



# PRESS RELEASE

## DETROIT WATER & SEWERAGE DEPARTMENT

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## **City of Detroit, GLWA and Michigan State University partner on virus detection project using the sewer system to help predict outbreaks**

- **The project began in November 2017 after initial meetings with the Detroit Water and Sewerage Department**
- **MSU research team takes samples from the city’s sewage collection system to determine if virus outbreaks can be detected in untreated sewage**
- **Recently, the team started a second phase in partnership with GLWA, including testing for the COVID-19 virus, in untreated sewage**
- **Once in the city’s sewer collection system, the untreated sewage does not interact with households or businesses before it arrives to the treatment plant**

**DETROIT** – The Detroit Water and Sewerage Department (DWSD) and Michigan State University (MSU) began a virus research project in November 2017 to determine if viruses can be detected in the city’s sewer collection system. This may be another mechanism for public health agencies, including the Detroit Health Department (DHD), to predict virus outbreaks. The original project was to detect known viruses at the time and now, with funding and technical expertise from the Great Lakes Water Authority (GLWA), has evolved to trace the COVID-19 outbreak.

“Detroit has been at the forefront of testing and providing the community resources during the COVID-19 pandemic,” said Mayor Mike Duggan. “This project with MSU [launched in 2017] again shows that we have a forward-thinking and collaborative mentality that puts the community first.”

The MSU study’s findings show that viruses can be detected in untreated sewage, including coronaviruses, and when that data is joined with healthcare data they can further trace outbreaks. In fact, the researchers took the data from the sewage samples and looked at county health data for the same timeframe. They discovered that viruses were apparent in the sewer collection system approximately 1-2 weeks prior to seeing increases in reported data at health departments for those same viruses.

“We are excited by the efforts of MSU and the implications this work may have in supporting our response to the COVID-19 pandemic,” said Denise Fair, the City of Detroit Chief Public Health Officer. “I

am encouraged and applaud any effort that seeks to enhance the health and wellbeing of our community.”

DWSD Deputy Director and Chief Engineer Palencia Mobley, P.E., who authorized the department’s participation in the study, said, “When we were approached by Dr. Irene Xagorarakis about her MSU research project in the fall of 2017, we immediately saw the value of using the sewer collection system to aid health officials in virus detection. I directed our DWSD staff to give the researchers complete access. This partnership supports our vision of DWSD being an anchor institution that solves problems in the community.”

The study is being led by Irene Xagorarakis, PhD, associate professor of environmental engineering at MSU. In 2017, Dr. Xagorarakis received a two-year National Science Foundation (NSF) grant titled: “A Wastewater-Based-Epidemiology System for Early Detection of Viral Outbreaks in Detroit MI.” This grant was followed by a two-year grant from GLWA titled: “SARS-CoV-2 in Detroit: Surveillance and Prediction” which started in April 2020.

“GLWA’s technical and financial support of this project aligns perfectly with our commitment to protecting the public health,” said John Norton, PhD, director of Energy Research and Innovation at GLWA. “This project has significant implications for providing an advance notice signal of disease incidence in the community. The various use case scenarios we are developing for the virus data found in the environment will have short, medium, and long-term uses. Short-term use may be to provide information regarding immediate response activities and regulations, while a medium-term use may be to help guide detection of infected people, and long-term uses concern general epidemiological work regarding diseases in general.”

The approach that Dr. Xagorarakis and the team are using is focused on community composite sampling and analysis. It is a wastewater-based-epidemiology method directly applicable to urban metropolitan areas with centralized wastewater collection.

“Our approach has the potential to provide warnings earlier than traditional systems focused on clinical diagnostics – rapid or not – which are inherently limited to an after analysis of an outbreak,” said Dr. Xagorarakis. “Our approach goes above and beyond simple surveillance of wastewater.”

Two models are developed:

1. The Viral Identification Model (Viral-ID) that determines diversity and genetic makeup of viral infections in a certain population; and
2. The Viral Prediction Model (Viral-PD) that provides early detection of fluctuations of specific viral disease, such as hepatitis, COVID-19 and others, in certain geographical areas over time.

### **The initial MSU and DWSD study**

During the recently completed NSF grant, untreated wastewater samples were collected from November 2017 to February 2018 to evaluate the diversity of human viral pathogens from the Detroit population.

To test the Viral-ID model, samples were collected, concentrated, and purified prior to metagenomic analysis and bioinformatics that detected the presence of multiple enteric, respiratory, bloodborne and vector-borne viral-related genomic sequences. The measured viral signatures were related to clinically important diseases reported within the study area during the sampling year. Viral species were confirmed with qPCR analysis that measures unique genetic regions related to specific viruses.

To test the Viral-PD model, the concentration of hepatitis A in wastewater, along with multiple other parameters, were correlated with clinical data. Increases in hepatitis A incidence in the surrounding community were revealed in wastewater approximately 7 to 9 days before symptomatic cases were reported to healthcare facilities.

### **The second phase/current grant expands into COVID-19**

For the work recently funded by GLWA, team members from the Authority's Water Resource Recovery Facility are collecting samples weekly and providing to Dr. Xagorarakis for her team to quantify concentrations of beta coronavirus SARS-CoV2 in wastewater using qPCR analysis. Furthermore, the team will determine diversity of human viruses, such as ssRNA coronaviruses, in wastewater with sequencing followed by metagenomic analysis. To estimate contributing population fluctuations, Dr. Xagorarakis and her team are quantifying concentrations of biomarkers and metabolites in wastewater. To estimate virus detention times in the city's sewer collection system, hydrological and other network data are analyzed and modeled. Historic data and data on COVID-19 and other beta-coronavirus disease characteristics, such as incubation times, shedding rates and duration of shedding are collected and modeled for estimation of delays between measured viral concentrations in wastewater and demonstration of disease symptoms. Clinical disease records will be used to determine correlations and validate predictions. The developed models are expected to describe patterns of endemic disease, identify potential novel viruses, and will predict hot-spots (counties) and critical-moments (time in weeks) for the onset or spread of outbreaks prior to full-blown demonstration of disease in clinical settings.

"The method we are using is at a research level at this point and multiple steps need to be followed to make it user-friendly for utilities around the country. Partnering with DWSD and GLWA, which operates the largest single site wastewater treatment plant North America, is crucial for the development of this method. If it can be done here with this massive system and show predictive results, it can be done in other smaller communities as well." said Dr. Xagorarakis.

Dr. Xagorarakis's team includes MSU PhD students Brijen Miyani and Camille McCall, recent graduates Huiyun Wu and Evan O'Brien, DWSD manager Anil Gosine and other personnel, GLWA's Norton, Dr. Andrea Busch and Dr. Xavi Fonoll, and CDM-Smith's Anna Mehrotra and other personnel.

DWSD and GLWA have committed staff resources to provide access to the sewer collection system and share system data with regard to sewage volumes, collection locations and other factors. "We will continue to support this project and look at long-term sewage sampling," added Mobley.

Dr. John Verboncoeur, Associate Dean for Research at MSU's College of Engineering said that "If successful at predicting viral outbreaks at the community level, integration of this method into the civil infrastructure may become a key cost-effective tool for managing outbreaks at early stages. By informing public health officials up to two weeks before symptoms prompt individual testing, this method can help contain infections for systems from the scale of cruise ships, to college campuses, to large cities."

"This study is an example of how a partnership between Michigan State University and the City of Detroit can lead to developing tools for managing outbreaks at early stages" added Dr. Neeraj Buch, Chair of the Department of Civil and Environmental Engineering.

"The results show the MSU approach will aid health departments in using the sewer system to not only support tracing viruses but also serve as an early alert system for outbreaks. We see extreme value in this effort and will be looking a long-term viability." concluded Fair.

**The public is not vulnerable to untreated sewage**

The public should be assured that once sewage enters the city's collection pipe, it is not encountered by the general public. Most basement backups are either stormwater or the household's own untreated sewage. The treatment process uses chlorine to kill viruses in sewage at the Water Resource Recovery Facility in southwest Detroit operated by GLWA. DWSD, GLWA and health experts always advise precautions when encountering raw fecal matter and sewage.

**EDITORS/PRODUCERS:** Virtual interviews can be scheduled with DWSD, DHD, GLWA and MSU representatives.

**About The Detroit Water and Sewerage Department**

The Detroit Water and Sewerage Department (DWSD) serves more than 230,000 accounts that includes a residential population of nearly 700,000. DWSD's water network consists of more than 2,700 miles of water main and nearly 3,000 miles of sewer collection piping within the city of Detroit. To learn more about DWSD or to request water services, make payments, or report water problems, call DWSD Customer Care at 313-267-8000 or contact us at [www.detroitmi.gov/dwsd](http://www.detroitmi.gov/dwsd).

**About the Great Lakes Water Authority**

The Great Lakes Water Authority (GLWA) is the provider-of-choice for drinking water services to nearly 40 percent and efficient and effective wastewater services to nearly 30 percent of Michigan's population. With the Great Lakes as source water, GLWA is uniquely positioned to provide those it serves with water of unquestionable quality. GLWA also has the capacity to extend its service beyond its 88 member partner communities. As part of its commitment to water affordability, the Authority offers a Water Residential Assistance Program to assist low-income households in participating member communities throughout the system. GLWA's board includes one representative each from Oakland, Macomb and Wayne counties, two representatives from the city of Detroit and one appointed by the Michigan governor to represent customer communities outside of the tri-county area.

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