Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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The international imperative to rapidly and inexpensively monitor community-wide Covid-19 infection status and trends

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Given the continuing concerns surrounding the lack of adequate diagnostic testing for Covid-19 (caused by SARS-CoV-2), even less attention is being paid to what could become an even more urgent need - - the ability to quickly determine the status and trends of Covid-19 within and across communities nationwide. The existing Covid-19 clinical diagnostic tests will prove woefully inadequate for rapidly monitoring (at comparatively low cost) the incidence of Covid-19 community-wide. It is simply not feasible to do repeated individual testing at very large scales.

Rapid community-wide monitoring could prove of immense international importance in quickly determining trends in whether the spread of Covid-19 (as well as future viral epidemics) in individual communities is increasing or decreasing. This ability is critical for better informing containment and mitigation strategies as well as for better-targeting follow-up diagnostic testing of individuals. This would prove even more important if SARS-CoV-2 reinfections and episodic outbreaks begin to widely occur.

Fortunately, the relatively new field of sewage epidemiology (also called wastewater-based epidemiology: WBE) has been advancing steadily over the last 15 years (for example, see Choi et al., 2018; Daughton, 2018), with research efforts largely concentrated in Europe. Originally geared toward determining the population-wide use of illicit drugs, this monitoring concept has since evolved to include a broad array of other types of substances in wastewater, including virus particles. So the time required for developing and implementing a wastewater monitoring approach specifically designed for SARS-CoV-2 (and therefore Covid-19) might be greatly reduced.

It is critical that governments worldwide be made aware of the important role that sewage epidemiology could play in controlling the spread of Covid-19. National agencies should encourage the development of sewage monitoring capabilities. This can be done partly by soliciting and funding grant proposals; one such example is a call for research proposals dealing with many aspects of coronavirus by the Swiss National Science Foundation (http://www.snf.ch/en/funding/programmes/coronavirus/Pages/default.aspx). Future calls for proposals focused solely on WBE might be more productive.

One problem is the very uneven worldwide distribution of not just R&D on WBE, but also the uneven adoption of WBE for existing purposes such as community-wide illicit drug monitoring. Some countries, such as the U.S., have less experience with the implementation of WBE. For this reason, it will be important to encourage international research collaborations. This would be the best way to ensure adoption of WBE worldwide for monitoring pandemics.

Development of a rapid and economical WBE tool for monitoring status and trends of Covid-19 mass infection will encounter a number of challenges, many of which are often shared by existing WBE methods for other targets of analysis (such as chemical micropollutants). Challenges include statistically representative sampling of sewage, which is heterogeneous. With respect to its occurrence in sewage, viable SARS-CoV-2 probably enters mainly via shedding in the stool. Non-viable virus (and associate viral debris such as RNA fragments, mRNA, or capsid subunits) could enter sewage via stool and urine.

Virus particle loadings in sewage can be quantified by targeting virus functional or structural motifs. Since the half-life of viable SARS-CoV-2 in wastewater seems to be very short, any detection method should account for both viable and non-viable particles. Degradation products (such as RNA fragments) from the virus could also be selected as targets. Detection approaches could include RT-PCR (or allied approaches) and ELISA, coupled with the Most Probable Number (MPN) method for quantifying sewage loadings of combined viable and non-viable virus particles.

For each individual sewage treatment plant (STP), the virus loading levels would then be directly used to establish status and time trends. The levels could also be normalized against the populations served by each STP plant in order to rank communities with respect to their community-wide infection rates. This would facilitate rapid identification of hot spots for better-informed intervention measures and prevention of emerging clusters.

It is imperative to develop WBE methods for mass surveillance and early warning – not just for controlling Covid-19, but also for future epidemics.

Declaration of competing interest

Christian Daughton is the sole author of this manuscript and has declared no conflict of interest.

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