Wastewater is Full of…Data! | How 12 Collaborating Entities Tapped into Ohio's Wastewater to Create an Early Warning System for COVID-19

Category: Cross-Boundary Collaboration & Partnerships

Business Areas: Health & Human Services, Public Health and Safety, Local Government, Counties, Cities, State Administration, Innovation, Local Public Utilities, State Universities

State: Ohio   **Agencies**: Department of Administrative Services (DAS), Ohio Department of Health (ODH), and Ohio Environmental Protection Agency (EPA)

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Project Initiation and End Dates: May 2020-May 2022
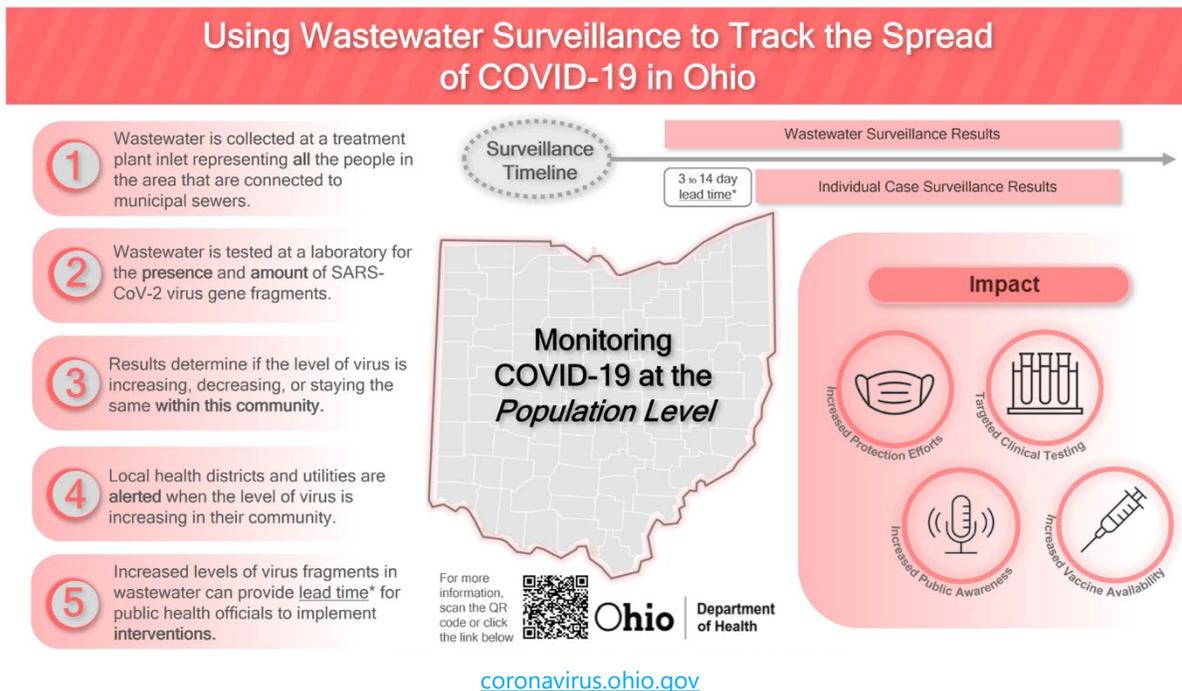
EXECUTIVE SUMMARY

When the uncontrollable spread of the COVID-19 virus paralyzed the world in early 2020, government entities and individuals alike quickly found themselves in reaction mode as the pandemic unfolded. Many were still trying to understand what was happening while others were looking at ways to get ahead of the situation through data found lurking in an unlikely repository: wastewater.

Ohio's Wastewater Monitoring Network brought together 12 entities – including a network of state university labs, the U.S. EPA, the CDC, three State of Ohio agencies, courier services and several commercial laboratories – for the purpose of monitoring wastewater trends.

At first glance, wastewater appears to be an "after" product that would naturally be considered near the very end of the information pipeline. Yet, upon closer inspection, and with a keen sense of what is possible, a coalition representing 12 separate entities across Ohio and the nation; was able to quickly turn wastewater's gold mine of data into a leading indicator of disease trends that state and local health districts could use to track and inform intervention actions to help further slow disease occurrence.

Bringing a shared vision of this magnitude to fruition required cross-boundary collaboration with numerous state and federal government agencies as well as partnerships with local universities. In just seven short weeks, the Wastewater Monitoring Network was established.

From Theory to Action

Within two months, the Ohio Wastewater Monitoring Network transitioned from theory to action. With the onset of sampling, local health districts proactively conducted outreach to their communities on wastewater testing results, thereby recommending protective actions to educate the public and slow the virus spread.

Notable Statistics

- **74 community wastewater treatment plants** geographically spread across the state are currently being monitored
- Wastewater sampling occurs twice weekly, providing insight for **56 of Ohio's 88 counties**
- Samples represent wastewater flows from **6.25 million Ohio residents (or 53%)**
- Since the network was established, over **1,500 alerts** have been sent to local health districts and utilities
- Over **150,000 hits to the coronavirus.ohio.gov website** were recorded in the first 12 months of public availability
- Over **9,100 samples** collected and analyzed (as of 5/13/22)
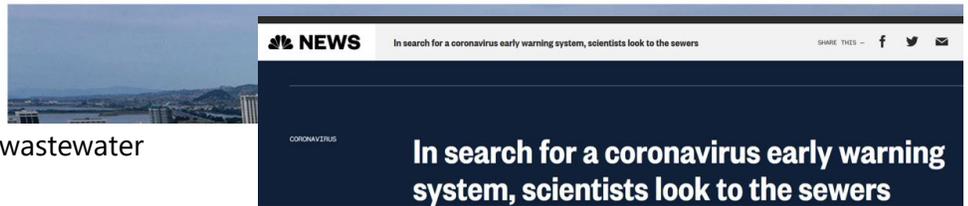- Over **1.2M cases** represented in all sewer shed areas, or about 44% of all cases (as of 5/13/22)

Infected individuals can shed a virus such as COVID-19 in their feces, even if they do not have symptoms. The virus can then be detected in wastewater. This allows wastewater surveillance to serve as an early warning that a virus – or variant - is spreading in a community.

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Idea

Thinking Differently
On Memorial Day 2020, Governor Mike DeWine asked the Ohio Department of Health (ODH) and the Ohio Environmental Protection Agency (EPA) what it would take to develop a state-based wastewater monitoring program.

Poop could help stop the pandemic. Really.

Wastewater offers a promising way to track the virus, a top CDC doctor says.

NEWS — In search for a coronavirus early warning system, scientists look to the sewers   SHARE THIS — f t ✉

CORONAVIRUS

In search for a coronavirus early warning system, scientists look to the sewers

According to the ODH, research in the U.S. and elsewhere has shown that non-infectious RNA (ribonucleic acid) from the virus that causes COVID-19 (called SARS-CoV-2) can be excreted in the feces of both symptomatic and asymptomatic infected people and can be detected in wastewater as many as three to seven days before those infections lead to increases in case counts or hospitalizations. As such, monitoring raw wastewater in sewage collection systems can provide an early warning of disease increase in a community. Community and public health leaders can use this leading indicator to make decisions about protective actions to help further limit the spread of the disease.

> **Ohio was the second state level wastewater monitoring network to be established in the U.S. in late summer of 2020.**

Armed with this knowledge, ODH combined efforts with the Ohio Water Resources Center at The Ohio State University to establish the Ohio Wastewater Monitoring Network in August of 2020. This coalition of 12 entities, including a network of state university labs, the U.S. EPA, Centers for Disease Control and Prevention (CDC), three state agencies, and two commercial laboratories, was assembled to monitor coronavirus gene copy trends in community wastewater across Ohio.

After the Wastewater Monitoring Network members were identified, they collectively initiated the work to:

- Develop a set of standardized methods and procedures for sample collection at wastewater treatment plants and laboratory analysis to ensure consistent and accurate comparison of results obtained from the laboratory network in coordination with the U.S. EPA and the CDC.
- Help with coordination and data sharing with the CDC to support other organizations collecting similar wastewater data (i.e., Biobot, Battelle, Stanford University and other state health departments) to ensure all data collected in Ohio is available to inform decisions.
- Establish management and collection of the data from the university networks and U.S. EPA into one database for upload to the Department of Administrative Services (DAS) InnovateOhio Platform (IOP).
- In coordination with ODH and Ohio EPA, identify and develop a prioritization process for selecting the next group of monitoring sites to add to the network using the Ohio Health Advisory System and community vulnerability data related to issues such as higher populations, increased disease burden, health disparities, and congregate settings.
- Display viral gene copy trends via graphs/charts on the coronavirus.ohio.gov website to help state agencies and local communities implement appropriate intervention actions (such as recommending mask-wearing in public spaces, providing additional testing, contact tracing or vaccine availability).

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Implementation

With much of the vision and planning work underway, the team quickly moved to the implementation phase.

Multidisciplinary Approach

ODH was identified as the lead state agency, with Ohio EPA providing support. The Water Resources Center at The Ohio State University was chosen to assist with onboarding sites, recruiting, and managing sample collection and data analysis. Functional workgroups and routine meeting cadences were established.
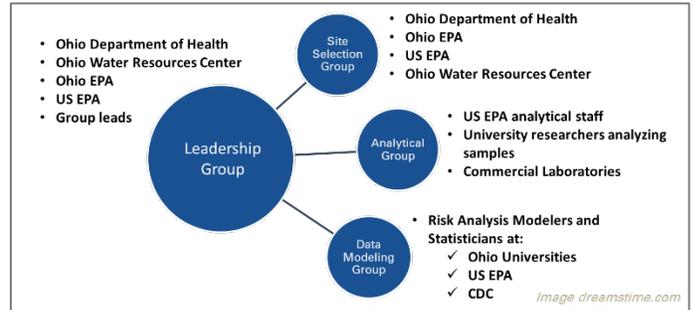

Sewershed Sites

Initial sewershed sites were chosen with a focus on seven major metropolitan areas (Cleveland, Columbus, Cincinnati, Dayton, Toledo, Akron, Youngstown) to quickly provide disease information for the larger population areas. Additional medium and small communities were added to the network based on various agreed upon criteria.


Data Collection

Initial data collection began through partnerships with five university laboratories and a U.S. EPA lab. Commercial labs were added later. Close coordination occurred with the CDC on metadata and data field requirements to support thorough data review, analysis and reporting. Stringent quality control, assurance measures and reviews were implemented to ensure data quality and accuracy. In addition to creating an interactive dashboard, the Wastewater Monitoring Network defined standards for consistent use of data across the various entities.
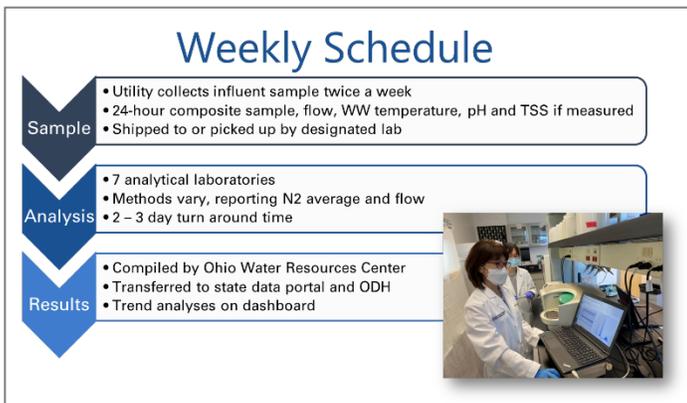
Data Management and Analytics

The data management and logistics functions are handled by the DAS IOP Data Analytics team. This group is accountable for:

- Receiving and consolidating data for ingestion and use by epidemiologists within ODH.
- Data display and data sharing for both the DataOhio Portal and the public website coronavirus.ohio.gov.
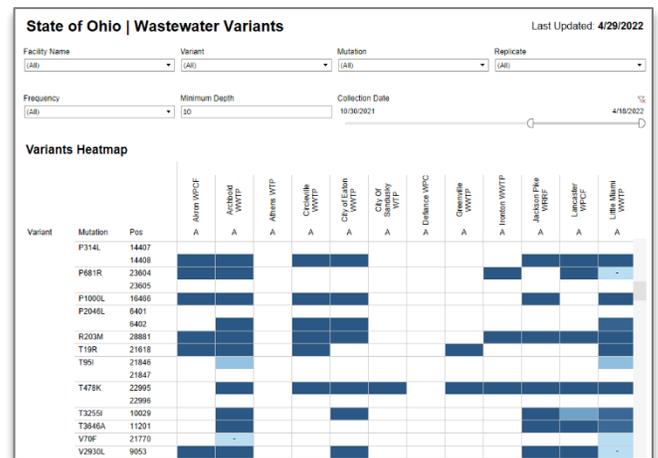
Impact

With twice weekly sampling at 74 Ohio facilities, cross-boundary data was flowing at an unprecedented rate between state university labs, the U.S. EPA, the CDC, three State of Ohio agencies, utilities, and several commercial laboratories. Equipped with this knowledge, state and local agencies were able to employ proactive measures to promote the safety of Ohio's 11.7 million citizens.

Summary: How Does the Ohio Wastewater Monitoring Network Improve Public Health?
- Serves as an early warning of infection in communities or congregate settings
- Provides information that can help local communities more quickly intervene with protective measures to slow disease spread
- Helps communities measure the effectiveness of such interventions (quarantine/face coverings/business limitations)
- Develops methodologies/predictive models to translate viral loads detected for comparison with other data, such as rates or percentage of infection in communities
- Where possible, compares results to previously collected data on prevalence in specific communities to better understand factors affecting disease spread
- Determines impacts on disproportionately affected communities or communities where risk of infection is greater

Earlier alerts to local health districts and utilities
Studies have shown that wastewater data can indicate disease trends up to three to seven days before clinical testing data is available. These few critical days can give public health officials lead time to increase prevention and protection efforts. When at least three samples show a sustained and substantial (or ten-fold) increase in COVID-19 viral gene copies, alerts are emailed to local health districts and utilities with concurrent notification to the state contract tracing, testing and vaccination teams. Over **1,500** alerts have been sent to local health districts and utilities since the network was established.

Streamlined notifications to the public
To facilitate efficient and speedy delivery of information in a consistent manner to local agencies, the network also developed:
- Communication toolkits and templates
- Best practices for identifying trends
- Information for interpreting the data

> **Scan the QR code to view the home page for the ODH Local Toolkit**

State officials inform communities and direct resources where they are needed
Data within the wastewater dashboards helps public officials better understand the trends of COVID-19 viral gene copies in their communities, and how resources such as targeted clinical testing can be better allocated. Examples include:

- Mobilizing additional testing and personal protective equipment, contact tracing, and later, vaccination resources.
- Alerting hospitals, physicians, other health care providers
- Closely monitoring and evaluating data, hot spots and contact tracing
- Providing recommendations to local health district leaders to take direct actions

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Local health districts take action

Providing early warning of infection in communities, and possibly more targeted areas within communities, can slow the spread of the disease and conserve limited resources. Here are just a few real-life examples that illustrate how early detection and notification have been effective across Ohio:

- One Ohio county health district scheduled testing with the National Guard on December 28, 2021, following notification of an increase in viral gene copies provided by ODH on December 23, 2021.
- The ODH routinely receives email responses from a mid-sized city's department of water regarding infection notice alerts, which are passed on to the city administration of the local utility department who then post information on websites and social media to inform the public.
- One district health commissioner requested pop-up testing in response to October 30, 2020, notifications. He also requested social media posts, and draft press releases that he could use to inform the public of the need for increased protective actions.

**Graphical representations of data help to communicate information**

In addition to "pushing" agency notifications, the Ohio Wastewater Monitoring Network data became an integral part of the state's coronavirus data. Graphical data representations generated by DAS IOP Data Analytics, including a display of normalized viral gene copy results, became available on the ODH website, which is used to easily retrieve information on demand by local health districts, communities, utilities, and the general public. Over 150,000 hits to the coronavirus.ohio.gov website were recorded in the first 12 months of availability.
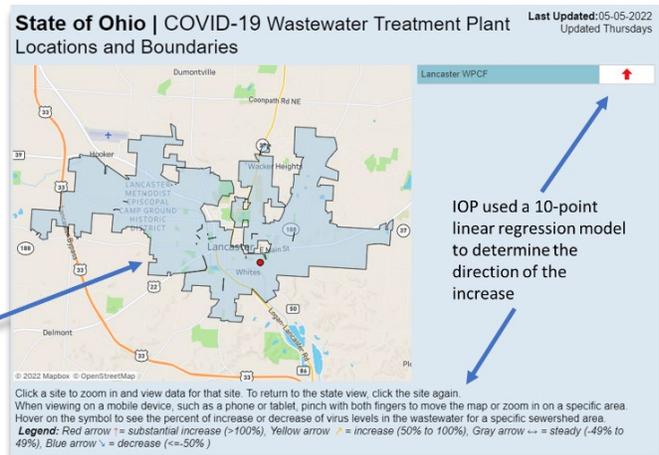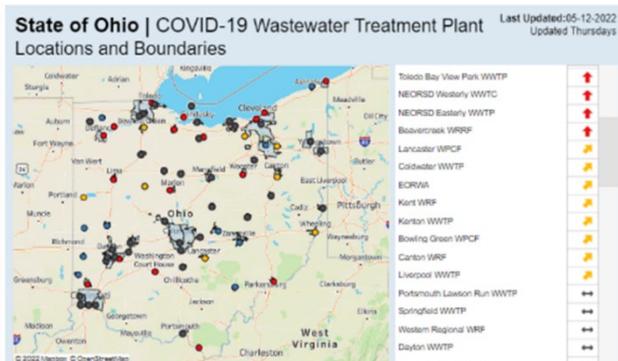
Using a Spatial Join, IOP can determine the cases in a wastewater treatment plant which have jagged boundaries that cross county, zip, and census tract lines

IOP used a 10-point linear regression model to determine the direction of the increase

December 7, 2022: Spike in **Wastewater**

January 12, 2022: Spike in in **Cases**
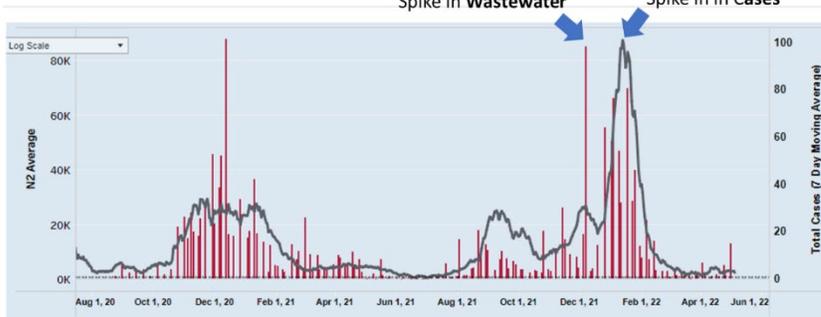
## Earlier identification of new variants

In early January 2021, technologies used to gnomically sequence clinical samples to identify the presence of variants were quickly adapted to wastewater. Wastewater genomic sequencing data has allowed ODH to track each of the COVID-19 variant strains across Ohio. This helps ODH inform local public health leaders of their community's transition to new, more virulent variant strains of the virus. It also helps to inform them on the abundance of each strain in each community at any given time since the inception of wastewater sequencing. Studying small changes in wastewater data can help scientists detect mutations associated with variants in a community even before clinical data from doctor's offices or hospitals get reported to public health officials. Monitoring and understanding disease trends can inform intervention actions to help further prevent the spread of disease.
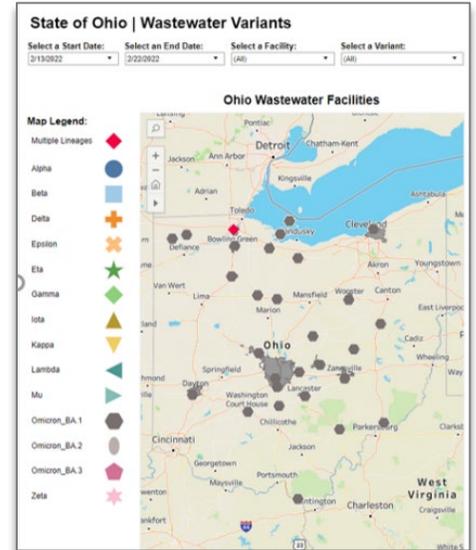
National impact beyond Ohio's borders

Beyond state and local impact, Ohio continues to be a key player at the national level as well. Ohio was one of the original pilot participants in the CDC National Wastewater Surveillance System (NWSS) that was launched in September 2020. Since December 1, 2020, Ohio has completed daily uploads of data to the CDC NWSS database.
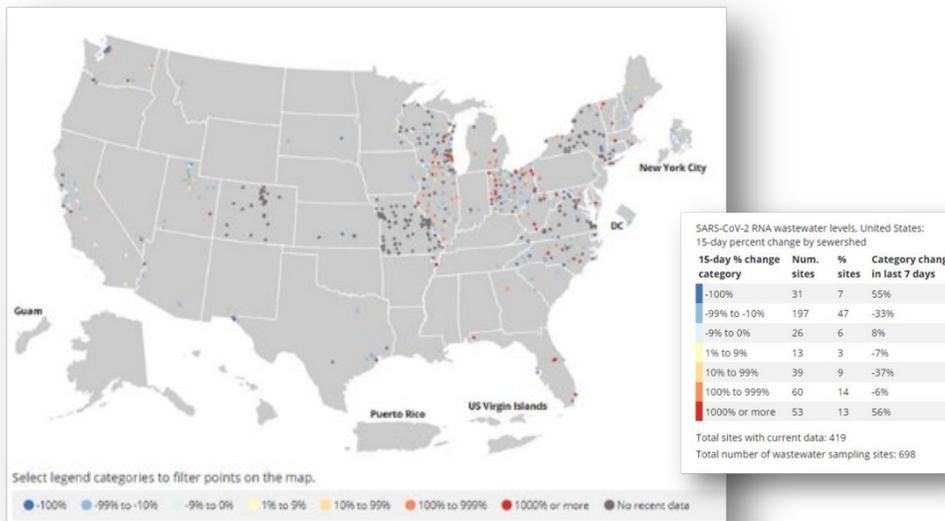
Future applications of wastewater monitoring will offer additional multidisciplinary benefits

Wastewater monitoring is becoming increasingly vital for community disease surveillance at the local, state, and national level. The CDC NWSS team indicated that funding will continue through at least 2025. ODH is currently coordinating with the CDC, The Ohio State University, and the DAS IOP Data Analytics team on a pilot project to streamline the upload of wastewater sequencing data to national databases to support enhanced analysis. By fall of 2022, the network plans to expand monitoring for other microbial agents of concern, including seasonal influenza, and in the future, foodborne illness, and anti-microbial resistant strains of bacteria.