Biobot Analytics

# Wastewater Monitoring: The Foundation for Pandemic Planning

## About Biobot Analytics

Biobot Analytics is the leading company for wastewater epidemiology and detection of SARS-CoV-2 in community wastewater in the United States.
The company was founded in 2017 by Dr. Mariana Matus, an MIT-trained computational biologist, and Newsha Ghaeli, an architect and urban planner with a background in civic innovation.

Biobot was the first team to successfully detect SARS-CoV-2 in wastewater in the United States in March 2020. In May 2021, Biobot entered into a partnership with the U.S. Department of Health and Human Resources and the Centers for Disease Control to measure the level of Covid-19 in communities across the country through wastewater testing. Find the press release here.
To date, Biobot has monitored over 500 communities across the US, covering over 30% of the American population.

Biobot uses wastewater data to learn valuable insights that shape the health of communities. Biobot is headquartered in Cambridge, MA, and is serving states and localities nationwide.

## What is wastewater monitoring?

Wastewater monitoring involves testing sewage for the presence of virus, bacteria and chemicals excreted in human waste. Any biological pathogens and biomarkers of infection which are excreted in human feces or urine can therefore be monitored via testing wastewater.
Since the start of the pandemic, because SARS-CoV-2, the virus responsible for COVID-19, is shed in the stool of infected individuals, wastewater monitoring has been implemented in many communities across the United States and globally, as a community risk assessment tool to monitor the spread of COVID-19, detect clusters of infections, and more generally to get a snapshot view of the evolution of the pandemic in their communities.

## Role of wastewater monitoring at different stages of the Covid-19 pandemic

Wastewater monitoring can serve different purposes across different phases of a pandemic:

- **Early detection: Is there SARS-CoV-2 in my community?** Wastewater monitoring can identify a spike in Covid-19 in wastewater 4-7 days before symptoms onset and cases are reported to public health authorities. Wastewater monitoring continues to act as an early warning system because infected individuals shed the virus in their stool several days before symptom onset. The advance notice has been largest in communities with limited access to testing or when testing results were delayed.

This strategy has also been employed in closed-space settings such as congregate places of living and places of work, including schools, universities, correctional settings, and nursing homes as an early warning system and supplement to in-person testing.

- **Independent trend estimation: Are cases rising, falling, or steady?** Due to the high proportion of asymptomatic infections, fluctuating availability and access to clinical testing, clusters of Covid-19 cases may become widespread before they are identified by traditional public health mechanisms. In this context, wastewater monitoring provides an independent estimate of disease prevalence and trends, offering public health officials and decision makers an additional data set, indicating whether Covid-19 disease activity is on the rise or diminishing.

- **Measuring vaccine effectiveness: What is the impact of vaccination on community spread?** By continuing to measure SARS-CoV-2 viral concentrations in wastewater during the Covid-19 vaccine roll out, we will be able to understand the scale at which the virus is still circulating in communities and start to understand the impact that vaccine uptake is having on community transmission. Further, wastewater data analysis will assist epidemiologists in their understanding of community progress towards herd immunity.

## Wastewater monitoring as a permanent pillar of public health infrastructure

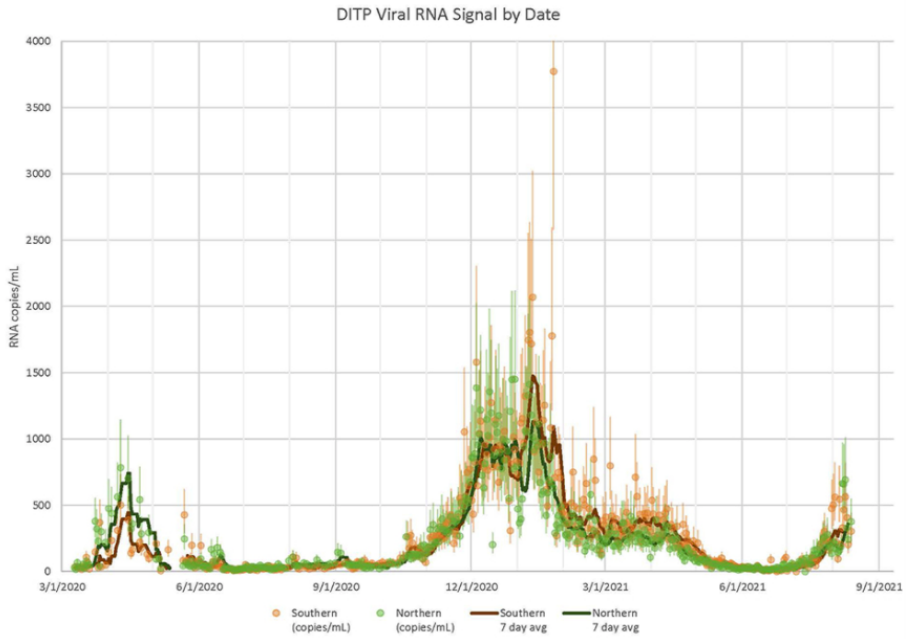
Building on the success of wastewater monitoring in tracking the spread of Covid-19, as well as our previous work using wastewater to better inform public health responses to the opioid epidemic, we anticipate a growing role for wastewater analysis in population health monitoring. This is because wastewater monitoring has three distinct advantages over traditional healthcare reporting systems:

- **Wastewater testing is inclusive:** Because everyone uses the bathroom, wastewater testing is a non-invasive and passive way of testing at scale. Many infectious disease viruses are shed in stool or urine regardless of individuals' symptomatic status. Monitoring wastewater provides health officials with a more comprehensive picture of disease burden in communities and includes individuals who lack access to testing and healthcare. This approach limits the risk of undercounting the severity of a potential outbreak of Covid-19, for example.
- **Wastewater testing is cost-effective:** Because one wastewater sample is representative of a large population – effectively a large pooled community sample – wastewater testing can be done at a fraction of the cost of widespread clinical testing and can help allocate diagnostic testing (e.g., PCR tests) resources more efficiently.
- **Wastewater testing offers granular and near real time data:** Because wastewater testing can be sampled at various scales – from a neighborhood manhole to a city's wastewater treatment plant – it can offer data at the sub-county level to the degree of granularity desired. In addition, with a 24h turnaround time, wastewater analysis can offer near real time data for government officials.

## Examples of Biobot's data used by local governments

### Case study #1: The Commonwealth of Massachusetts

The Massachusetts Water Resource Authority (MWRA) has been working with us to analyze wastewater for the Greater Boston Area since March 2020. They publish this data on their public website; a screenshot of their most recent time series is below. This data is shared daily with the Massachusetts Covid-19 Command Center and Governor's Office. In August 2020, Governor Baker's public health advisors advised him to postpone Phase 3 re-openings across the Great Boston Area, citing an increase in SARS-CoV-2 virus concentration in wastewater as one of their concerns.

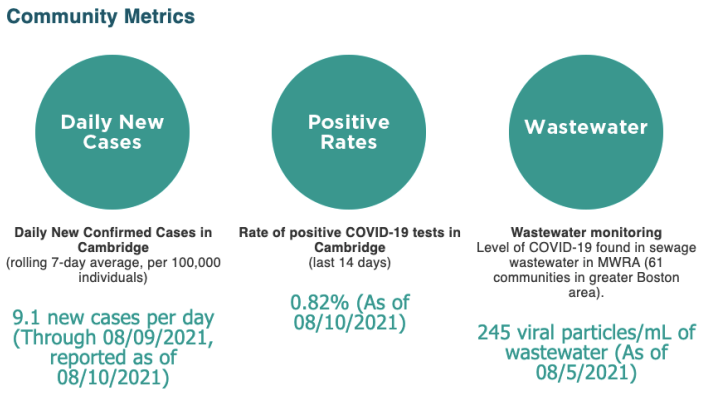



In July 2021, as a result of an outbreak of Covid-19 in Provincetown, Massachusetts, Biobot worked with MWRA to spin up testing in Provincetown within 72 hours to track the spread of the outbreak. Provincetown publishes Biobot reports on their Covid-19 Information Page.[1]

[1] https://www.provincetown-ma.gov/1391/Provincetown-Wastewater-Surveillance---C

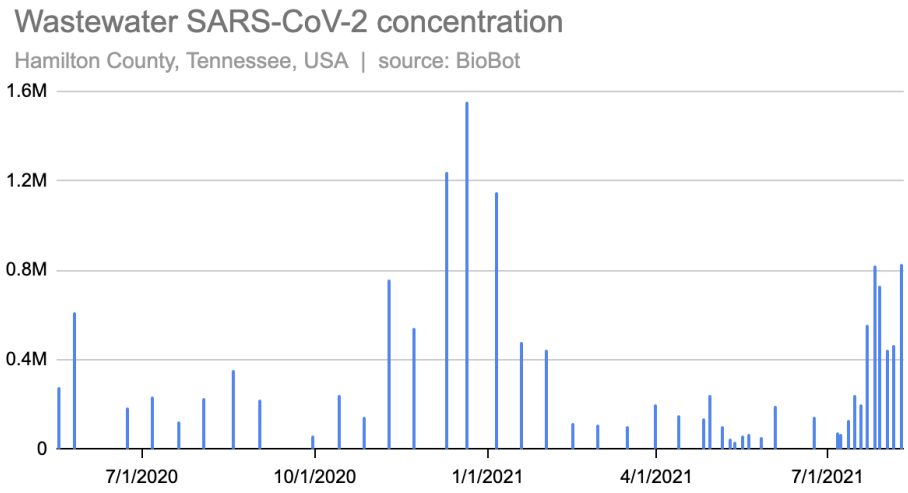
### Case study #2: The Cambridge Public School System, Massachusetts

The Cambridge Public School System is monitoring g wastewater data from the Greater Boston area as one of three indicators that reflect community spread. You can see a screenshot of their dashboard, which is hosted on their website, below.[2]




### Case study #3: Chattanooga, Tennessee

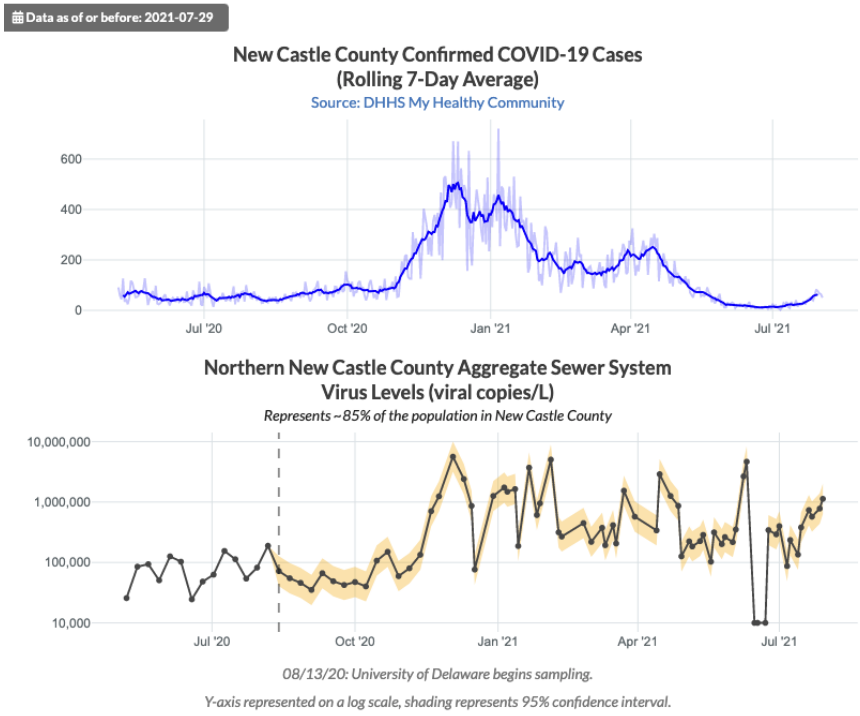
The City of Chattanooga uses the data generated by wastewater analysis as a key component of their Covid-19 data hub with the hopes that it can serve as an additional tool for decision makers and the public to understand the prevalence and spread of the virus in their community.[3]




[2] https://www.cpsd.us/covid19data
[3] https://connect.chattanooga.gov/covid-biobot-analysis-reports/

## Case study #4: New Castle County, Delaware

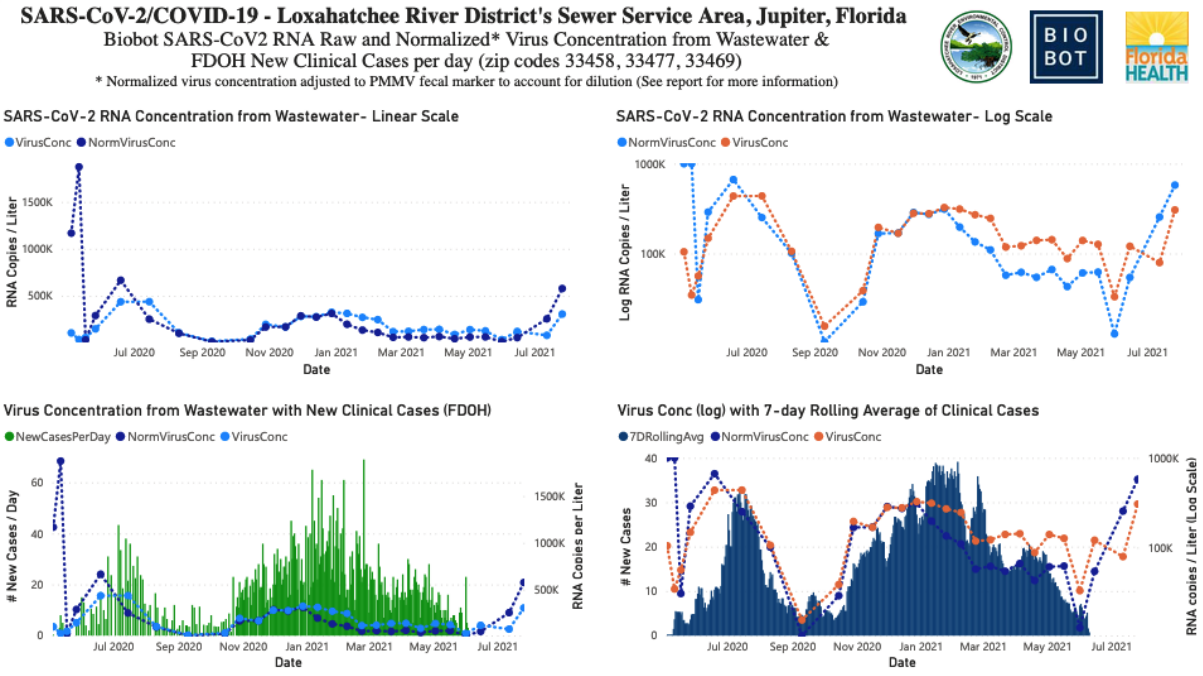
The County of New Castle in Delaware is using COVID-19 data gleaned from our wastewater testing to more effectively place their mobile testing units. Because New Castle County is testing at the neighborhood level, they are able to leverage the granularity of the data to detect spikes in smaller portions of their populations, and then direct individual testing resources in targeted geographies.[4]




[4] https://compassred.shinyapps.io/ncco_wastewater

## Case study #5: Loxahatchee River District, Florida

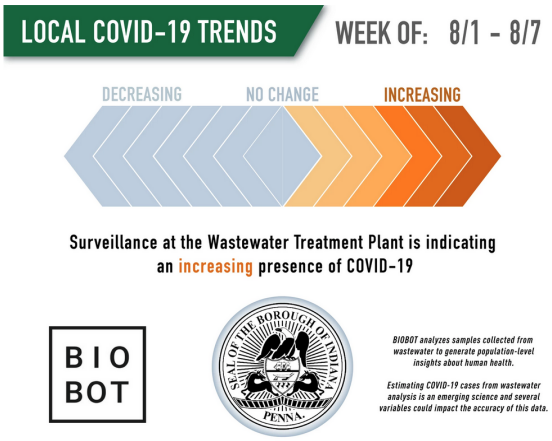
The Loxahatchee River District publishes the results from wastewater monitoring since May 2020 alongside local case counts.[5]




[5] https://loxahatcheeriver.org/wastewater-surveillance/

### Case study #6: Indiana Borough, Pennsylvania

Indiana Borough uses wastewater monitoring testing as a source of data for independent trend analysis. Through comparing COVID-19 viral concentrations in samples across time, Indiana Borough is able to show whether the prevalence of COVID-19 is decreasing, increasing, or at the same level over the previous week.[6]




[6] https://www.indianaboro.com/news/categories/wastewater-surveillance