

Instrument Business Outlook

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COVID-19 Testing in Wastewater Opens Up Market Possibilities

As the COVID-19 pandemic continues to rapidly spread in countries across the world, having taken more than 580,000 lives so far, new solutions for tracking and tracing the SARS-CoV-2 infections are urgently needed. Wastewater-based epidemiology provides such a solution, according to researchers, and labs that have used the technique to detect and quantitate the virus in wastewater by testing the feces found in samples taken at wastewater processing plants. The wastewater is tested for the presence of inactive fragments of the virus' RNA in wastewater using qPCR or digital PCR. Recent studies have proven that viral fragments appear in human feces in as little as three days after infection. The approach could enable tracking by region and over time periods.

The use of wastewater COVID-19 testing has quickly gained momentum across the world. Countries including Australia, the Netherlands and the UK have announced plans for network-based environmental surveillance projects.

Adoption of the approach by wastewater testing labs in the private, academic, government and commercial sectors would open a new market for qPCR and digital PCR systems and reagents, which have not been used on a widescale for wastewater testing. Interest is clearly escalating, with research publications multiplying, and all levels of government announcing new projects. In this article, ***IBO*** takes a look at a few of the latest developments influencing the uptake of such testing.

Water Research Foundation

The Water Research Foundation (WRF) is a worldwide water research organization whose activities include water research-project coordination and technology evaluation. In April, the WRF held a summit, "Environmental Surveillance of COVID-19 Indicators in Sewersheds" addressing the use of wastewater testing for monitoring COVID-19. The WRF subsequently published a report summarizing the summit's content and providing recommendations, including four use cases (see table below). The organization has conducted a survey of US labs doing such testing, whose results will be published shortly.

Sewershed Surveillance COVID-19 Data General Use Cases

Assess Level of Community Infection

Trends/Changes in Infection

Risk Assessment

Viral Evolution

Source: WRF

According to Christobel Ferguson PhD, Chief Innovation Officer at the WRF, RT qPCR has been used for wastewater analysis, mainly by academic researchers. “Even as early as 2009, there were commercially available PCR methods that were being used for source tracking and for tracing contamination in the environment,” she explained. “It’s particularly been used for microbial source tracking to try and differentiate the human and animal sources of contamination. So, it might be a more like research-orientated analysis service, rather than a routine service.” For example, she said, the WHO has used wastewater-based epidemiology to monitor and track the polio virus.

Now the use of qPCR for environmental surveillance of COVID-19 in wastewater is growing with individual labs creating their own method. “All across the globe people are looking at this approach, and most people are using a qPCR technique, some using digital PCR. But it’s being developed from the point of view of many of those laboratories were previously monitoring samples of perhaps sewage or environmental samples, looking for viruses like enteric viruses,” she explained. “But what generally has happened is people have modified their enteric virus collection technique and worked from that as their starting point to try and develop a new method that’s specific for the SARS-CoV-2 virus.”

A standardized method would facilitate a comparison of results from different labs and allow labs to better evaluate their own methods. To compare current methods being used, the WRF last month awarded Trussell Technologies the contract to lead its Interlaboratory and Methods Assessment of the SARS-CoV-2 Genetic Signal in Wastewater study. The study is expected to take six weeks.

As Dr. Ferguson told *IBO*, “We just awarded to Trussell Technologies to do a method comparison trial, because there are quite different concentration methods and extraction methods and even for the genetic assays themselves there are at least half a dozen different primers that people are using, and so we are trying to get a handle on which combination of those methods is most effective.” Sixty US labs and 30 labs in other countries have expressed interest in participating.

The study will incorporate labs not only using qPCR but digital qPCR, which is also being adapted for COVID-19 testing of wastewater even though the technique is not as established as qPCR. Sixty US labs and 30 labs in other countries have expressed interest in participating. As Dr. Ferguson told *IBO*, “I can confirm that our survey conducted in mid-April 2020 indicated that 17% of recipients doing molecular analysis for this purpose were using digital PCR techniques.”

A standard method could also help in the implementation of environmental surveillance testing networks. Among the countries undertaking such projects are Australia, the UK and the Netherlands. In the US, the CDC is currently working to evaluate the use of environmental surveillance testing network, according to Dr. Ferguson. For example, earlier this month, the UK Center for Ecology & Hydrology announced a £1 million (\$1.3 million = £0.80 = \$1) research program, running through October 21, to develop testing procedures for eventual use by the government across the country.

Current testing efforts by US utilities and academic partners, according to Dr. Ferguson are to detect an increase in the presence of the genetic signature. “It's already been used to, to pick up those new outbreaks of infection. So that's the use case where [current testing] is enough--the technique is developed enough to be able to actually inform and provide that that level of awareness....so that you know detection of an outbreak and looking at the trend and seeing the signal go up that, that's definitely working.”

But more research is needed to expand the types of tracking possible “We know that trend case, the detection of the signals is sufficient information to be able to see those increasing and decreasing trends,” explained Dr. Ferguson. “What we need to get a handle on now in terms of the methodology is to get a better understanding of the variability of that signal. What are the factors in the solution that can modulate the strength of that signal, so that we can get a better handle on, you know, a quantitative level of comparison clinical data to the actual detection of the [virus].”

The WRF will embark on a second COVID-19 project to examine these needs. “[It is] going to be looking at what are these other factors, experimental design factors, that can modulate the strength of the signal between the point where somebody makes a contribution to the system and the point where the samples are actually collected. These efforts will also rely on clinical research, such as the fecal shedding of RNA among asymptomatic people.” The project will study small, mid-sized and large regional sewersheds.

Pace Analytical Services

In an additional sign of the increasing momentum of using wastewater testing for environmental surveillance of the SARS-COV-2 virus, last month, Pace Analytical Services, a leading commercial environmental testing lab, launched services for analyzing and monitor wastewater treatment systems for tracking SARS-CoV-2, calling itself “the first commercial scientific lab offering this service.” The service tests for two variants, SARS COV-2 N1 and SARS COV-2 N2.

John Mitchell, Vice President of Operations, Pace Analytical National Center for Testing & Innovation, told *IBO* that Pace is initially targeting industrial-sector labs. “Some of these industrial plants, like refining or chemical plants, will have thousands of employees that must be on site for managing the daily health and safety requirements of these facilities. ...So, testing their wastewater gives these clients the ability to establish a baseline and monitor for potential rises in infection rates by location,” he explained.

Pace Analytical National Center for Testing & Innovation had not used qPCR for wastewater testing before, said Mr. Mitchell, but the company was able to work with Pace Analytical’s Life Science Division to adopt the technique for this purpose. In general, the use of PCR is new to the commercial environmental testing sector according to him. “In the environmental world, we were not using [qPCR] for any testing. There have been some suggestions in the past not related to infectious agents.”

The commercial testing sector could provide the capacity necessary for environmental surveillance efforts for COVID-19 testing in wastewater, according to Mr. Mitchell. “The research and academic world has been very active and helpful in getting some baselines established for proof of concept. Research has shown that this data can be used as a way to monitor changes in infection rates among a population,” he observed. “Several universities in the US have been working in that arena, but they're looking at it from the research perspective, e.g., ‘is this a viable concept?’ In a commercial testing market—and as demand increases—capacity becomes an issue. We can run several hundred tests a day based on well-established technology. Availability is a little limited at the moment, due to demand, but typically we can quickly initiate sample collection and testing for clients.”

Customers inquiring about the service have a wide range of needs. “Everything we're seeing is very dependent upon the client’s needs and how they want to monitor the situation. We have clients who want to test weekly; even twice weekly. Others want to test every other week or monthly,” noted Mr. Mitchell. “In these cases, the goal is to establish a baseline and, of course, an understanding of the infection rates of the general population in a local area is important.”

Regarding the launch of the services, Mr. Mitchell told *IBO*, “In our first few weeks of introducing wastewater testing for SARS-CoV-2, we’ve talked to a lot of organizations. Many haven't made final decisions of how they would like to move forward with testing.” He added, “I do think they are waiting on some regulatory guidance to assist them, but we do not believe that any guidelines from this direction are likely to come in the short term, and delays in establishing the baseline for comparison will limit the power to support health decisions in the coming months. While the actual collection of samples has been slow to start, we’re seeing that grow daily.” He expects the CDC’s efforts to help grow demand.

What could also contribute to increased utilization of such testing is more information. “There's a growing need for virologists and other personnel in the commercial industry to help us learn how to utilize this data most effectively. As an example, if you test twice a week in location X and you are seeing consistent concentration levels of SARS CoV- 2 variants in the wastewater, is that local area at a stable rate of infection? Is infection at a very high or at a very low rate of infection? And, as the test results change, how would the data be used in an epidemiological preparation?” asked Mr. Mitchell. “There is a growing need for interpretation and assistance in the commercial world to our wastewater testing and how to best utilize the data. There are a lot of questions around these issues that I believe the CDC is going to address in their study.”

Growing testing by municipalities would also drive demand in the commercial sector. “If you're one of the five largest municipal regions in the United States, not only is it important to track potential changes in infection rates in your population, but to isolate areas where it might be more prevalent,” explained Mr. Mitchell. “So, in the wastewater treatment system, we have the ability to collect samples from a local community area where maybe discharged water is being gathered. That will allow us to evaluate not only that the infection rate in city X is increasing, but to identify the local communities where the rate may be increasing at a higher rate within that larger metropolitan area.”

As both Dr. Ferguson and Mr. Mitchell attested, COVID-19 testing of wastewater is growing rapidly and will benefit from the many new resources being made available for method development, testing capacity and new projects.