewater is far from new, the rate of growth in the implementation of wastewater surveillance since the beginning of the COVID-19 pandemic has been extraordinary. Wastewater molecular biology has moved into the spotlight of the scientific arena, gaining attention, interest, and critique like never before. The importance of these activities for our research community, as well as for supporting the public health response to the pandemic, is reflected in the large number of papers in this special issue specifically focussing on wastewater surveillance.

Since the beginning of 2020, wastewater surveillance programmes have been implemented in 58 countries (COVID-Poops19 Dashboard|covid19wbec.org). Given this rapid global expansion of predominantly new programmes, Tlhagale *et al.* (2022) reported on the logistics, implementation, advantages, and limitations of national surveillance programmes. A range of countries were included with specific details on the situation in England, the Netherlands, Turkey, and South Africa. In all case studies, the aim of the surveillance programme was to provide scientific evidence regarding the trends in the circulation of SARS-CoV-2 in communities. Wastewater monitoring data has been recognised as an important thread of scientific evidence for public health authorities; however prior to the current pandemic, many decision-makers were unfamiliar with the science behind wastewater surveillance. The unique nature of molecular data coupled with the diversity of methods applied has meant that scientific details are not simple or trivial. This has presented a unique challenge for our scientific community needing to bridge the gap in translating our science for decision-making, accurately, quickly, and effectively. This is particularly addressed by Tlhagale *et al.* (2022) who comment that '*communication and knowledge dissemination have been demanding and time-consuming for the researchers and scientists working on the topic in all four case studies, which shows an area to better prepare for and support in the future*'.

In further support of research translation, we include an excellent review prepared by Hrudey & Conant (2022) drawing on their experience with the Canadian Water Network (CWN) Wastewater Coalition. Hrudey & Conant (2022) argue that appropriate interpretation of wastewater data for public health decision-makers requires an understanding of the importance of different knowns and unknowns. They seek to unpack these details by reviewing the literature regarding the strengths and limitations of wastewater surveillance for SARS-CoV-2 towards the goal of ensuring findings serve needs of public health authorities. In conclusion, it is noted that '*Perhaps one of the enduring benefits from all of the WBS initiatives has been that it required and achieved extensive interdisciplinary collaboration between environmental scientists/engineers and public health professionals.*' This is a welcome and needed avenue of growth for our entire scientific community.

In addition to these broader reviews, this special edition includes a selection of important individual scientific studies from Brazil, Austria, Hungary, Australia, and Japan, with each touching on different key aspects of wastewater surveillance.

Barbosa *et al.* (2022) used their wastewater surveillance programme to assess trends in SARS-CoV-2-RNA in four vulnerable urban communities (informal settlements and low-income neighbourhoods) in metropolitan Sao Paulo. They were able to positively correlate new cases of COVID-19 with N1 viral loads from the two largest communities. This study provides important and detailed information regarding the performance of their analytical methods, a valuable addition to this high-quality scientific study. Barbosa *et al.* (2022) comment that '*Poor sanitation conditions, water scarcity, hyper-dense dwellings, crowded household, lack of health care access, among other factors, make urban slums and other vulnerable communities major COVID-9 hotspots and relevant areas for application of wastewater surveillance.*' Limited studies have been reported in these contexts; however, many programmes are currently ongoing in several LMICs including Pakistan, Nepal, Malawi and Indonesia, and therefore we look forward to future publications in our journal.

Róka *et al.* (2022) demonstrated the use of wastewater surveillance as an efficient tool in tracing emerging SARS-CoV-2 variants of concern in Hungary, with sewage data closely correlated with the clinical emergence of B.1.1.7 cases.

In Tyrol (a federal province of Austria), wastewater monitoring programme was initiated by health authorities. Daleiden *et al.* (2022) report on this programme and show how wastewater surveillance provided value as an early warning system; provided independent confirmation of temporal trends in COVID-19 prevalence; enabled the assessment of the effectiveness of measures, alerted about bursts of disease activity; and provided evidence for the absence of COVID-19.

Camphor *et al.* (2022) report data from Australia and illustrate the interpretation of wastewater data within a more traditional epidemiologic framework used for decision support by public health professionals. They calculate odds ratios

(odds of a positive detection given case notifications in the catchment) and evaluate the performance of wastewater testing as a population-level diagnostic tool.

Finally, the case study from an urban community in Japan addresses the important issue of back-calculation, which refers to the process of quantitatively interpreting community disease prevalence from wastewater data. Many studies have sought to estimate the number of cases in the community from the reported number of genome copies in a wastewater sample. Zhu *et al.* (2022) review the uncertainty associated with estimating the number of cases in the catchment area using back-calculation and conclude that '*at the current stage, the uncertainty associated with the wastewater viral load is still a great hindrance to reliable back-calculation*'. Their results, however, demonstrate a strong correlation between virus detection and reported cases, which they argue may guide towards novel wastewater surveillance strategies.

PATH

PATH, with support from the Bill & Melinda Gates Foundation, is delighted to sponsor this very important special issue on SARS-CoV-2 in water, which gathers articles highlighting the role that water plays in transmission, control, and surveillance of SARS-CoV-2 and reflects on the challenges encountered in different settings.

PATH is a global non-profit organisation dedicated to achieving health equity. We believe that wastewater-based surveillance and more broadly environmental surveillance can provide a cost-effective tool for disease surveillance in countries where clinical surveillance is severely hampered by limited resources and where the population get delayed access to vaccines. However, integrating non-sewered areas and the resulting variety of sample types in wastewater surveillance systems increases challenges in implementation with the interpretation of data. With funding from the Bill & Melinda Gates Foundation and the Global Innovation Fund, PATH is supporting groups in Indonesia, Malawi, Nepal, and Pakistan to set up and implement wastewater-based surveillance of SARS-CoV-2 and to estimate the costs and cost-effectiveness of environmental surveillance, which is essential for scale-up and buy-in by public health authorities.

PATH has been supporting water sanitation and hygiene (WASH) with several projects, and acknowledges the topics presented in this issue which highlight the importance of WASH in the control of the transmission of the disease and as a factor of inequities. We are also pleased to see the representation of articles presenting wastewater surveillance initiatives and use cases from high-income countries but also from low-resource settings, where wastewater surveillance could potentially have the greatest impact. Several articles discuss the challenges of interpreting wastewater data, highlighting some of the barriers to wastewater surveillance data-based public health decision-making. This is an issue that will need to be addressed to build momentum from the SARS-CoV2 pandemic.

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REFERENCES

Barbosa, M. R. F., Garcia, S. C., Bruni, A. D. C., Machado, F. S., de Oliveira, R. X., Dropa, M., da Costa, A. C., Leal, E., Brandão, C. J., da Silva, R. L. O. & Iko, B. Y. 2022 One-year surveillance of SARS-CoV-2 in wastewater from vulnerable urban communities in metropolitan São Paulo, Brazil. *Journal of Water and Health* **20** (2), 471–490.

Biswas, S. S. & Karmakar, R. 2022 Determinants of hand-hygiene practices in India: reflections from the 76th round National Sample Survey, 2018. *Journal of Water and Health* **20** (1), 68–82.

Camphor, H. S., Nielsen, S., Bradford-Hartke, Z., Wall, K. & Broome, R. 2022 Retrospective epidemiological analysis of SARS-CoV-2 wastewater surveillance and case notifications data – New South Wales, Australia, 2020. *Journal of Water and Health* **20** (1), 103–113.

Daleiden, B., Niederstätter, H., Steinlechner, M., Wildt, S., Kaiser, M., Lass-Flörl, C., Posch, W., Fuchs, S., Pfeifer, B., Huber, A. & Oberacher, H. 2022 Wastewater surveillance of SARS-CoV-2 in Austria: development, implementation, and operation of the Tyrolean wastewater monitoring program. *Journal of Water and Health* **20** (2), 314–328.

Denpetkul, T., Pumkaew, M., Sittipunsakda, O., Mongkolsuk, S. & Sirikanchana, K. 2021 Effects of face masks and ventilation on the risk of SARS-CoV-2 respiratory transmission in public toilets: a quantitative microbial risk assessment. *Journal of Water and Health* **20** (2), 300–313.

Dey, R., Dlusskaya, E. & Ashbolt, N. J. 2022 SARS-CoV-2 surrogate (phi6) environmental persistence within free-living amoebae. *Journal of Water and Health* **20** (1), 83–91.

Hrudey, S. E. & Conant, B. 2022 The devil is in the details: emerging insights on the relevance of wastewater surveillance for SARS-CoV-2 to public health. *Journal of Water and Health* **20** (1), 246–270.

Kumpel, E., Billava, N., Nayak, N. & Ercumen, A. 2022 Water use behaviors and water access in intermittent and continuous water supply areas during the COVID-19 pandemic. *Journal of Water and Health* **20** (1), 139–148.

Róka, E., Déri, D., Khayer, B., Kis, Z., Schuler, E., Magyar, N., Pályi, B., Pándics, T. & Vargha, M. 2022 SARS-CoV-2 variant detection from wastewater: rapid spread of B. 1.1. 7 lineage in Hungary. *Journal of Water and Health* **20** (2), 277–286.

Sobsey, M. D. 2022 Absence of virological and epidemiological evidence that SARS-CoV-2 poses COVID-19 risks from environmental fecal waste, wastewater and water exposures. *Journal of Water and Health* **20** (1), 126–138.

Tlhagale, M., Liphadzi, S., Bhagwan, J., Naidoo, V., Jonas, K., van Vuuren, L., Medema, G., Andrews, L., Béen, F., Ferreira, M. L. & Saatci, A. M. 2022 Establishment of local wastewater-based surveillance programmes in response to the spread and infection of COVID-19 – case studies from South Africa, the Netherlands, Turkey and England. *Journal of Water and Health* **20** (2), 287–299.

Zhu, Y., Oishi, W., Maruo, C., Bandara, S., Lin, M., Saito, M., Kitajima, M. & Sano, D. 2022 COVID-19 case prediction via wastewater surveillance in a low-prevalence urban community: a modeling approach. *Journal of Water and Health* **20** (2), 459–470.