

COVID-19 spread tracked via a rapid, large-scale early wastewater surveillance alert system

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Detecting COVID-19 outbreaks before they spread could help contain the virus and curb new cases within a community. This week in *mSystems*, an open-access *Journal of the American Society for*

Microbiology, researchers from the University of California San Diego describe a mostly-automated early alert system that uses high-throughput analysis of wastewater samples to identify buildings where new COVID-19 cases have emerged—even before infected people develop symptoms.

The approach is fast, cost-effective, and sensitive enough to detect a single case of COVID-19 in a [building](#) that houses nearly 500 people, said UC San Diego environmental engineer and first author Smruthi Karthikeyan, Ph.D., who led the design of the system. "It really lets us get a handle on new outbreaks before they get worse," she said.

Previous studies have shown that analyzing viral concentrations in sewage can accurately predict trends in clinical diagnoses up to a week in advance. However, conventional approaches to wastewater surveillance are laborious and time-consuming, said Karthikeyan.

To get around these bottlenecks, she said, the UCSD team designed a system from scratch that automates most of the analysis. Automation makes it possible to get results quickly, and the system is already watching for community outbreaks in San Diego, Karthikeyan said. Every morning by 10:30 am, UCSD researchers collect wastewater samples from nearly 100 stations, representing every building on campus and a local hospital.

Back at the lab, a robotic platform can process 24 samples in just 40 minutes. Then an automated, high-throughput tool extracts RNA from the samples and uses PCR to search for three telltale genes associated with SARS-CoV-2. If the sequencing reveals all 3 genes, the [sample](#) is classified as positive. By early afternoon, the researchers can update the data on an online dashboard that shows where new cases have emerged.

Such a surveillance system is only useful if it has a quick turnaround

time, Karthikeyan said, and "there's no way we could get all those samples done on the same day unless we automated." And because every step is automated, she said, the process isn't vulnerable to human error.

A positive test also triggers an alert that is sent to residents of the building where the sample was collected, and they test themselves using kits from a vending machine. People who then test positive are quarantined, and the process is repeated, said Karthikeyan, a postdoctoral researcher in the lab of microbiologist Rob Knight, Ph.D., whose research uses computational techniques to study the ecosystems of the body.

After a pilot experiment showed that the system reliably reported new cases in individual buildings, the group scaled up and began surveillance of the more than 2 million people who live in San Diego county. "Southern California has a lot of cases, and we're bound to see it in the sewage," said Karthikeyan.

In the post-pandemic future, Karthikeyan predicted, a cost-effective and fast surveillance system could be particularly useful in tracking viral outbreaks in vulnerable communities with limited access to healthcare.

More information: Smruthi Karthikeyan et al, High-Throughput Wastewater SARS-CoV-2 Detection Enables Forecasting of Community Infection Dynamics in San Diego County, *mSystems* Mar 2021, 6 (2) e00045-21; [DOI: 10.1128/mSystems.00045-21](https://doi.org/10.1128/mSystems.00045-21)

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