Wastewater: A "Smelly" Source for Critical Epidemiological Information

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Who would have thought that our wastewater would become so popular during the COVID outbreak? Yet here we are in 2023 and wastewater has become mainstream for COVID detection and monitoring to the extent that in the US, an online service provided by BioBot Analytics gives you up-to-date levels of Sars-CoV-2 in wastewater nationwide (Biobot Analytics, 2023), and yes, the levels are rising again. So, how is it that wastewater can tell us about COVID? Science has shown that the SARS-CoV-2 virus is spread in human feces and sometimes urine by those who are infected with the virus. Unfortunately, that spreading happens independently whether the person is symptomatic or not. While this fact raises concerns about spreading the virus in locations like toilets or situations where people are in contact with human feces, this question is not explicitly addressed here today. Nevertheless, the virus is found in wastewater.

A Picture Of Covid Infections Based On Groups Of People Or Populations

Human wastewater has all kinds of origins and is never the same. It becomes diluted with industrial wastewater, mixed with other effluents, and its chemical composition changes over time. In municipalities connected with sewage treatment plants, it is treated and discharged into streams or other water bodies. In any case, wastewater is not a suitable environment for the virus to stay active very long in contrast to other infectious agents. Having said that, we don't need to find active viruses in the wastewater. Thanks to science, we now have detection tools that can identify parts of the virus. That's where the famous PCR technology comes in. PCR or "polymerase chain reaction" technology will identify the genetic information of the virus, its RNA, if it is intact or in pieces, and can tell us how much there is in the wastewater. Yes, there still needs to be some mathematical adjustment or what the experts call "normalization" of the data to account for dilution, source, changes in wastewater volume over time etc. However, the analysis provides a picture of Covid infections based on groups of people or populations.

Wastewater analysis for epidemiological purposes is nothing new. In the 1930s, wastewater was first analyzed to track the poliovirus (Paul, Trask & Gard, 1940) and to learn more about how the virus was transmitted. Now the World Health Organization (WHO) has long published international guidelines on wastewater-based surveillance for tracking polio (World Health Organization, 2003). In the 1950s, wastewater was used to track the parasite Schistosoma in Africa (Bayer, 1954).

Potential For Wastewater Surveillance To Be An Early Warning Indicator

Surveillance methods for COVID have their limitations, especially since infected individuals can be asymptomatic or pre-symptomatic, spreading the virus without any indication of illness. Individual testing relies on the individual being available and willing to be tested. Hospital-based surveillance requires patients to be submitted, and so on. COVID wastewater tracking started right at the beginning of the pandemic. In the Netherlands, the first SARS-CoV-2 fragments were analyzed in wastewater three weeks before the first official case of COVID infection was reported (Medema et al., 2020). These and other findings in wastewater pointed to the potential for wastewater surveillance to be an early warning indicator for COVID.

Assuming that wastewater surveillance of wastewater provides an early warning, the advantage of such testing is that it will allow for more targeted testing and management. The closer the wastewater is sampled to the source, the faster specific testing can occur. The earlier we test, the sooner we find the virus, and infected individuals can be managed, which will help stop the spread. This is helpful on the municipality level and can also aid organizations and companies in implementing control measures before a local outbreak occurs. Individual employees can be proactively tested, physical distancing measures can be established, and working-from-home policies enacted etc. All this and more might help sustain local operations and capacities, and facilities can use this as a risk-based approach to preparedness (Biobot Analytics, 2022). One of the current limitations of this approach is the cost and reliance on external laboratories. However, the more PCR technology advances and becomes mainstream, the more equipment, supplies, and operation will be in the end-user's hands. It could become a facility-specific surveillance tool as common as a smoke detector and not limited to COVID.

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