



NY State wastewater surveillance for COVID-19

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COVID-19 transmission is an unobservable phenomenon



Indicators provide us clues that transmission is occurring or has occurred



Cases / test positivity – dependent on symptoms and testing access and reporting



Hospitalizations – lags days or weeks behind transmission – tip of the iceberg

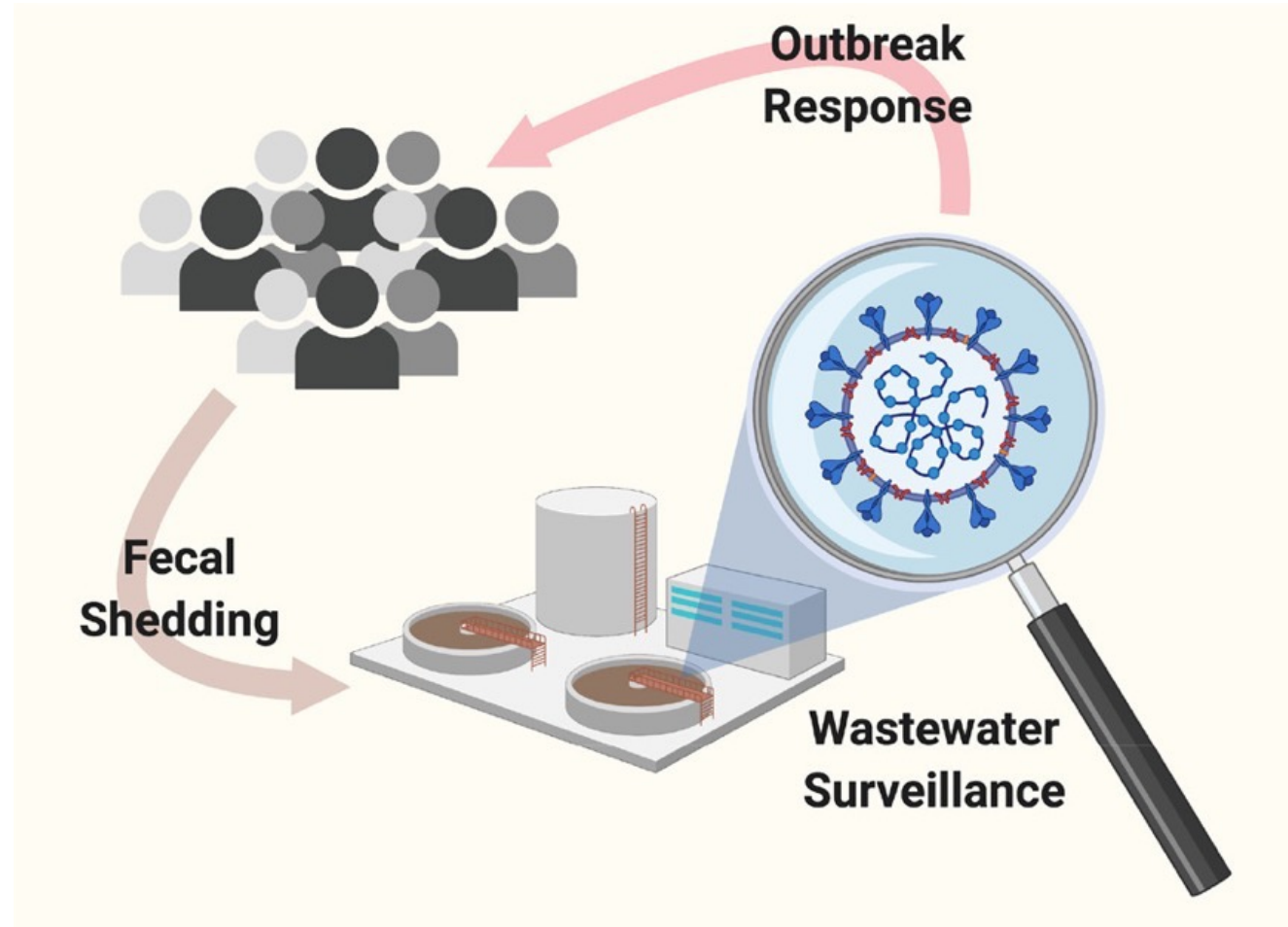


Deaths – lags days or weeks behind transmission – tip of the iceberg

Wastewater surveillance was broadly used in the 1990's to fight polio

Wastewater surveillance has caught polio outbreaks and triggered mop-up vaccination campaigns before any children were paralyzed

Wastewater surveillance has been adopted to monitor illicit drug use, microbial resistance, and other non-polio pathogens



Bivins A, North D, Ahmad A, Ahmed W, Alm E, Been F, Bhattacharya P, Bijlsma L, Boehm AB, Brown J, Buttiglieri G. Wastewater-Based Epidemiology: Global Collaborative to Maximize Contributions in the Fight Against COVID-19.

1. Sewage is sampled



2. Sample is filtered/concentrated



3. Sample is tested for presence of pathogens



4. Interventions are deployed when pathogens are found





Cases / test positivity – dependent on symptoms and testing access and availability – many missed



Hospitalizations – lags days or weeks behind transmission – tip of the iceberg



Deaths – lags days, weeks, or months behind transmission – tip of the iceberg

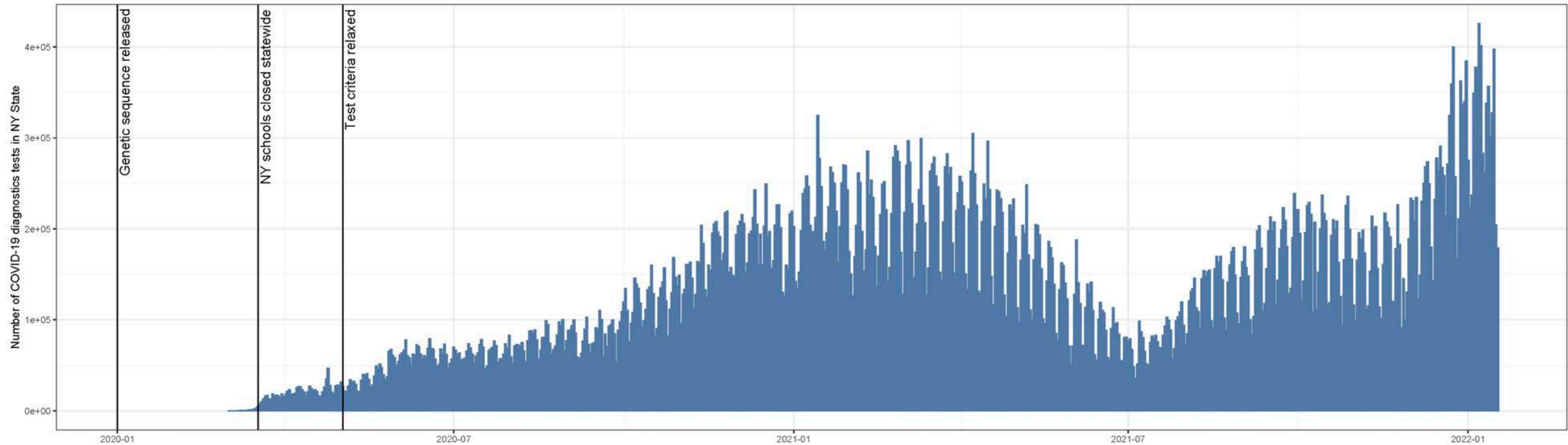


Wastewater – a real-time, unbiased community-level indicator?

Genetic sequence of SARS-CoV-2 published Dec 31, 2019

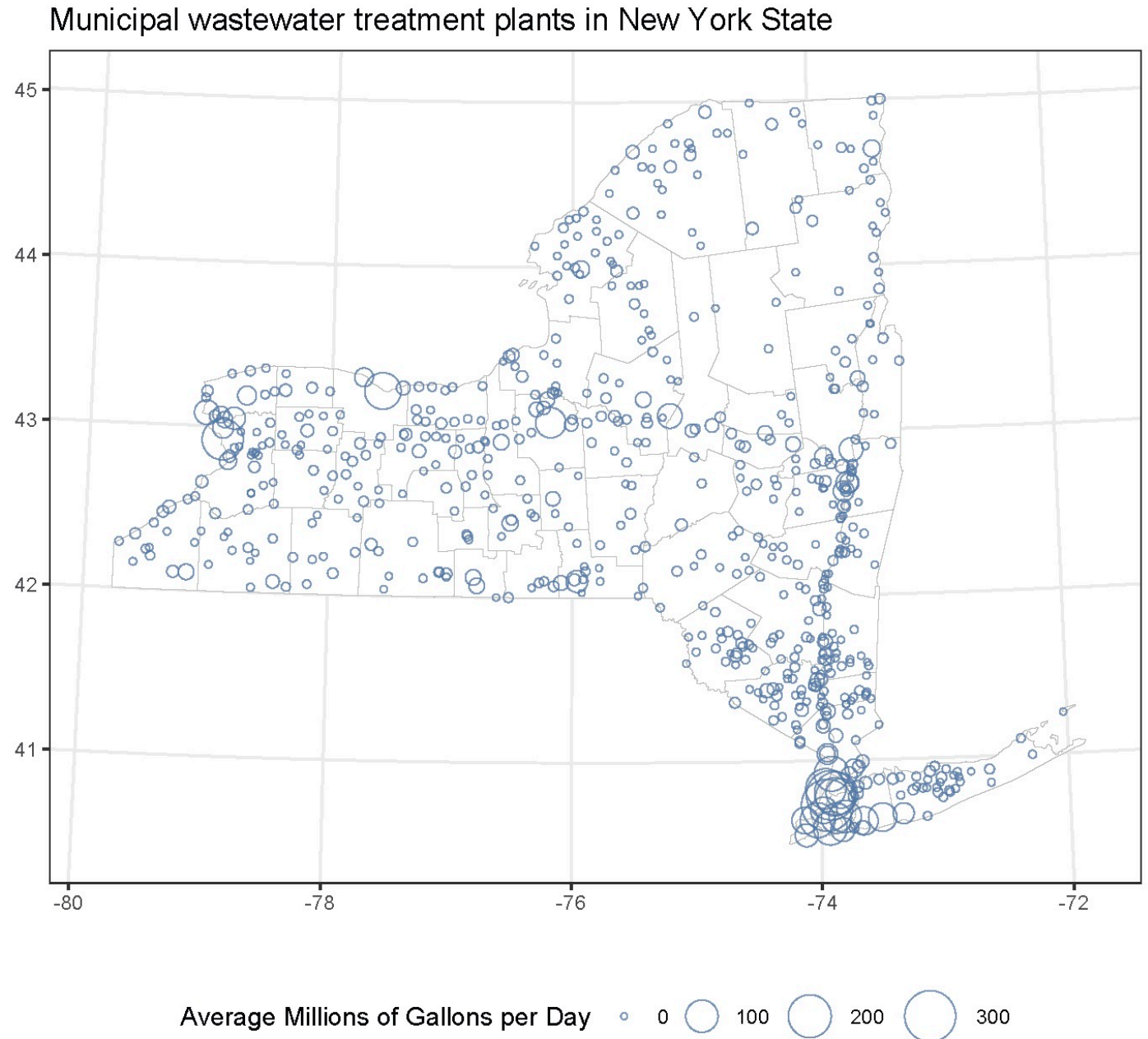
Scale-up of diagnostic testing was disastrous

NY state schools closed on March 18, before widespread testing was available



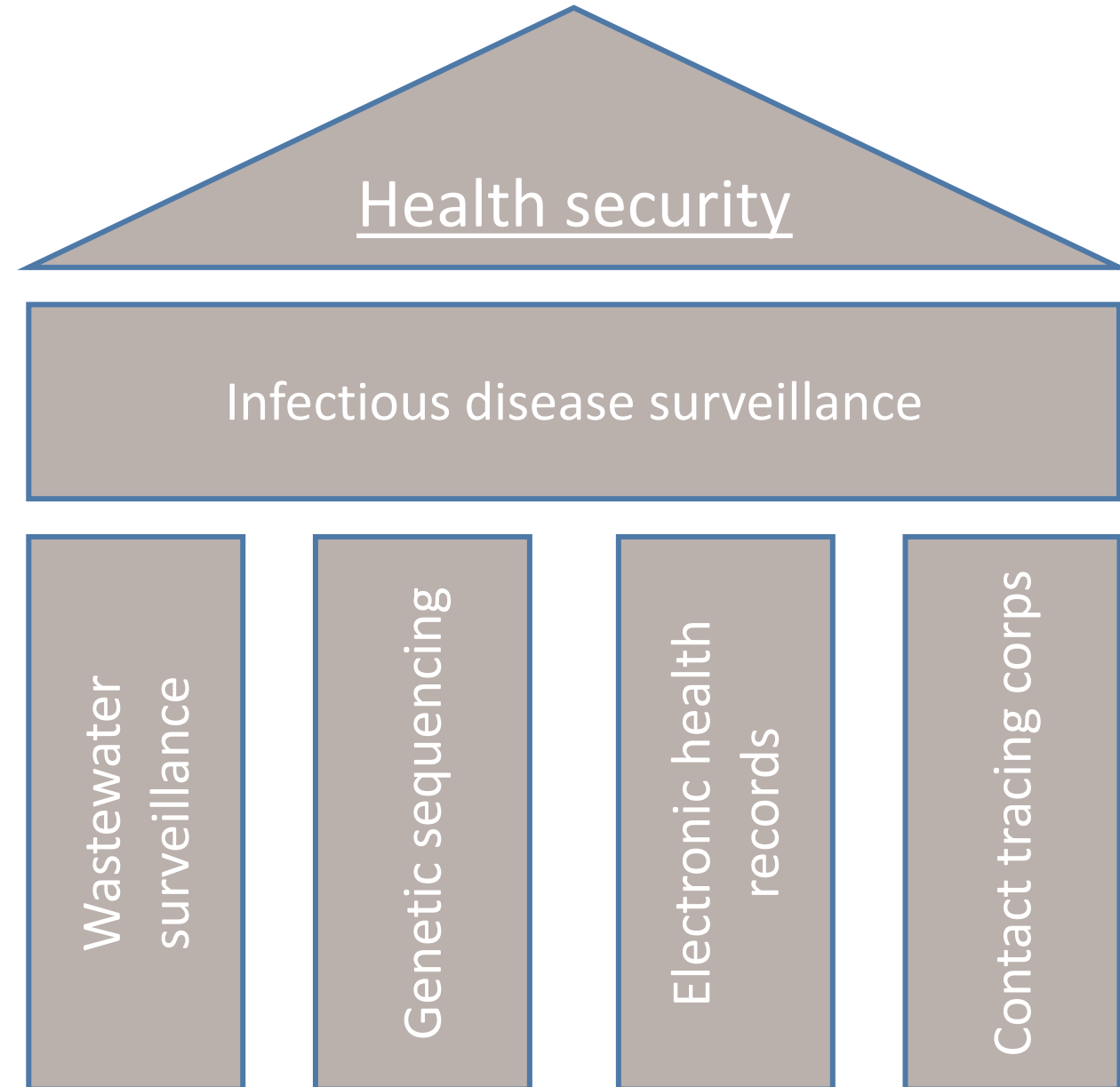
Wastewater provides a representative sample of the community

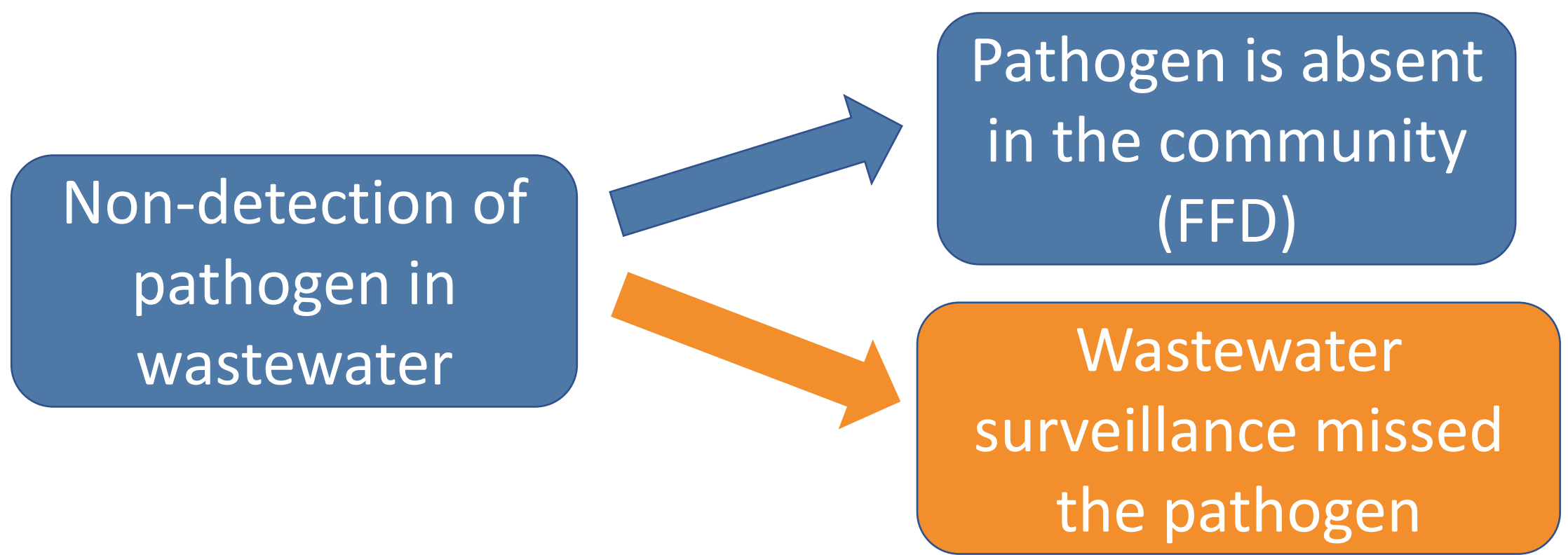
- Everybody poops
- Human waste gives detailed information on the health and consumption of an individual
- 80% of homes across New York State are connected to sewer
- A sample from the wastewater treatment plant provides **representative** information about the **community**
- Wastewater treatment plants **routinely** sample their wastewater
- Just over 600 wastewater treatment plants across the state
- **Low cost and convenient**



Wastewater surveillance – a pillar of health security

- Infectious disease surveillance systems need to be capable of confirming that a community is safe
- Wastewater surveillance provides a community-level measure of transmission and as such is much more scalable than surveillance based upon individual clinical diagnoses
- We are training the system and local health departments on how to utilize the information from wastewater surveillance





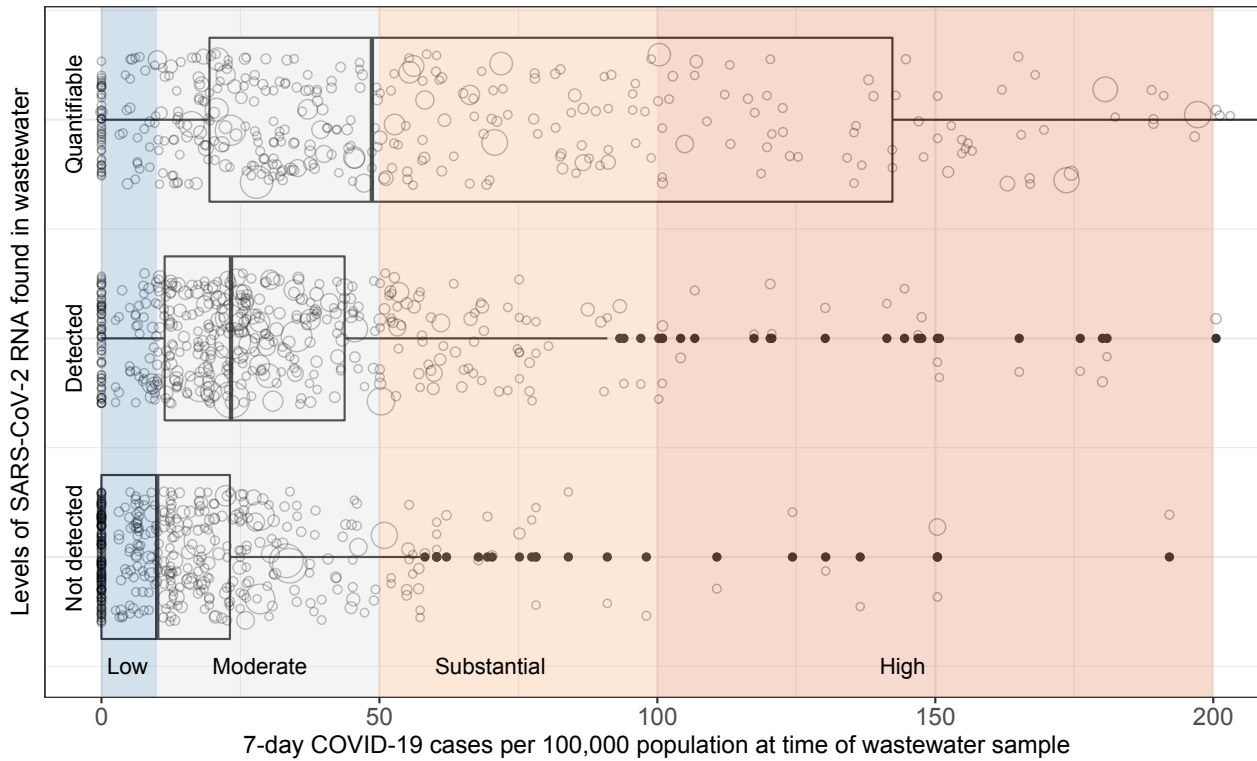
$$FFD = 1 - (1 - \textit{sensitivity})^n$$

FFD = freedom from disease

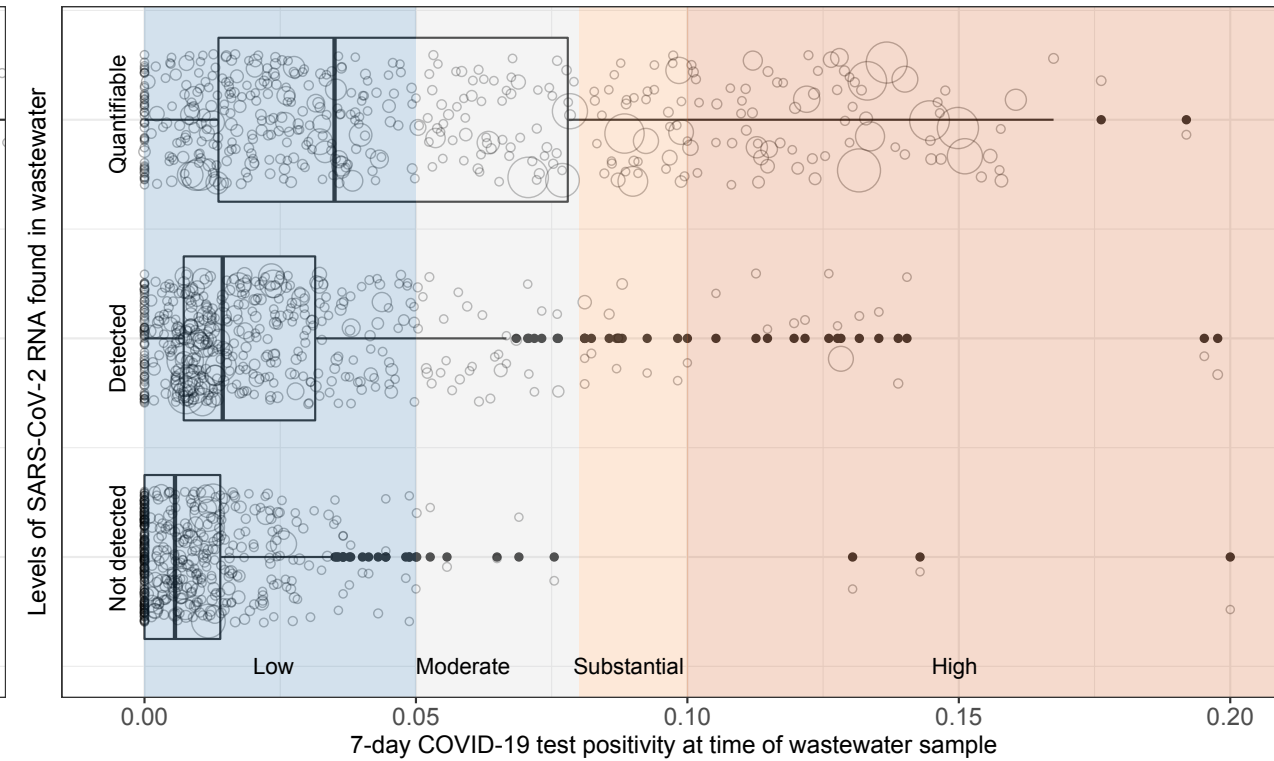
sensitivity affected by community population size, community sewer connection, and method sensitivity

n = number of consecutive non-detections

A) COVID-19 Incidence

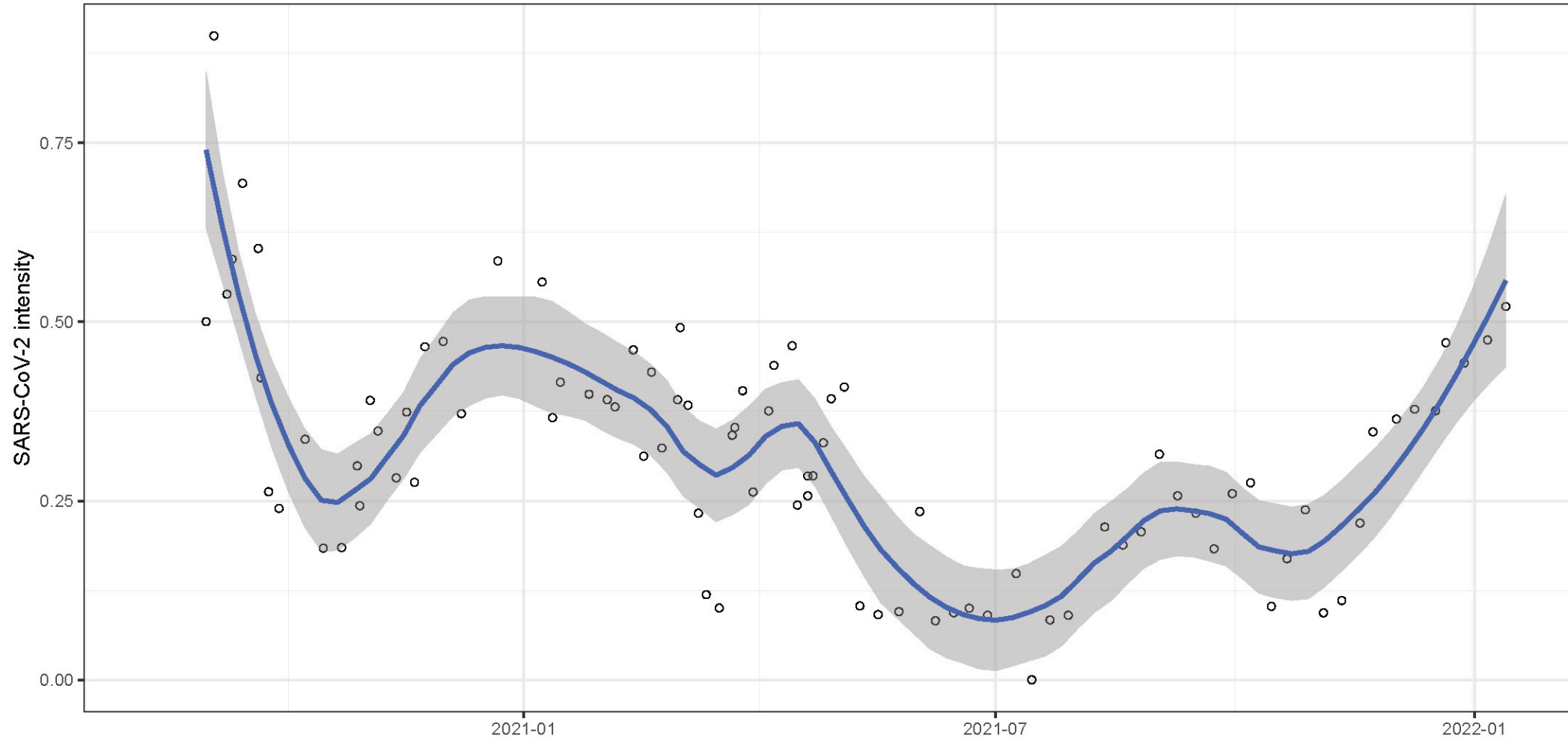


B) Test positivity



CDC classification of COVID-19 transmission	New COVID-19 cases in past 7 days	Test positivity in past seven days
Low	0-9 per 100,000	< 5%
Moderate	10-49 per 100,000	5-7.9%
Substantial	50-99 per 100,000	8-9.9%
High	≥ 100 per 100,000	≥ 10%

Oneonta WWTP

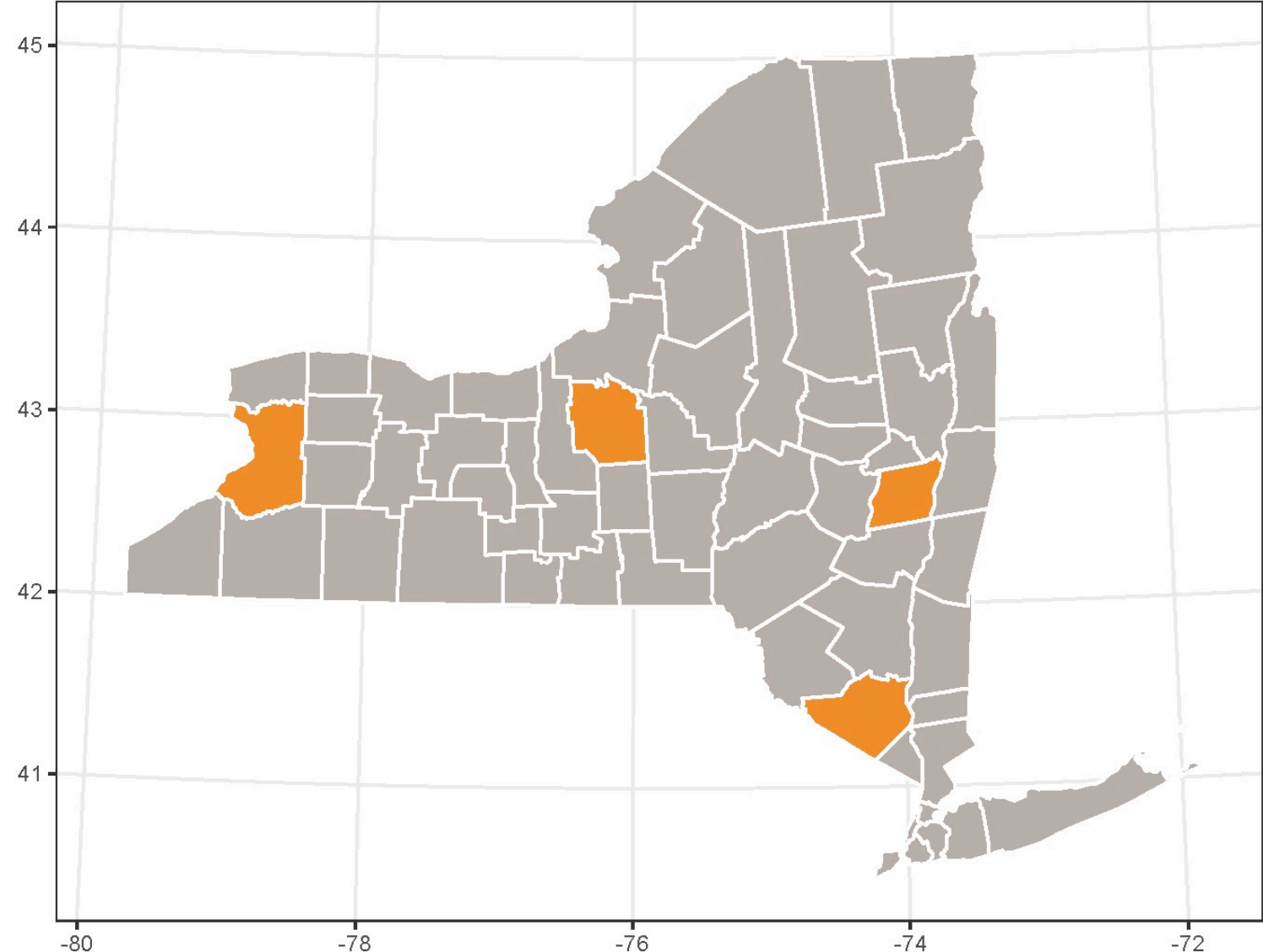


- *Surveillance data gains strength over time*

New York State announces wastewater surveillance for COVID-19

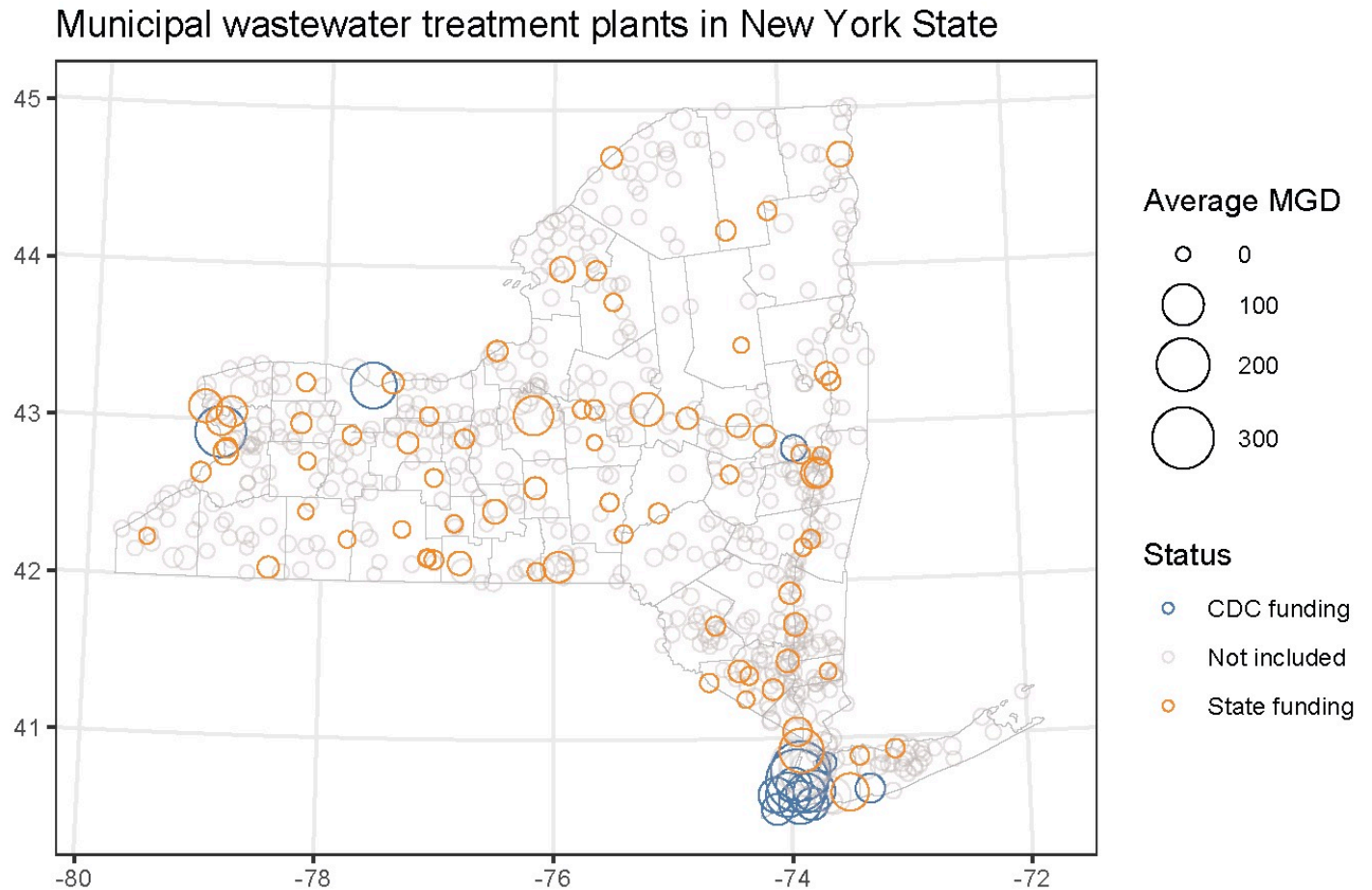
- Governor's announcement:
<https://www.governor.ny.gov/news/governor-hochul-announces-department-health-partnership-syracuse-university-expand-innovative>
- State website:
<https://storymaps.arcgis.com/stories/b30ca571e00b42779875e3eaf7577b1b>

Counties in state wastewater surveillance pilot - 2020



A treatment plant in network in every county

- Provide unbiased estimates of transmission in each county
- Inform public regarding risk of COVID-19
- Empower County Health Departments and policymakers
- Build health security



CDC National wastewater surveillance system

Morbidity and Mortality Weekly Report (MMWR)

Using Wastewater Surveillance Data to Support the COVID-19 Response — United States, 2020–2021

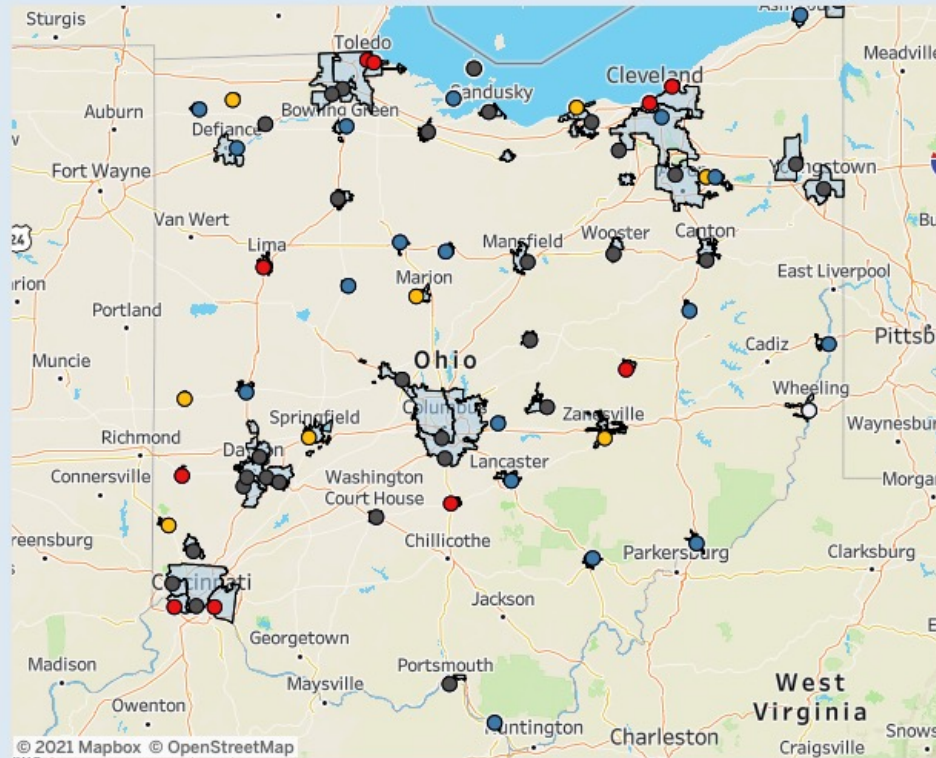
Weekly / September 10, 2021 / 70(36);1242–1244

Amy E. Kirby, PhD¹; Maroya Spalding Walters, PhD²; Wiley C. Jennings, PhD¹; Rebecca Fugitt, MS³; Nathan LaCross, PhD⁴; Mia Mattioli, PhD¹; Zachary A. Marsh, MPH¹; Virginia A. Roberts, MSPH¹; Jeffrey W. Mercante, PhD¹; Jonathan Yoder, MPH¹; Vincent R. Hill, PhD¹ ([View author affiliations](#))

Kirby AE, Walters MS, Jennings WC, et al. Using Wastewater Surveillance Data to Support the COVID-19 Response — United States, 2020–2021. MMWR Morb Mortal Wkly Rep 2021;70:1242–1244. DOI: <http://dx.doi.org/10.15585/mmwr.mm7036a2externalicon>

<https://www.cdc.gov/healthywater/surveillance/wastewater-surveillance.html>

State of Ohio | Wastewater Treatment Plant Locations and Boundaries



Circleville WWTP	↑
Little Miami WWTP	↑
Muddy Creek WWTP	↑
City of Eaton WWTP	↑
Coshocton WWTP	↑
Lima WWTP	↑
NEORS Easternly WWTP	↑
NEORS Westernly WWTP	↑
Toledo Bay View Park WWTP	↑
Oregon WWTP	↑
City of Marion WPC	↗
Springfield WWTP	↗
Zanesville WWTP	↗
Greenville WWTP	↗
Kent WRF	↗
EORWA	↗
Archbold WWTP	↗

Click a site to zoom in and view data for that site. To return to the state view, click the site again.

When viewing on a mobile device, such as a phone or tablet, pinch with both fingers to move the map or zoom in on a specific area. Hover on the symbol to see the percent of increase or decrease of virus levels in the wastewater for a specific sewershed area.

Legend: Red arrow ↑ = substantial increase (>100%), Yellow arrow ↗ = increase (50% to 100%), Gray arrow ↔ = steady (-49% to 49%), Blue arrow ↘ = decrease (<=-50%)

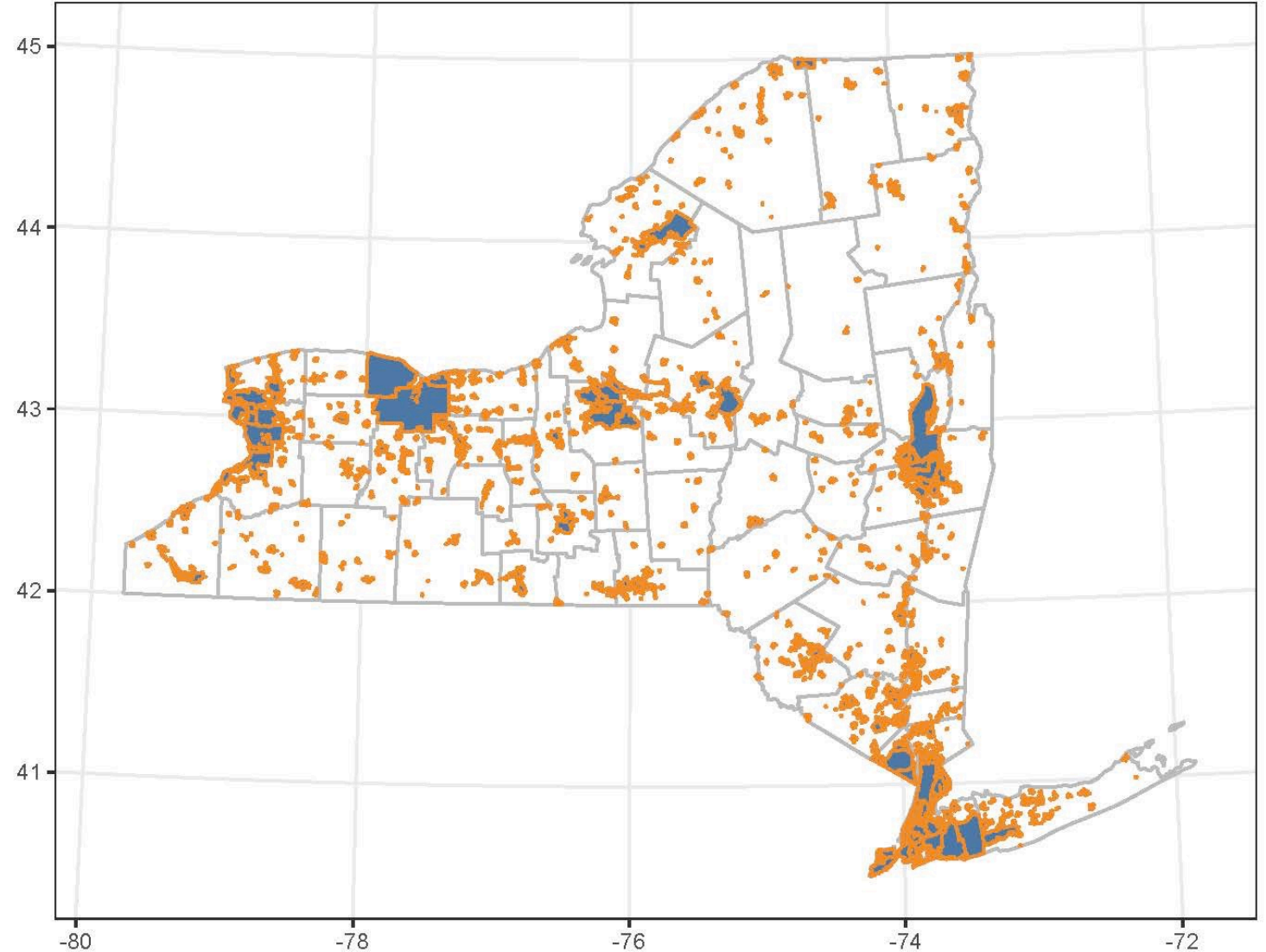
Last updated:12-20-2021

<https://coronavirus.ohio.gov/wps/portal/gov/covid-19/dashboards/other-resources/wastewater>

Surveillance system infrastructure built in last few months

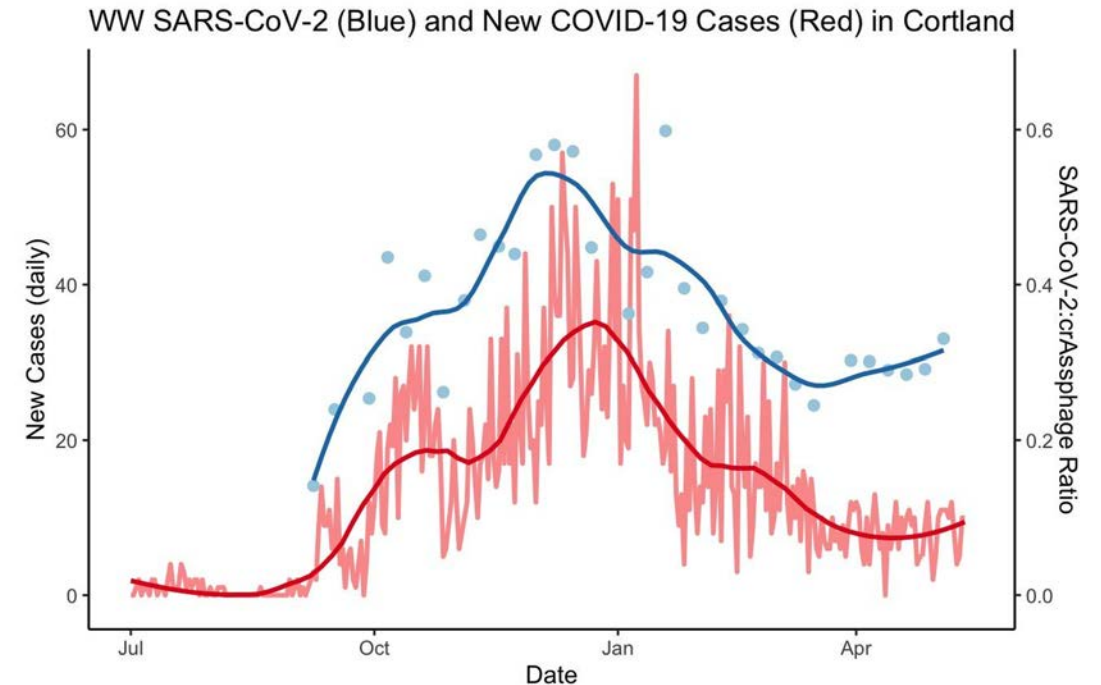
- 85% of New York State is on sewer
- State surveillance network will cover 75% of New York State population
- State surveillance network will cover 70% of the non-New York City population

Municipal sewersheds across New York State

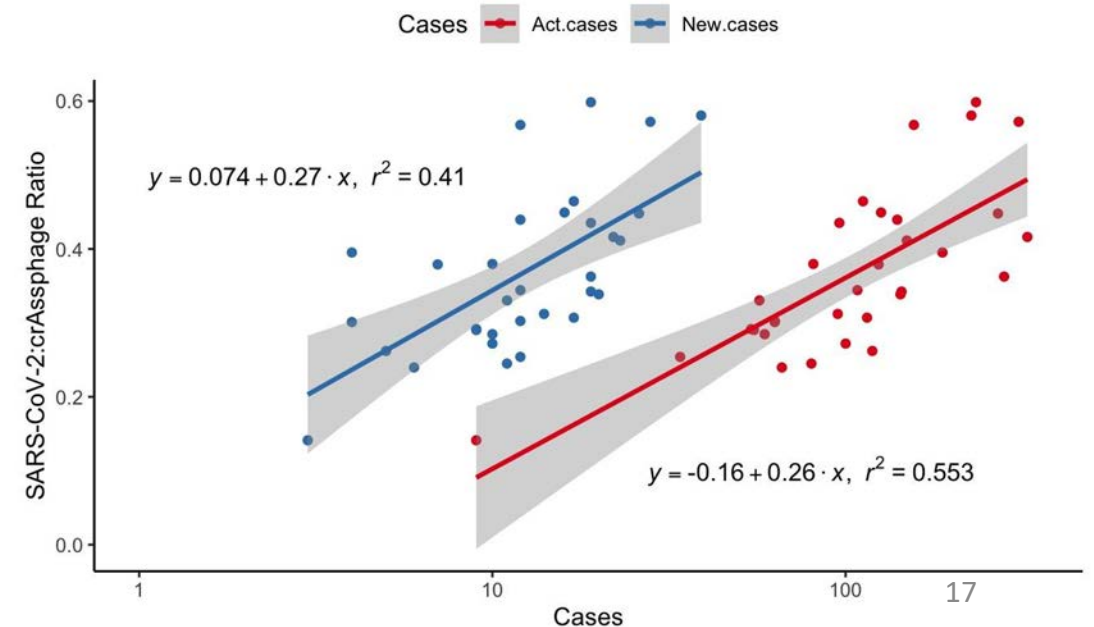


Complementary measure of transmission to support public health

- Strongest correlation with active cases and test positivity
- 3-5 day lead time from date of test for wastewater compared to clinical surveillance

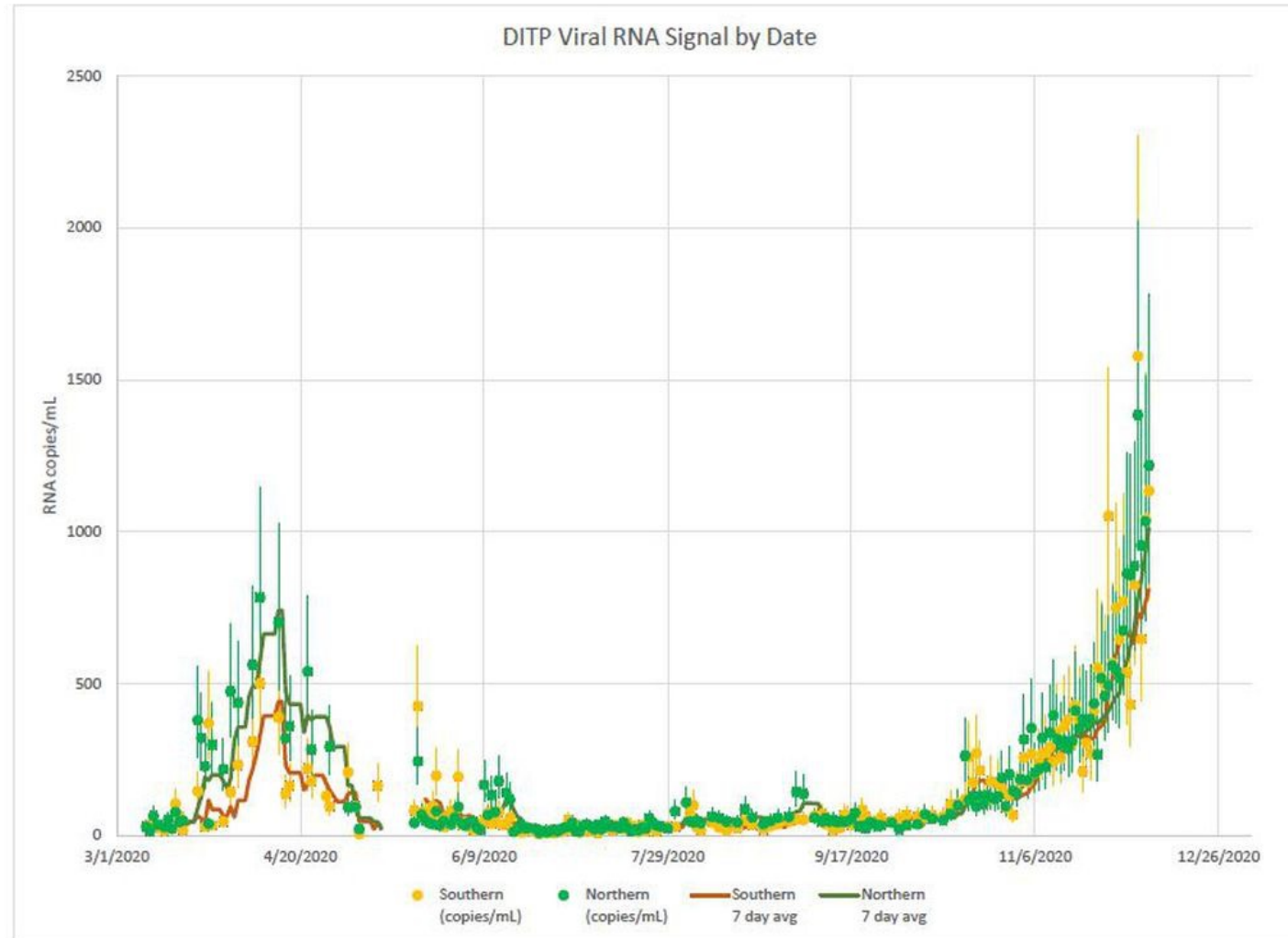


Relationship between SARS/CrAssphage Ratios and Cases in Cortland

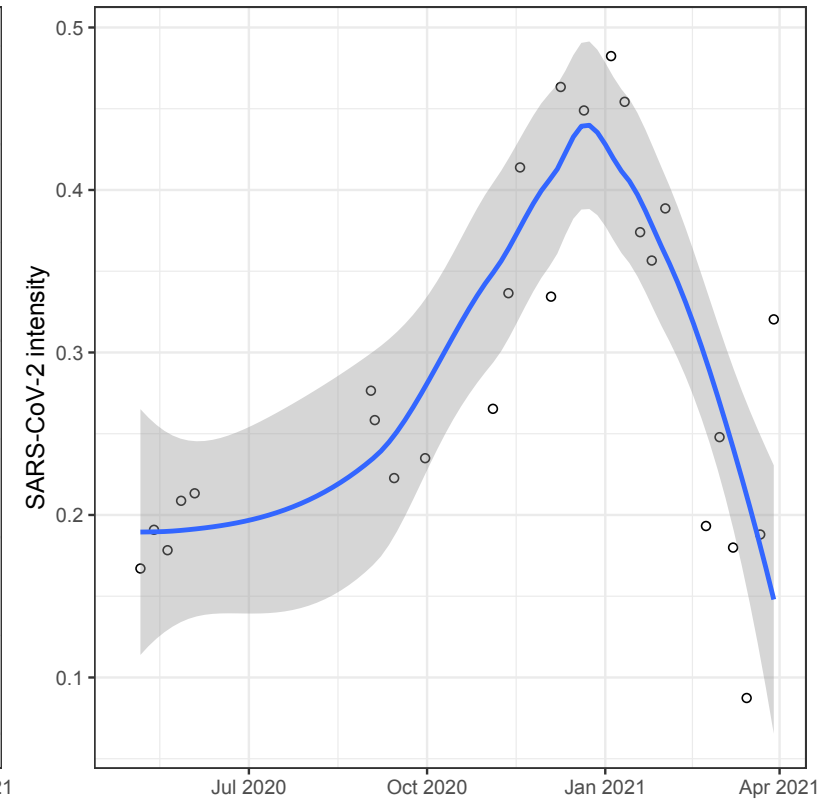
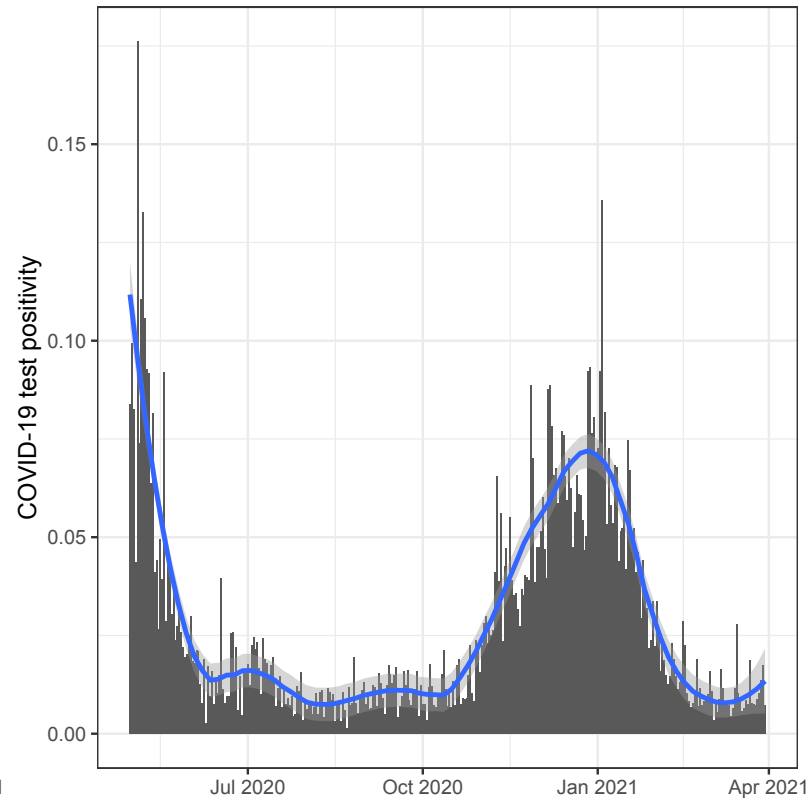
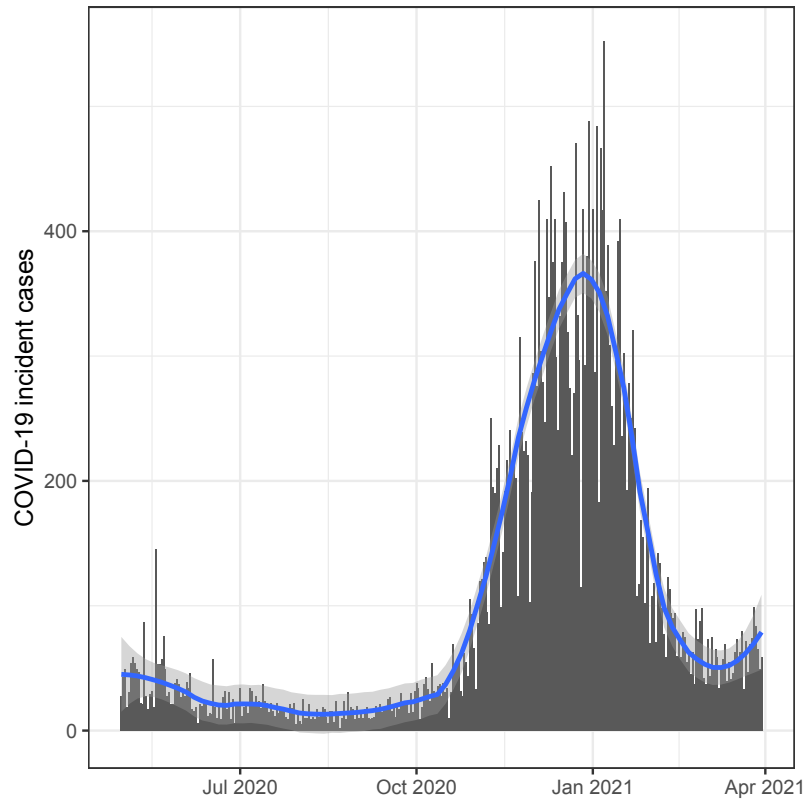


Coronavirus levels in Massachusetts wastewater hit new records

By [Christina Prignano](#) Globe Staff, Updated December 8, 2020, 4:54 p.m.



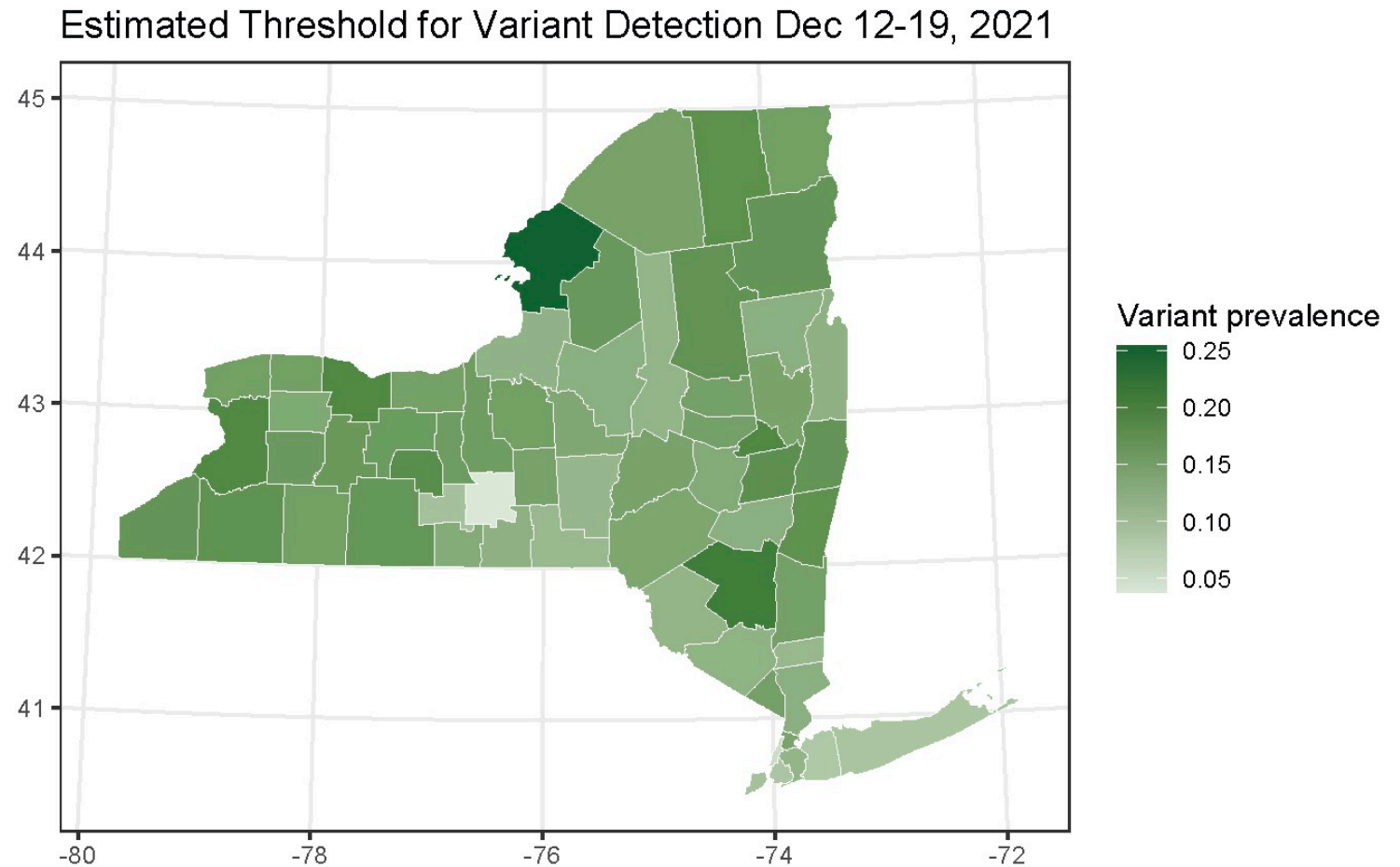
Use case – decline



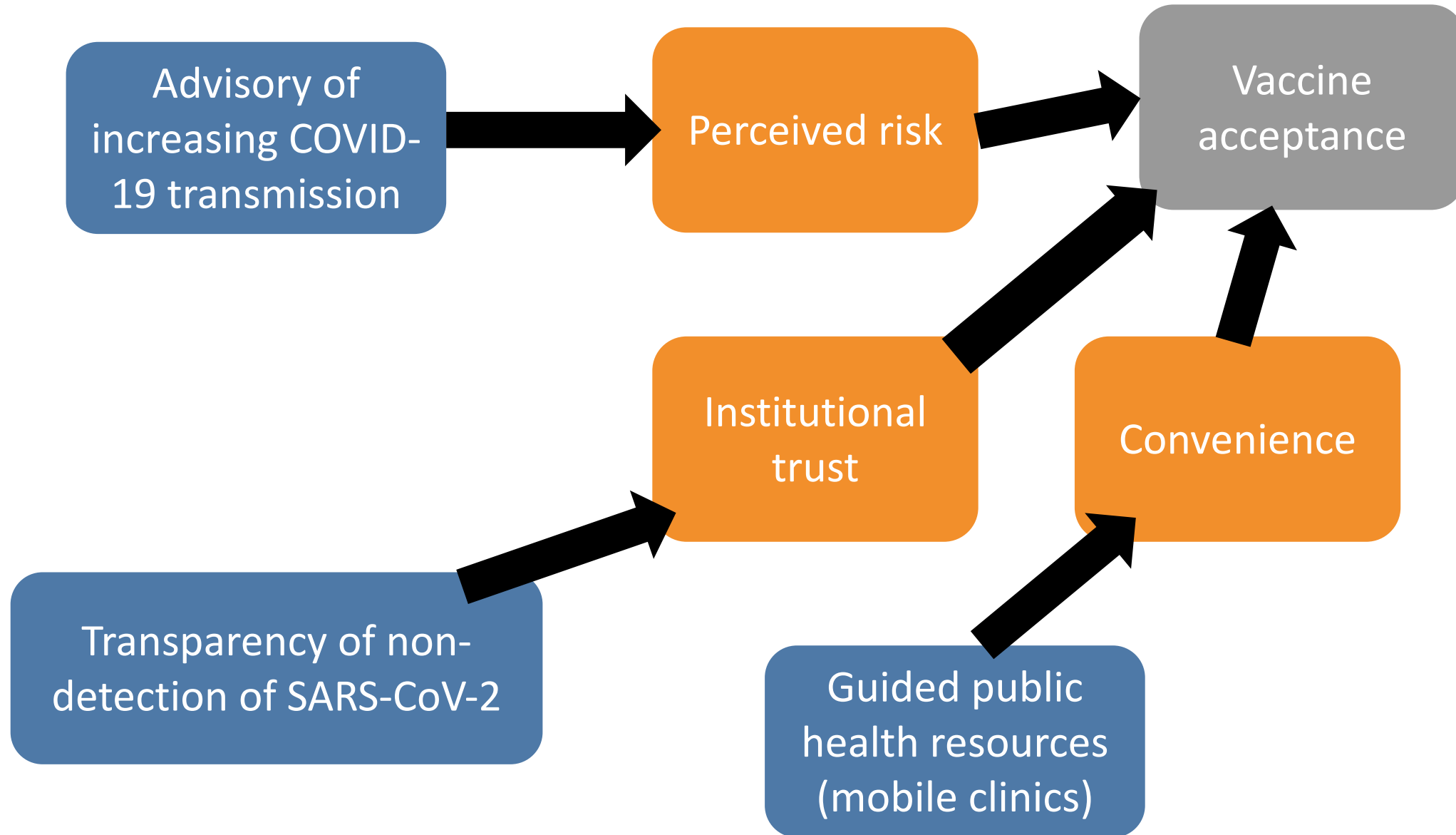
How will case and testing numbers and change in the future?

Use case - variant detection and sequencing

We are building capacity for whole genome sequencing from wastewater including rapid geographic estimation of distribution of variants of concern



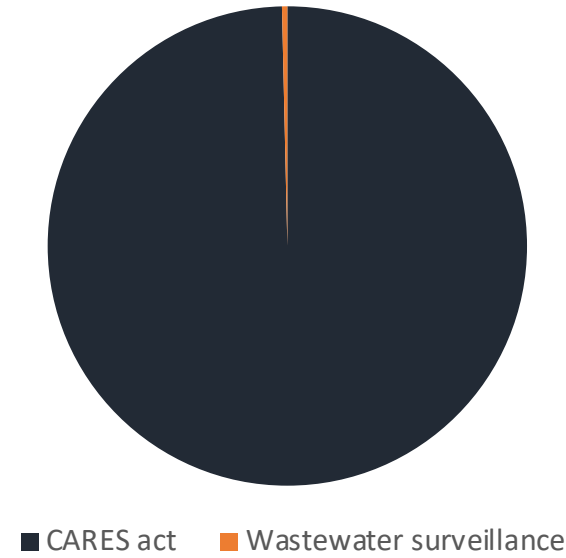
Nudging vaccine acceptance and guiding mobile clinics



What is the cost of a comprehensive statewide wastewater surveillance program?

- Estimated \$350 per sample for centralized program
- \$23 million for twice weekly sampling for one year at 632 municipal plants
- \$1.19 per NY state resident
- 0.36% of CARES funding
- 3% of lost sales tax revenue

Proportional cost



Proportional cost



Future steps

- Wastewater surveillance is simply a system – it can be applied to many public health issues
- Monitoring opioid use
- Influenza, RSV, and other infectious diseases
- The next pandemic threat?

Pathogens detected in wastewater

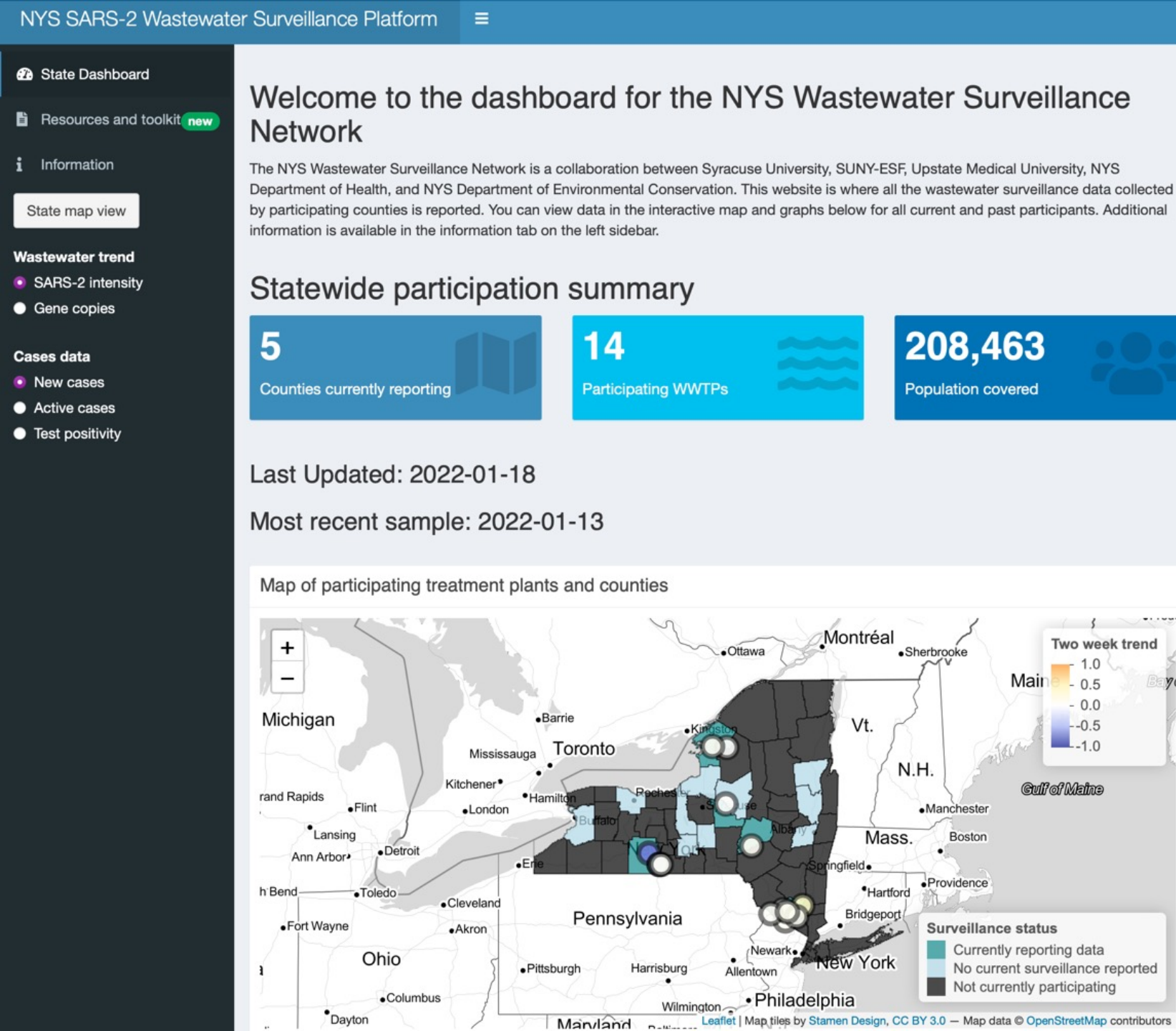
- | | |
|---|---|
| - Adenoviridae (Mastadenovirus, and Unspecified) | - Herpesviridae |
| - Astroviridae | - Hexamitidae (Giardia) |
| - Caliciviridae (Norovirus, Sapovirus, and Unspecified) | - Matonaviridae |
| - Coronaviridae | - Papillomaviridae |
| - Cryptosporidiidae (Cryptosporidium) | - Parvoviridae |
| - Enterobacteriaceae (Salmonella, Escherichia, and Unspecified) | - Picornaviridae (Enterovirus, Parechovirus, Hepatovirus, Kobuvirus, Cosavirus, Salivirus, and Unspecified) |
| - Filoviridae (Ebola virus) | - Poxviridae |
| - Flaviviridae (Flavivirus) | - Reoviridae |
| - Hepeviridae (Hepevirus, and unspecified) | - Retroviridae |
| | - Togaviridae |

Greatest burden of disease (Family, Genus):

- Lower respiratory infections
- Diarrheal diseases
- HIV/AIDS (Retroviridae, Lentivirus)
- Tuberculosis (Mycobacteriaceae, Mycobacterium)
- Malaria (Plasmodiidae, Plasmodium)
- Meningitis
- Whooping cough (Alcaligenaceae, Bordetella)
- Measles (Paramyxoviridae, Morbillivirus)

Infectious diseases of international concern (Family, Genus) :

- Coronavirus* (Coronaviridae)
- Ebola* (Filoviridae, Ebolavirus)
- Influenza (Orthomyxoviridae)
- HIV/AIDS (Retroviridae, Lentivirus)
- Poliovirus* (Picornaviridae, Enterovirus)
- Zika* (Flaviviridae, Flavivirus)



Welcome page:

- Supporting information
- Summary information
- Navigation of:
 - Wastewater and Case data
 - By county

State Dashboard

Resources and toolkit new

Information

State map view

Wastewater trend

SARS-2 intensity

Gene copies

Cases data

New cases

Active cases

Test positivity

Welcome to the dashboard for the NYS Wastewater Surveillance Network

The NYS Wastewater Surveillance Network is a collaboration between Syracuse University, SUNY-ESF, Upstate Medical University, NYS Department of Health, and NYS Department of Environmental Conservation. This website is where all the wastewater surveillance data collected by participating counties is reported. You can view data in the interactive map and graphs below for all current and past participants. Additional information is available in the information tab on the left sidebar.

Statewide participation summary

5

Counties currently reporting

14

Participating WWTPs

208,463

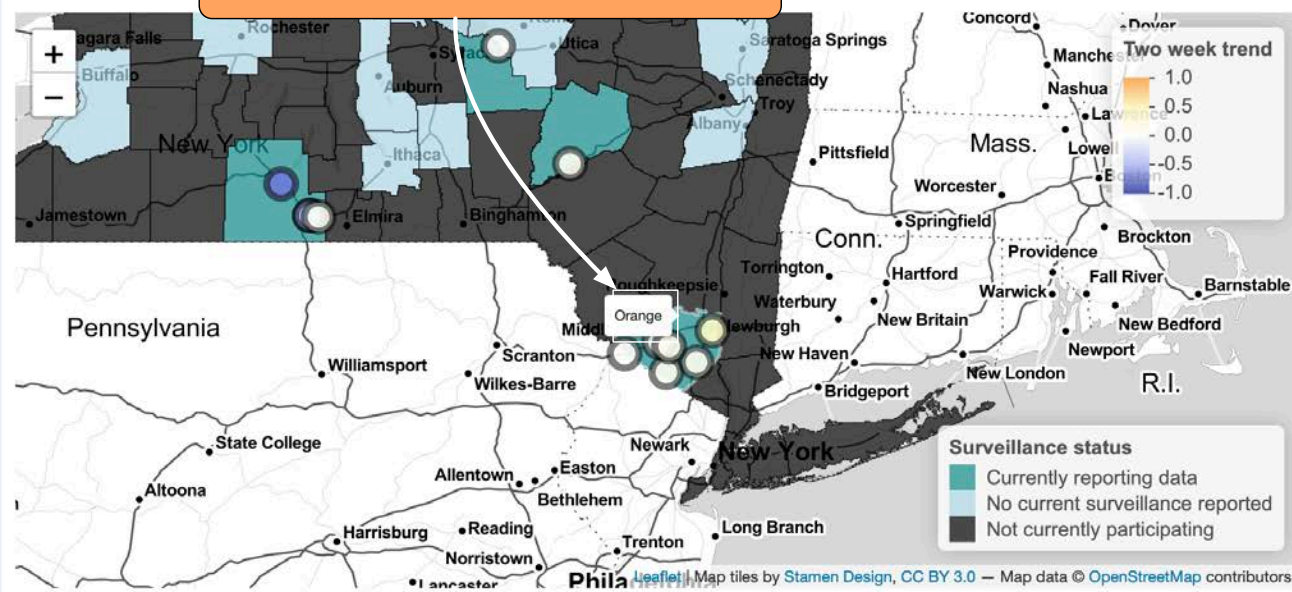
Population covered

Last Updated: 2022-01-18

Most recent s

Click on the county
you want to learn more about

Map of participa



Choose your county:

- Zoom map to see county details.
- Choose wastewater trend
- Choose case data

State Dashboard

Resources and toolkit **new**

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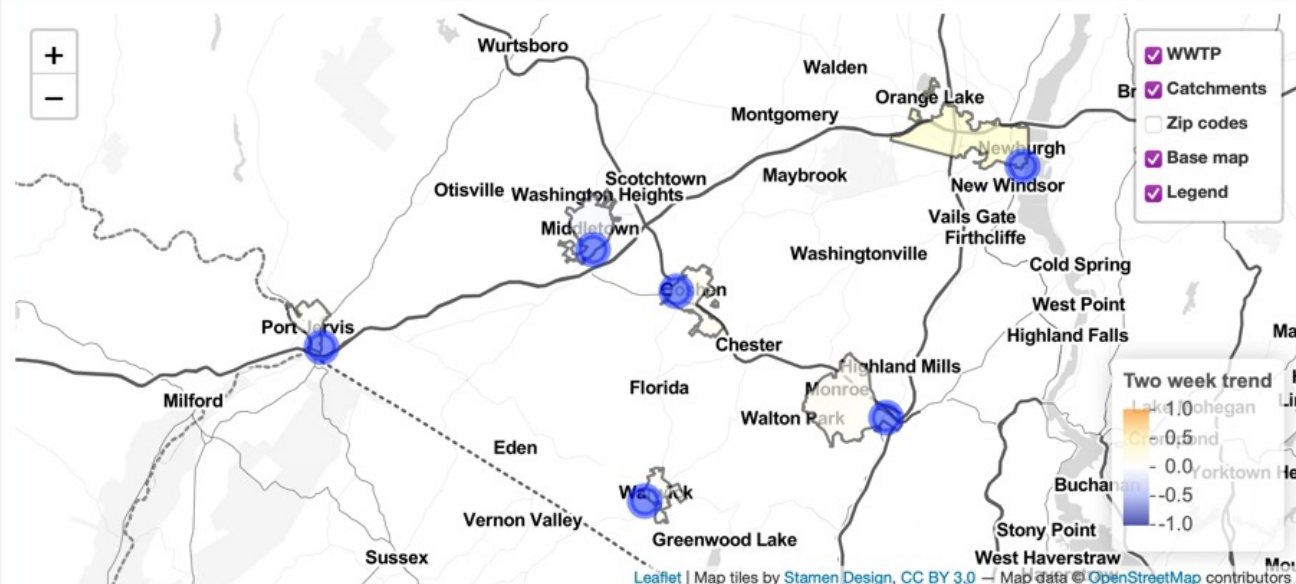
208,463

Population covered

Last Updated: 2022-01-18

Most recent sample: 2022-01-13

Map of participating treatment plants and counties



Zoom in example:

- Orange county
- Display various base maps
- Specific collection points

Stat

Res

Information

State map view

Wastewater trend

SARS-2 intensity

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Click on gene copies radio button to display wastewater trend

Orange County SARS-2 RNA gene copies detection trend

WWTP: MIDDLETOWN STP , City of Middletown sewershed

Gene copies

1000

500

0

Sep Oct Nov Dec Jan

Detected, <LOQ Quantifiable detection

Trend graph description show / hide

Case data

Orange County new cases

New cases (total)

2000

1500

1000

500

0

Sep Oct Nov Dec Jan

Middleton collection point

- Interested in comparing gene copies various case data values

Stat

Res

Information

State map view

Wastewater trend

SARS-2 intensity

Gene copies

Cases data

New cases

Active cases

Test positivity

Click on gene copies radio button to display wastewater trend

Click on new cases radio button to change the case data trend

Orange County SARS-2 RNA gene copies detection trend

WWTP: MIDDLETOWN STP , City of Middletown sewershed

graph description show / hide

Middletown collection point

- Comparing gene copies to new cases

Case data

Orange County new cases

State Dashboard

Resources and toolkit new

Information

State map view

Wastewater trend

SARS-2 intensity

Gene copies

Cases data

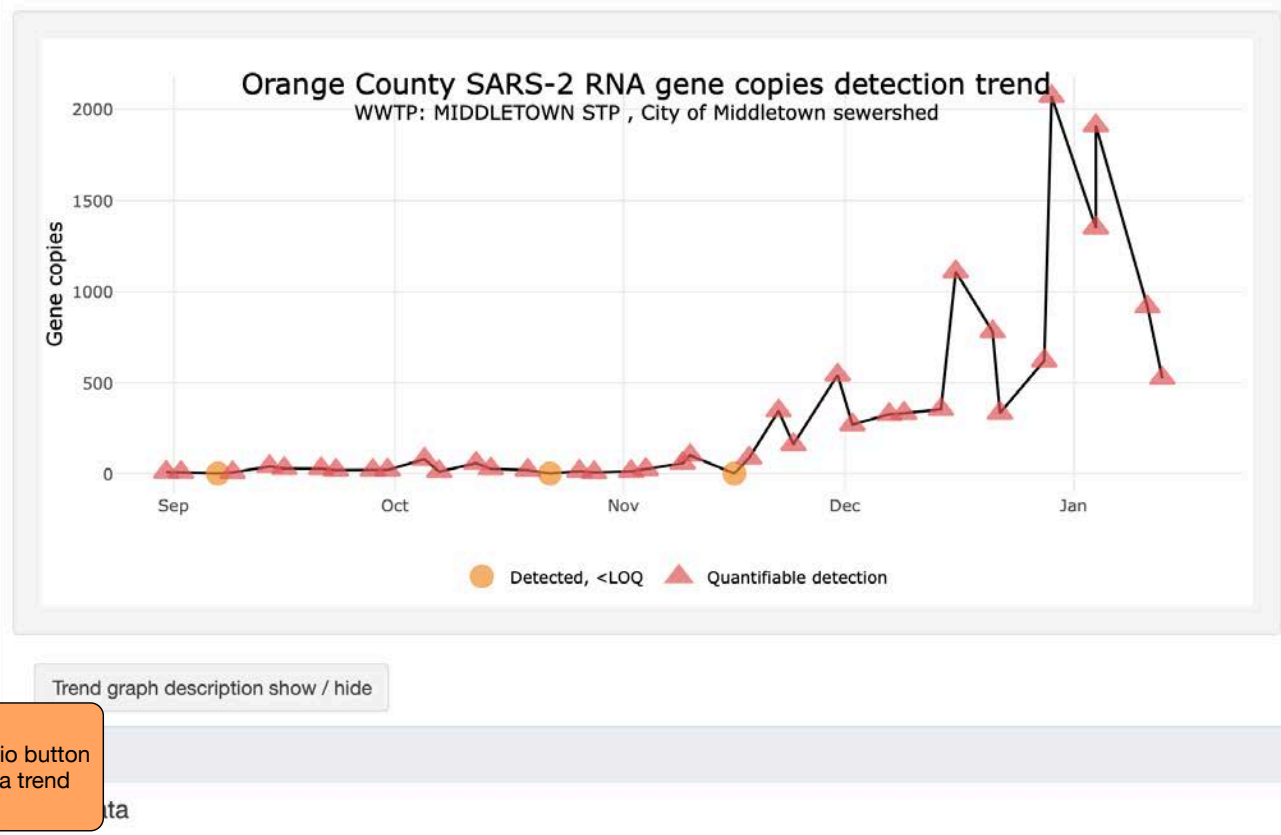
New cases

Active cases

Test positivity

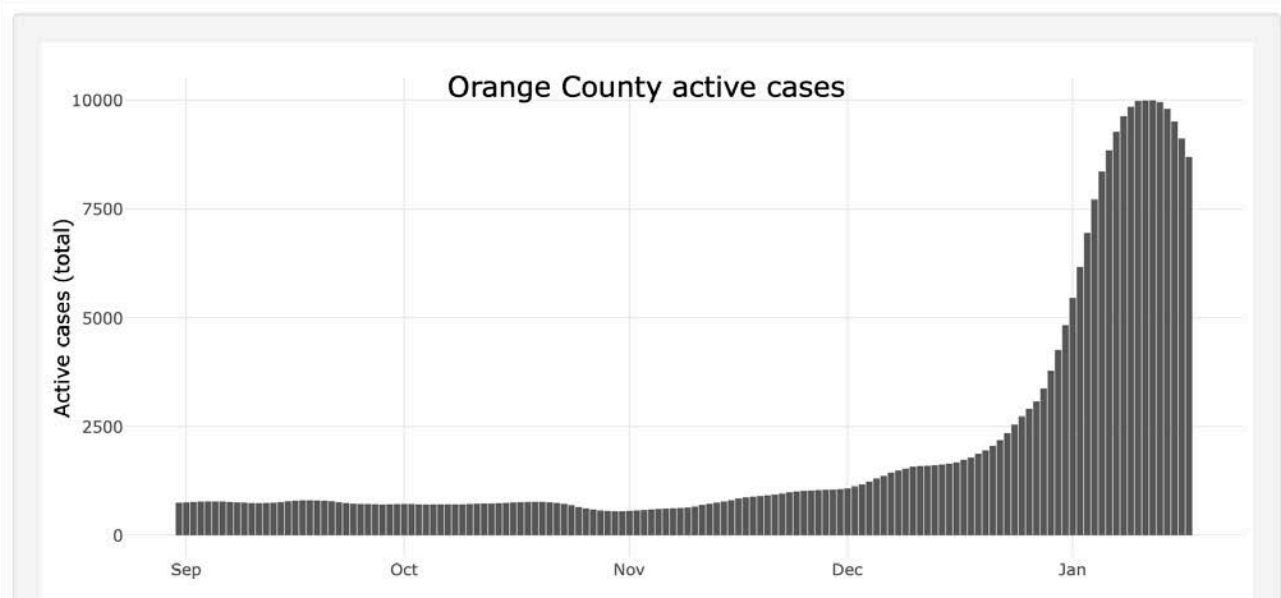
Switch the case plots between new cases, active cases, and positivity.

Click on active cases radio button to change the case data trend



Middleton collection point

- Comparing gene copies to active cases



State Dashboard

Resources and toolkit new

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State map view

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SARS-2 intensity

Gene copies

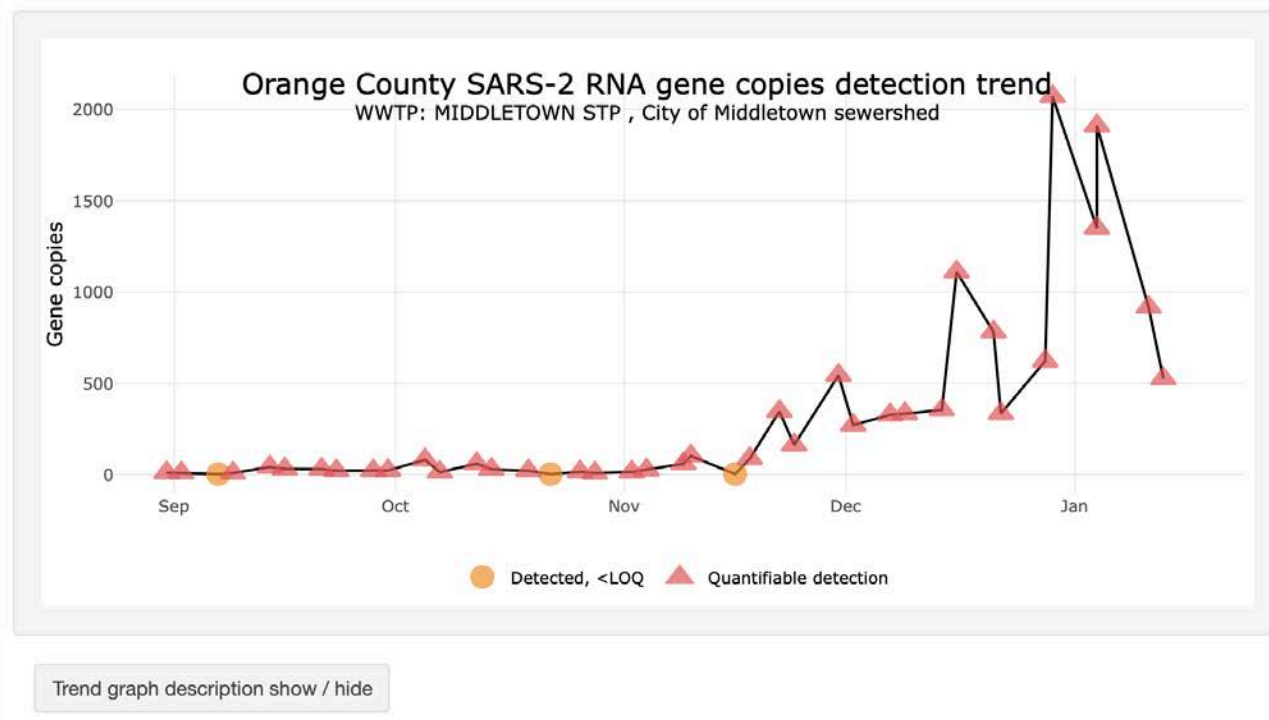
Cases data

New cases

Active cases

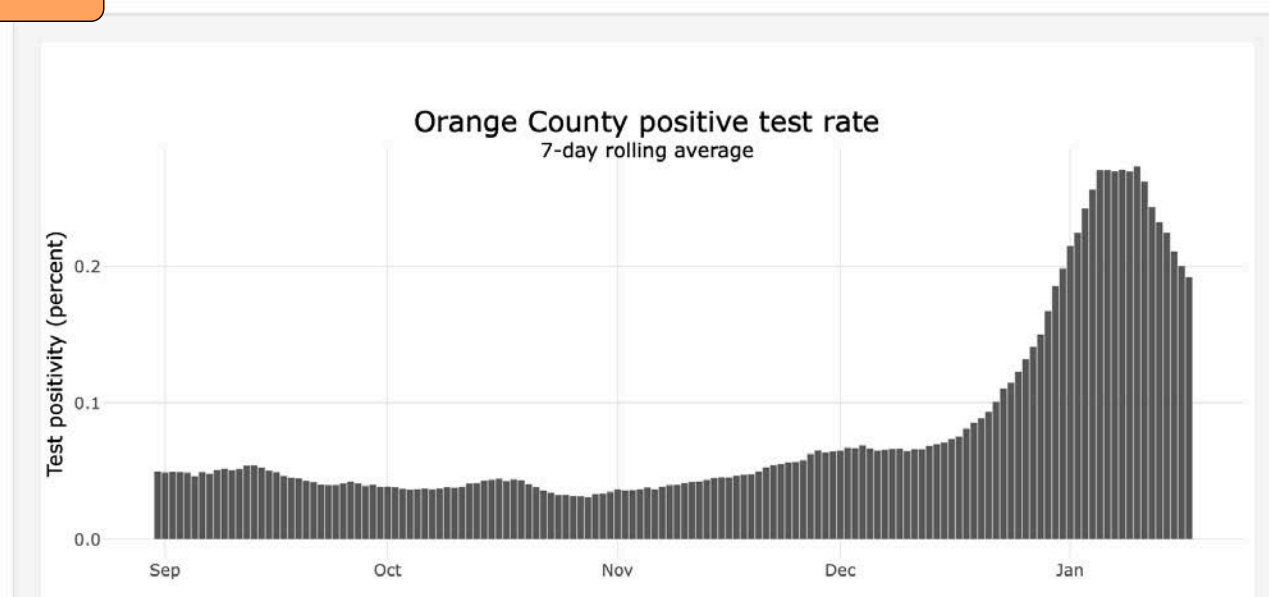
Test positivity

Switch the case plots between new cases, active cases, and positivity.

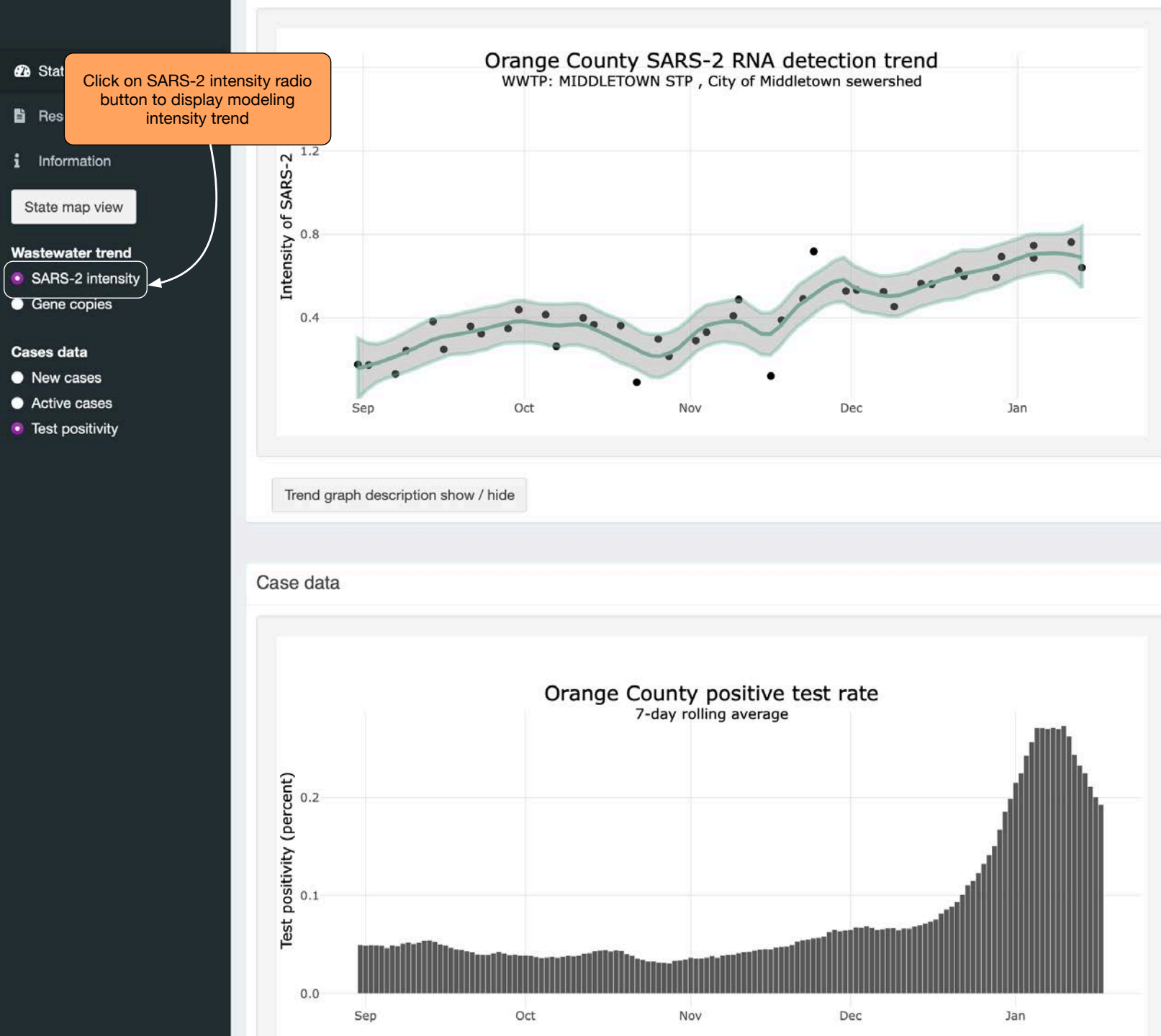


Middleton collection point

- Comparing gene copies to test positivity



Click on test positivity radio button to change the case data trend



Intensity model:

- Normalized gene copy data, to account for upstream population
- Higher values are higher loads, potentially higher transmission
- Log adjustment dampens the peaks

Click the state map view button to start looking at another county

State map view

Wastewater trend

● SARS-2 intensity

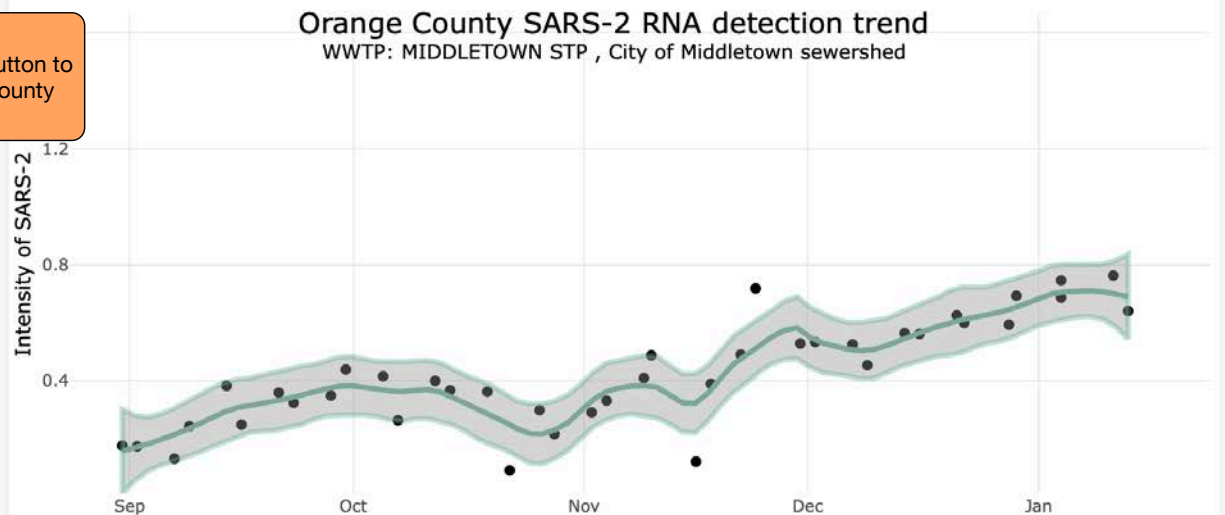
● Gene copies

Cases data

● New cases

● Active cases

● Test positivity



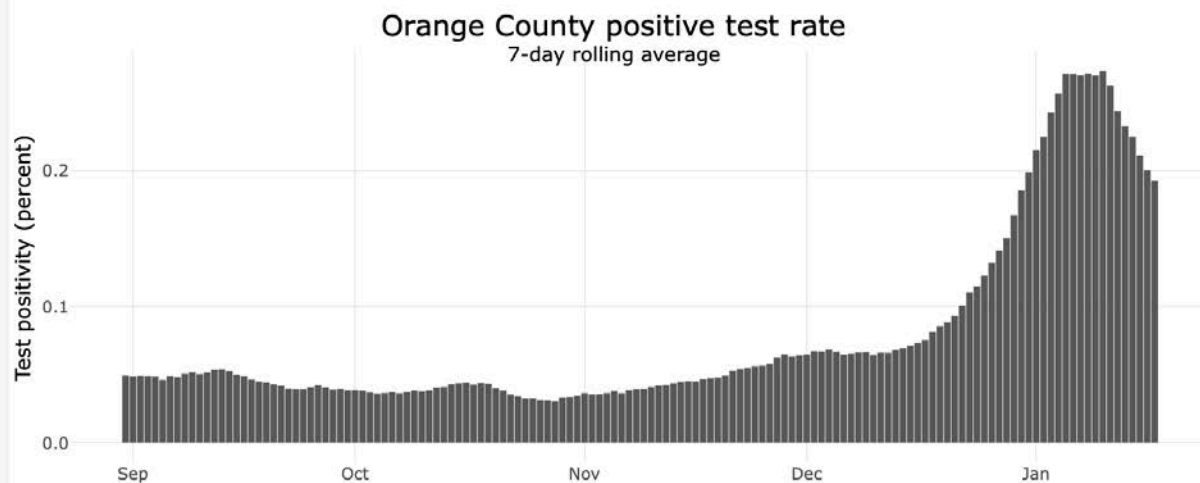
Trend graph description show / hide

Start over by clicking on the “state map view” button!

Link:

https://mbcolli.shinyapps.io/SARS2EWSP/?_ga=2.69659536.1244882177.1640180383-1272141875.1640180383

Case data





Thank you!

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