Data report: Monitoring COVID-19 in Wastewater in the Chicago region

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Background

The Illinois Department of Public Health (IDPH), Cook County Department of Public Health (CCDPH) and Chicago Department of Public Health (CDPH) collect data from a variety of sources to understand the COVID-19 pandemic.

One way to monitor the spread of SARS-CoV-2 is by monitoring wastewater (sewage). Wastewater can be used to track spread since the virus is shed in the feces of infected individuals, and unlike relying on reports from diagnostic testing, which are dependent on someone having symptoms or being able to access testing, infected individuals shed SARS-CoV-2 to the sewer when using the toilet or other drains. By measuring the amount of SARS-CoV-2 in wastewater, public health officials may gather information about the amount of COVID-19 transmission at a community level.

Combined with other types of data, wastewater monitoring helps public health officials better understand transmission of SARS-CoV-2 in Chicago and the suburbs. Follow these links to read more about the wastewater monitoring program in Chicago and Illinois.

The wastewater monitoring system in the Chicago region

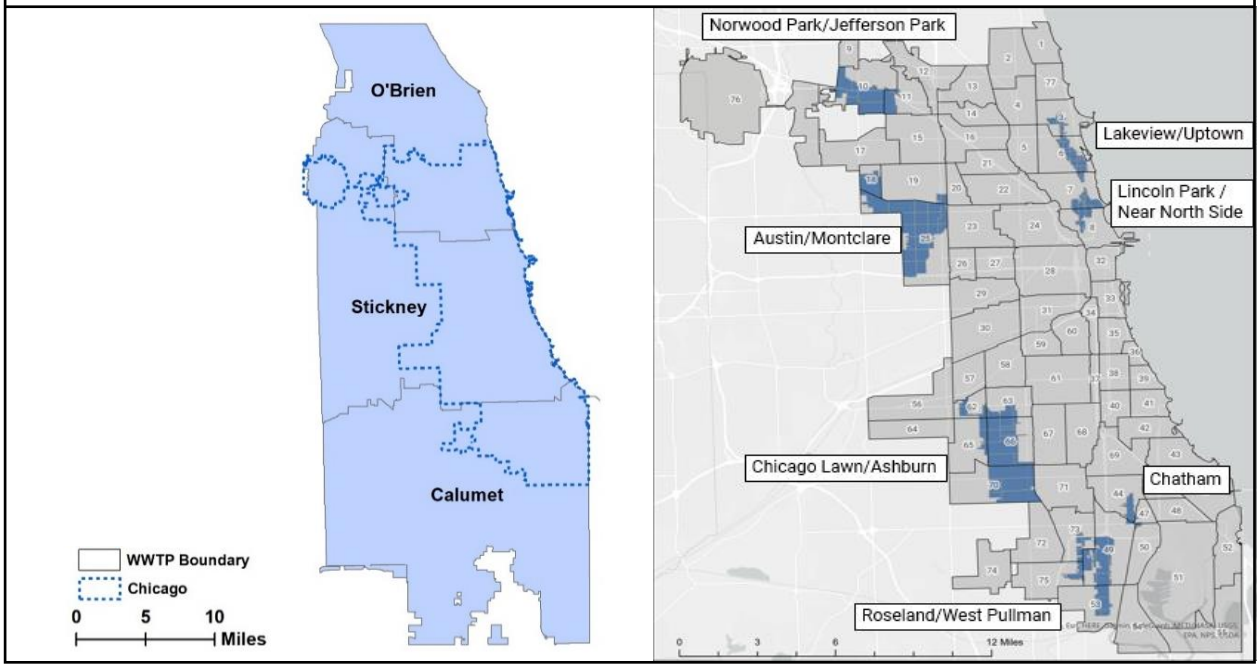
IDPH, CCDPH, and CDPH partner with the University of Illinois Discovery Partners Institute (DPI) and the Metropolitan Water Reclamation District of Greater Chicago (MWRD) to conduct surveillance at two main levels: wastewater treatment plants, and neighborhood sewers.

The three large wastewater treatment plants serving Chicago and Cook County (the O'Brien, Stickney and Calumet Water Reclamation Plants) each collect and process wastewater from over a million people. Samples are also collected from seven local sewers in Chicago, including one in each Healthy Chicago Equity Zone. The number of people living in each sewershed ranges from 3,600 to 215,000 people (**Figure 1)**.

Samples are usually collected from each plant and neighborhood sewer twice each week. However, beginning in mid-April, three samples are collected weekly at treatment plants to improve the ability to monitor trends. As recommended by the CDC, the concentration of SARS-CoV-2 is compared to the concentration of genetic material from Pepper Mild Mottle Virus (pMMoV). The pMMoV concentration reflects the amount of human waste in wastewater relative to other things like stormwater runoff. In February 2022, the laboratory that conducts our wastewater testing implemented a new method to amplify the SARS-CoV-2 concentration in order to increase our ability to detect very small quantities of virus in wastewater. The data before and after February 15 therefore cannot be directly compared at this time.

Data from the local wastewater monitoring system is submitted to the CDC as part of the National Wastewater Surveillance System (NWSS). You can view NWSS data on the CDC's COVID-19 data tracker. In March 2022, we reported data from the Chicagoland area demonstrating the sharp increase and decrease associated with the Omicron (BA.1) wave, which corresponded with trends in the number of incidence cases, hospitalizations and deaths due to COVID-19. This report displays data from February 15, 2022 through April 30, 2022.

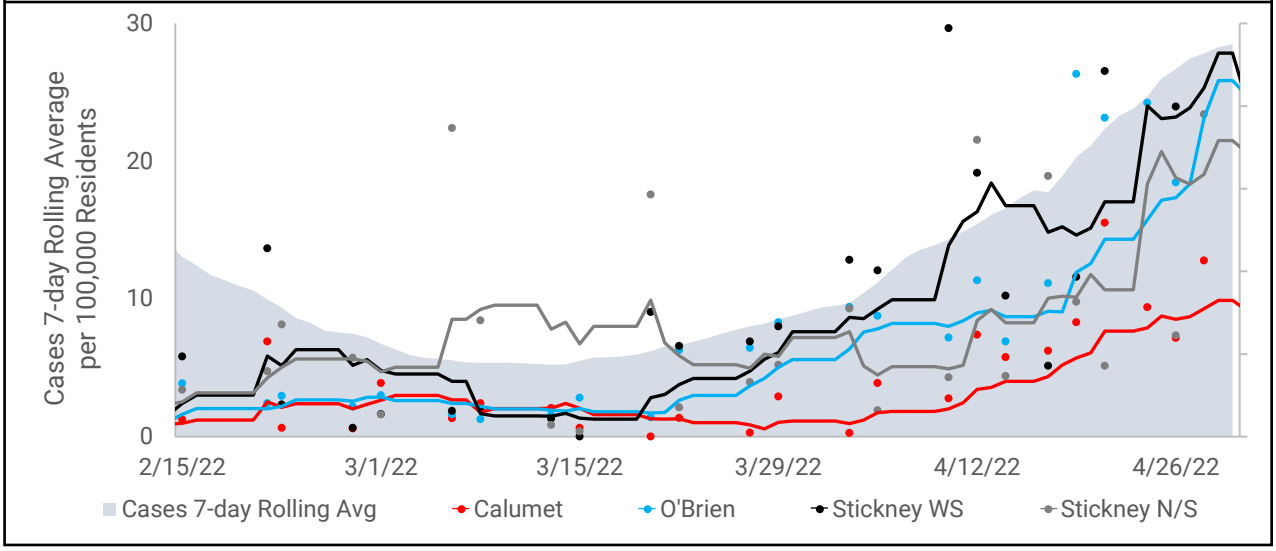
Figure 1: Wastewater treatment plants (left) and neighborhood sewers (right) that are monitored for SARS-CoV-2.



Wastewater concentrations in the Chicago region

Trends in the concentration of SARS-CoV-2 in wastewater increased at all wastewater treatment plants during late March and early April 2022, after remaining relatively low throughout much of February and early March (**Figure 2**)

Figure 2: SARS-CoV-2 concentration at wastewater treatment plants serving Chicago (lines) and 7-day rolling average of daily reported infections per 100,000 Cook County residents (gray), February-April 2022.



At the neighborhood sewer level, the concentration of virus detected in wastewater remained low in most community areas for February and March, and began to increase in north side community areas from mid-March. (**Figure 3**) Occasionally, high outliers were observed that neither seemed to correspond to case incidence nor overall trends in viral concentration. These outliers reflect the highly variable conditions in sewers and the importance of considering trends in wastewater data rather than individual values. Additionally, the viral concentration trends in local sewers appeared to map less closely to other COVID-19 trends than at the wastewater treatment plant levels, particularly in smaller sewershed areas with irregular wastewater flow. As with Figure 2, the data only display data collected after February 15, when the new laboratory method was implemented.

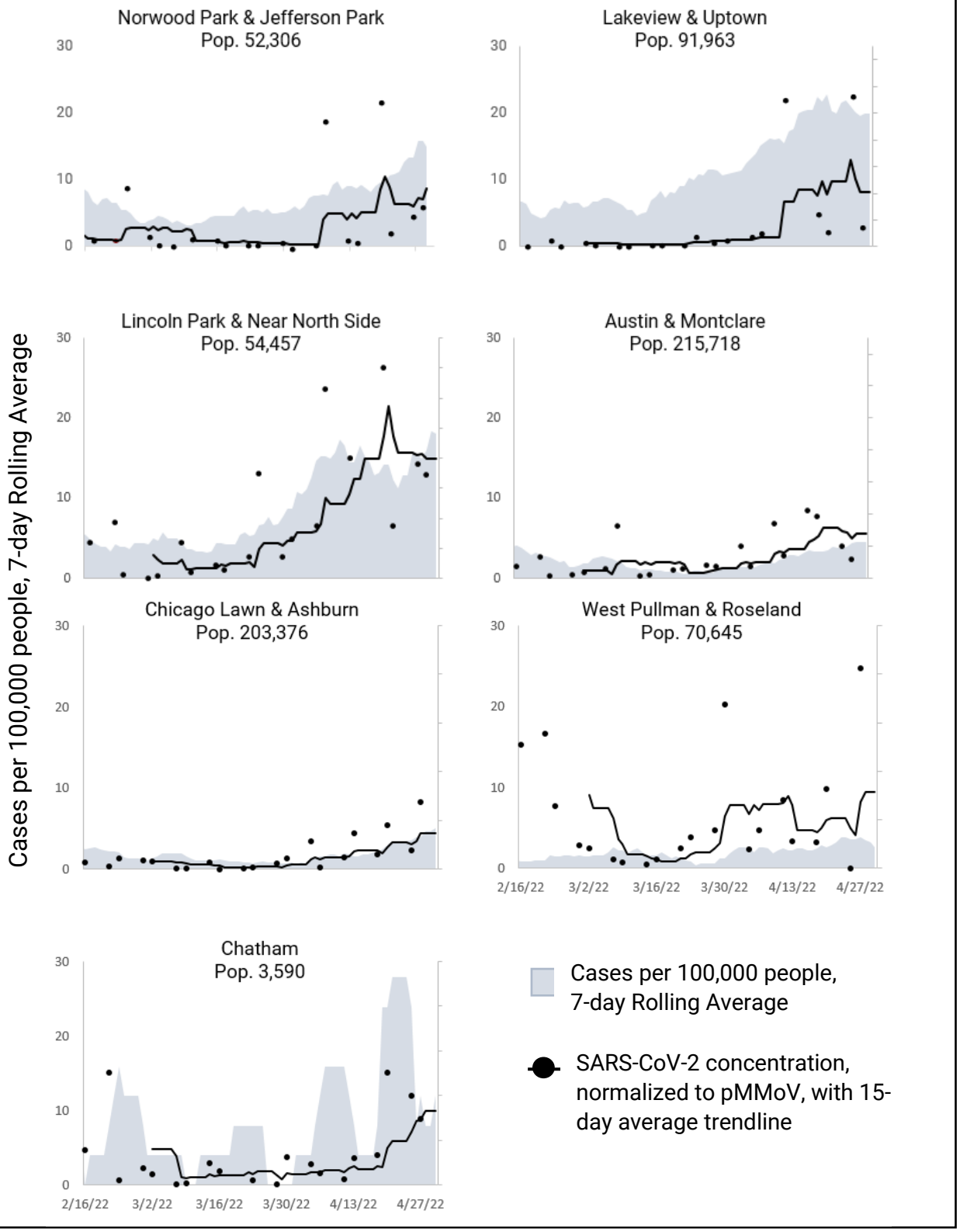
During the process of preparing wastewater for measurement, some of the viral particles we want to measure cannot be retrieved. The new, enhanced laboratory method does a better job of recovering viruses from wastewater than the old method. This is helpful for detecting very small quantities of virus in wastewater. However, this also makes it appear as though the concentration of virus is higher using the new method than it would have been using the old method, even when the amount of virus is the same. While data from before this new method cannot be directly compared with data after the new method, both are displayed in **Appendix 1** to demonstrate how the recent concentrations of virus in sewersheds observed using the new, enhanced laboratory method compares to the concentrations observed during the peak of the Omicron wave in late December 2021 and early January 2022 using the old method.

Monitoring variants of SARS-CoV-2

Like all viruses, SARS-CoV-2 constantly changes through genetic mutation. These mutations can lead to the emergence of new SARS-CoV-2 variants and sublineages of those variants. Omicron and Delta are examples of SARS-CoV-2 variants of concern, while BA.1 and BA.2 are examples of sublineages of the Omicron SARS-CoV-2 variant of concern.

When SARS-CoV-2 is identified in wastewater, specialized laboratory testing, including genomic sequencing, can identify variants, including variants of concern. The Omicron variant was first detected in wastewater from O'Hare International Airport in mid-December 2021, and has been the dominant variant in wastewater since mid/late December 2021. The initial Omicron wave was driven by the BA.1 sublineage, though as with clinical samples the BA.2 sublineage and its descendants have been the dominant sublineage in Cook County wastewater samples. In particular, the BA.2.12 sublineage of Omicron has been increasingly detected in Chicago and Cook County wastewater. The BA.4 and BA.5 sublineages have not yet been detected in wastewater in Cook County.

Figure 3. SARS-CoV-2 concentration at 7 sewersheds in Chicago (lines) and 7-day rolling average of reported infections in each sewershed per 100,000 people (grey), February 16 - April 30 2022.



Summary

The increasing concentration of SARS-CoV-2 in wastewater in April at water reclamation plants reflects the growing transmission and reported cases of COVID-19 in Cook County and Chicago, which have both moved to the medium Community Level according to the CDC's guidance. IDPH has increased the number of samples collected from these treatment plants from two times per week to three times per week to offer greater ability to monitor trends.

Infrequently, high levels of virus were detected in wastewater samples that did not appear to correspond to trends in cases. There are many reasons this could occur, though all point to the need for caution in interpreting individual wastewater results rather than trends in concentration over time.

What comes next?

IDPH, CCDPH and CDPH continue to refine wastewater monitoring systems in the Chicago region and across the state. As the availability of rapid At-Home COVID-19 tests continues to increase, it is possible that a smaller proportion of COVID-19 cases will be reported to public health departments. Wastewater data, which is not affected by reporting to public health authorities, may become more valuable for monitoring levels of community transmission. Wastewater will also continue to be used to track the presence and proportion of SARS-CoV-2 variants and sublineages.

We anticipate continuing to produce reports in the future, and updated data is available through the Wastewater Surveillance dashboard on the CDC's COVID-19 Data Tracker.

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Appendix A.

Figure A.1: SARS-CoV-2 concentration at wastewater treatment plants (points) and 7-day rolling average of reported infections in Cook County residents (grey), November-April 2022. The two-week trend for data is shown for samples collected since February 15. A new laboratory method was implemented beginning February 15 (black dashed line) in which an enhancement reagent was added to the quantification procedure to improve the recovery of virus from wastewater and thus amplify the concentration of virus detected, compared to not using the enhancement reagent. Data collected before February 15 are thus not directly

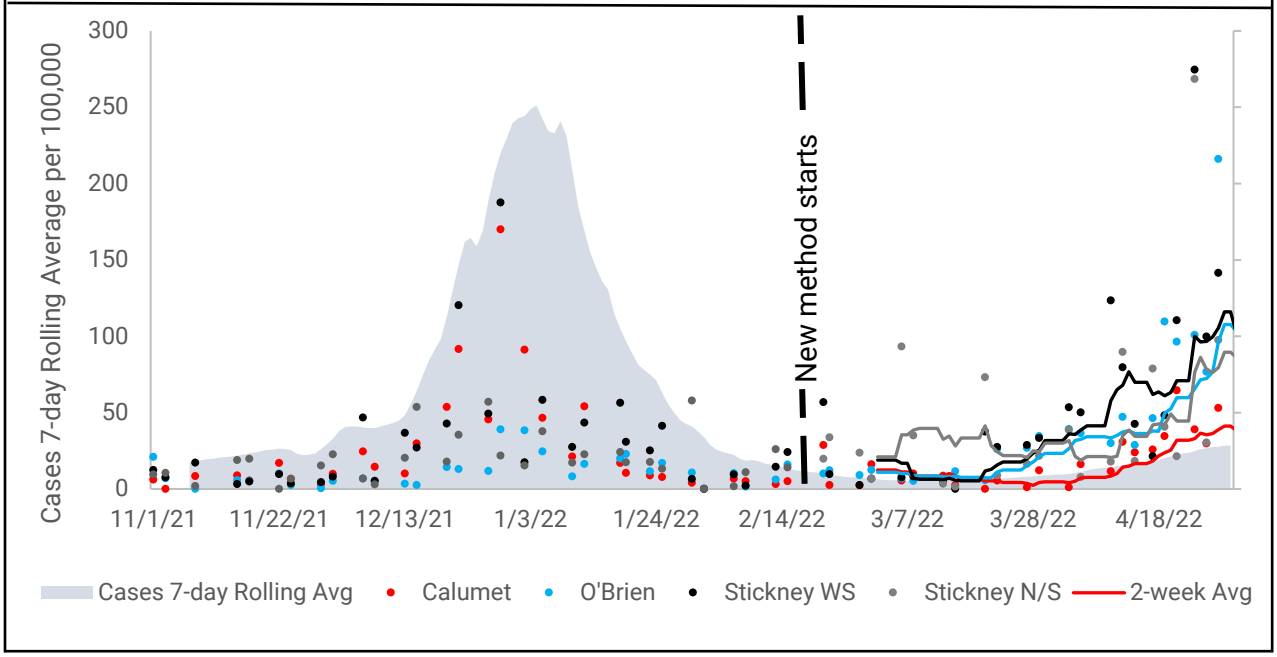

Figure A.2: SARS-CoV-2 concentration at 7 sewersheds in Chicago (lines) and 7-day rolling average of reported infections in sewershed residents per 100,000 people (grey), November-April 2022. Data collected using the new laboratory method (black) and without the new method (blue) are displayed together, though they are not directly comparable.