Ohio Coronavirus Wastewater Monitoring Network Frequently Asked Questions

What is the Ohio Coronavirus Wastewater Monitoring Network?

In a new effort to help mitigate the spread of COVID-19, a network across Ohio is studying samples of wastewater to look for the presence of gene copies/fragments of the virus that causes the disease. The initiative is a collaboration between the Ohio Department of Health (ODH), the Ohio Environmental Protection Agency (Ohio EPA), the U.S. Environmental Protection Agency (U.S. EPA), the Ohio Water Resources Center (Ohio WRC) at The Ohio State University, and other participating universities, including The University of Toledo, Kent State University, and The University of Akron. As the network expands, sampling and analysis will include other universities with laboratory capabilities.

Why is Ohio monitoring wastewater for viral gene copies?

The increase of COVID-19 cases in communities is typically tracked by testing people with symptoms, an indicator that lags behind the actual spread of the disease. Because of this, there is a need to use early monitoring methods that estimate the disease’s impact on the broader community. 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 early warning information to make decisions about protective actions to help limit further spread of the disease before cases begin to occur.
Where is monitoring being done?

The sewage monitoring network will analyze wastewater samples for coronavirus RNA gene copies/fragments at key locations around the state, including the larger cities. The network will be expanded over the next few months to include additional wastewater collection sites.

What is a sewershed and how is it monitored for RNA from SARS-CoV-2?

A sewershed is an area of land where the raw sewage from homes, businesses, and industries flows through a series of sewer pipes to a single downstream point, where it enters a wastewater treatment plant. Samples of the raw wastewater can be collected and monitored for the virus’s RNA before going through treatment. Additional data collected at this point helps researchers evaluate the strength and nature of the wastewater to allow for proper analysis of the RNA fragments. Before being discharged from the treatment plants, wastewater is treated to remove viruses and bacteria and is monitored to meet all state and federal discharge limits.

Ohio Scientists Using Sewage to Track Coronavirus
Are the Ohio SARS-CoV-2 wastewater results available on a website?


Where are samples collected to look for SARS-CoV-2 RNA remnants?

Wastewater entering treatment plants is sampled regularly for fragments of the virus RNA. The wastewater comes from homes in a treatment plant service area and travels through sewer pipes to the plant. A mixed wastewater sample (24-hour composite) is collected in an area where all the sewage from a service area enters the plant. This sample is analyzed by a laboratory to determine the number of virus gene copies present, related to the wastewater flow that occurred on the sample day and the population that contributed to the flow.

How are sampling sites being selected?

Sampling sites are being selected to include the monitoring of large, medium, and smaller cities, with a smaller set of sites targeted at Census tracts with vulnerable populations. Group 1 sample site selection began with the seven largest cities in Ohio — Columbus, Cincinnati, Cleveland, Dayton, Akron, Toledo, and Youngstown — to cover the largest percentage of Ohio residents potentially exposed. Small and medium sized communities have since been identified (Group 2) and added. Additional sites will be added depending on remaining sampling capacity and will be prioritized based on Ohio Public Health Advisory System alert levels and data trends and the availability/willingness of the city to participate in the sampling effort.

How are the gene copies measured in the wastewater?

Wastewater samples are first processed to concentrate and isolate genetic material (RNA and DNA) that is present in the sample. Within this genetic material, RNA sequences specific to SARS-CoV-2 are then detected and quantified using a common molecular biology tool called PCR (polymerase chain reaction).

During PCR, a targeted segment of the RNA (the N2 gene) is amplified (copied many times) so it can be detected by laboratory instruments and then counted. Specific methods for sample processing and PCR differ among the participating laboratories.

What level of viral gene fragments can be detected in wastewater?

When there are very low concentrations of SARS-CoV-2 RNA in the sample, or when there are considerable losses during sample processing, PCR methods cannot detect it. This "limit of detection" varies across participating laboratories due to differences in their methods but is typically around 1,000 RNA copies per liter of wastewater. Since measurements near this limit of detection have greater uncertainty and are not precise, the concentrations that can be accurately detected are slightly greater than this amount.
How are gene copies counted?

Infected individuals shed the virus RNA in their feces at different rates based on the severity and timing of their infections, and wastewater flowing from homes with infected individuals can change during the course of a day. In addition, the amount of flow received at a wastewater treatment plant on any given day can change based on water use in a community, the age of the system, and other factors. Because of these factors, the number of gene copies detected at each sampling location is multiplied by the average flow on the sampling day. (This is referred to as “normalizing” the viral gene copy results.) Four samples are analyzed from each sampling site, and the data is presented as the geometric mean (a way scientists determine the average value of this type of data) of those samples.

How should we read the viral gene copy trend graphs?

When reviewing the sampling results, it is most important to evaluate the trend in viral gene copies. A 10-times, 100-times, or higher increase is more significant than smaller increases in the number value. For example, an increase from 600 to 5,000 gene copies (a nearly 10-times increase) is more significant than an increase from 1,200 to 3,000 viral gene copies. Because each community has different populations and different wastewater flow volumes, it is not appropriate to compare viral gene copy numbers between communities. Rather, reviewing the trend in a specific community can be used to help understand whether cases or hospitalizations are likely to increase.

What do the results mean?

There are several factors to consider when interpreting viral data in wastewater. Because scientists are still learning about the timing and rate of shedding of the virus RNA in feces of infected people, it is only appropriate to monitor and observe the trends of viral gene copies detected in a community over time. The data presented in the graphs on the coronavirus.ohio.gov website show the total number of RNA copies detected in the area from which the wastewater was collected. The data are adjusted for the total daily flow to the treatment plant and shown in million gene copies per day. A significant increase in viral gene copies over time is an indicator that cases may be increasing in the community. Because infected individuals can continue to shed the virus RNA in feces for 20 to 30 days after they are no longer infectious, decreases in the number of viral gene copies in wastewater might lag behind decreases in cases in a community. Trends in viral gene copies should be considered along with community case numbers and other COVID-19-related data to inform decisions about taking actions to help limit disease spread.

Can I compare results from one community with another?

Comparison of the number of gene copies found between communities is discouraged due to the variability in wastewater flows and the various sources (industrial discharges or rainwater) that can contribute to each community’s wastewater flow. It is better to use the information to observe trends in the data at a location. You may compare trends between different locations.
There are a few reasons that trends are the better indicator to follow. The first reason is time. With time, the RNA gene copies break down. Depending on the time between collection and analysis due to shipping to the lab, there will be unavoidable decay in the number of gene copies present. Moreover, the size of the community that is served by a wastewater plant affects the time the sewage spends in the sewer system before getting to a wastewater facility. The bigger a community, the more time sewage from more distant homes takes to reach a wastewater facility. More decay of RNA gene copies may be expected with longer time in the sewer collection system.

The second reason is variability of samples and analysis. The university laboratories and commercial labs analyzing results from the sampled sites work closely with U.S. EPA and the Centers for Disease Control and Protection (CDC) to ensure best methods are used. The laboratories participate in both in-state and national validation tests to ensure the reliability of the sample results; however, variability may occur. The presence of other factors such as chemicals from industrial discharges in the wastewater may inhibit the ability to detect the gene copies. Temperature differences also play a role in RNA gene copy decay. For all these reasons, the information is best used to observe trends at a location.

**What are factors to consider when reviewing results?**

- The focus is on trends or significant changes in the number of viral gene copies detected, such as a 10, 100, or 1,000 times increase in gene copies per day, with increases over more than one data value indicating a sustained trend.

- This data can provide a three- to seven-day leading indicator of disease in locations where samples are collected at least weekly, with better predictive ability where samples are collected at least twice per week.

**What actions should be taken quickly by local health districts if increases in gene copies are observed?**

- Provide additional messaging to the community where wastewater data is showing an increase in shedding of virus, which may be indicative of increased cases and that extra precautions should be taken (vigilant social distancing, masking, handwashing, avoiding crowds and enclosed spaces).

- Consider mobilizing additional pop-up testing resources in a community with increases in viral gene shedding.

- Alert hospitals, clinics, and local physicians that an increase in viral gene shedding has been observed and that an increased number of cases may be imminent.

- Evaluate and closely monitor case data in the community. Identify potential hot spots and increase testing/contract tracing in those areas.

- Provide recommendations to community leaders or take direct actions on implementation of additional restrictions.
How should local health districts monitor and respond to the trend data after an increase?

- After a sustained increase in gene copies is observed, continue to monitor gene copy trends for decreases in shedding. Individuals can continue to shed the virus for a period of time after infection; however, long term trends in declines in communities may be observed.
- Long term trends in gene copies can also help communities measure the effectiveness of interventions (quarantine/face coverings/business limitations).

What are future potential applications of this data?

- Develop methodologies/predictive models to translate viral loads detected for comparison with health surveillance data or percentage of infection in communities.
- Predict or compare results to data from a prevalence study for specific communities to better understand factors affecting disease spread.

Monitor discrete locations within sewersheds to detect disease occurrence in settings (universities or other congregate settings) or disproportionately affected communities (based on income, ethnicity, race, etc.) where risk of infection is greater.

How will the Ohio Wastewater Surveillance Network improve public health?

The network will:

- Serve as an early warning of infection in communities or congregate settings.
- Provide information that can help local communities more quickly intervene with protective measures to slow disease spread.
- Help communities measure the effectiveness of such interventions (quarantine/face coverings/business limitations/etc.).
- Develop methodologies/predictive models to translate viral loads detected for comparison with other data, such as rates or percentage of infection in communities.
- Where possible, compare results with previously collected data on prevalence in specific communities to better understand factors affecting disease spread.
- Determine impacts on disproportionately affected communities or communities where risk of infection is greater.

What are the objectives of the Ohio Coronavirus Wastewater Monitoring Network?

- Coordinate a network of state university labs, in addition to the U.S. EPA, to analyze wastewater for virus gene copies at several locations across the state.
In coordination with the U.S. EPA and the CDC, develop a set of standardized methods and procedures for sampling and analyzing at wastewater treatment plants and specific locations in the plant service areas to ensure consistent and accurate comparison of results obtained from the laboratory network.

Help with coordination and data sharing with other organizations collecting similar wastewater data (i.e., Biobot, Battelle, Stanford University) 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 Innovate Ohio Platform.

In coordination with ODH and Ohio EPA, identify and develop a prioritization process for selecting sites to add to the network using the Ohio Health Advisory System.

Display viral gene copy trends (at all sampling locations via graphs/charts on the coronavirus.ohio.gov website) that can help state agencies and local communities implement appropriate intervention actions (such as closing certain facilities) to help prevent spread of the virus.

Evaluate current models that can use the raw viral load data to make predictions on the likely percentage of people infected in the area the sewage came from. (Project researchers are collaborating with the CDC and U.S. EPA on model development with projected model results by fall 2020.)

What are the protocols and standards for wastewater sampling for SARS-CoV-2 RNA?

The development and use of standard protocols and methods for sampling and analyzing the waste are important to ensure the sample results are correct. The Ohio Water Resources Center and participating university researchers are closely collaborating with the U.S. EPA, CDC, and ODH to develop standard methods for wastewater sample collection, processing the waste to prepare it for laboratory analysis, analysis of the waste, verification of results, and reporting of the data. More information on these standard protocols and methods can be found at https://wrc.osu.edu/.

Are workers at a wastewater treatment plant at risk from COVID-19?

Based on current research, these virus fragments are not thought to be infectious at this sample collection point. The CDC states: “Recently, ribonucleic acid (RNA) from the virus that causes COVID-19 has been found in untreated wastewater. While data are limited, there is little evidence of infectious virus in wastewater, and no information to date that anyone has become sick with COVID-19 because of exposure to wastewater. Standard practices associated with wastewater treatment plant operations should be sufficient to protect wastewater workers from the virus that causes COVID-19. These standard practices can include engineering and administrative controls, hygiene precautions, specific safe work practices, and personal protective equipment (PPE) normally required when handling untreated wastewater. No additional COVID-19-specific protections are recommended for workers involved in wastewater management, including those at wastewater treatment facilities (https://www.cdc.gov/coronavirus/2019-ncov/faq.html#Water).”
If SARS-CoV-2 RNA remnants are found in the raw wastewater, are wastewater treatment plants able to treat and remove the virus from the wastewater?

SARS-CoV-2 RNA in wastewater reflects the presence of COVID-19 in the community that the wastewater treatment plant serves. It is important to note that the water discharged from the treatment plants is treated to remove viruses and bacteria and is monitored to meet all state and federal discharge limits.

If you are measuring wastewater to look for prevalence of COVID-19, can I get COVID-19 from going to the beach?

We are looking for genetic remnants (RNA) of the virus in the raw wastewater as it first reaches a wastewater treatment plant. There are many processes to treat the wastewater, including disinfection, before it is discharged to a receiving body of water. Those processes eliminate many contaminants in the wastewater, including any remaining virus. In addition, we are measuring for RNA remnants of the virus. Currently, there is not evidence that viable virus survives long enough in the sewers to reach a wastewater treatment plant.

Can drinking water be a route of transmission of SARS-CoV-2?

The virus that causes COVID-19 has not been detected in drinking water.