

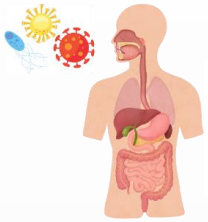
MISSOURI DEPARTMENT OF
HEALTH &
SENIOR SERVICES

Missouri Wastewater Surveillance

Bi-state Infectious Disease Conference
Oct 9, 2026

Chenhui Li, Epidemiologist
Wastewater Surveillance Program

Wastewater Surveillance



Excretion of pathogen fragments and human metabolic product



Transport to wastewater treatment plant



Lab testing



Data analysis and Reports



- Community/Population-Level insight
- Continuous and passive contribution-no active participation required.
- Early Detection & Trend Monitoring
- Objective & Unbiased Measurement
- Cost-Effective & Scalable
- Multi-Use Public Health Platform

Missouri Wastewater Program: A Statewide Partnership



1. Wastewater Operators and Local Public Health Departments collect samples.

Mizzou
University of Missouri

2. University of Missouri–Columbia conducts the laboratory testing.

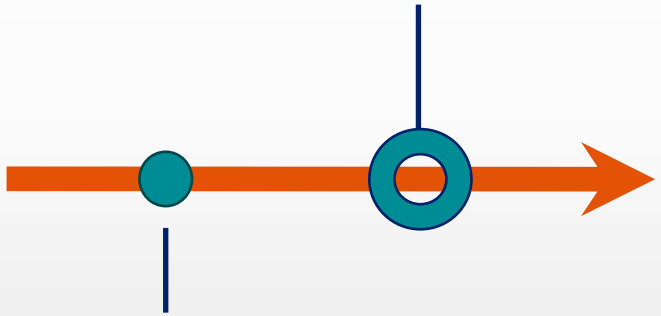
MISSOURI DEPARTMENT OF HEALTH & SENIOR SERVICES

3. DHSS administers project funding and conducts data analysis to inform public health strategy.

Project Timeline: From Pilot to Statewide Surveillance

1. Planning & Launch

Pilot study begins at 9 sites
(7 St. Louis and 2 Springfield facilities)
May 2020



April 2020
First studies appear
MO-Pilot study began with a phone call from DNR

COVID19 Pandemic– April 2020

- Partners
- Advantages
- Logistics
- Funding
- Data
- Public Health Actions

Wastewater testing gains traction as a Covid-19 early warning system

By SHARON BEGLEY @sxbegle / MAY 28, 2020 Reprints



NEWS · 03 APRIL 2020 · CORRECTION 03 APRIL 2020

How sewage could reveal true scale of coronavirus outbreak

Wastewater testing could also be used as an early-warning sign if the virus returns.

Poop could be the key to tracking COVID-19 outbreaks

Searching wastewater for the coronavirus is fast, cheap, and anonymous.

Kate Baggaley | Updated: April 27, 2020



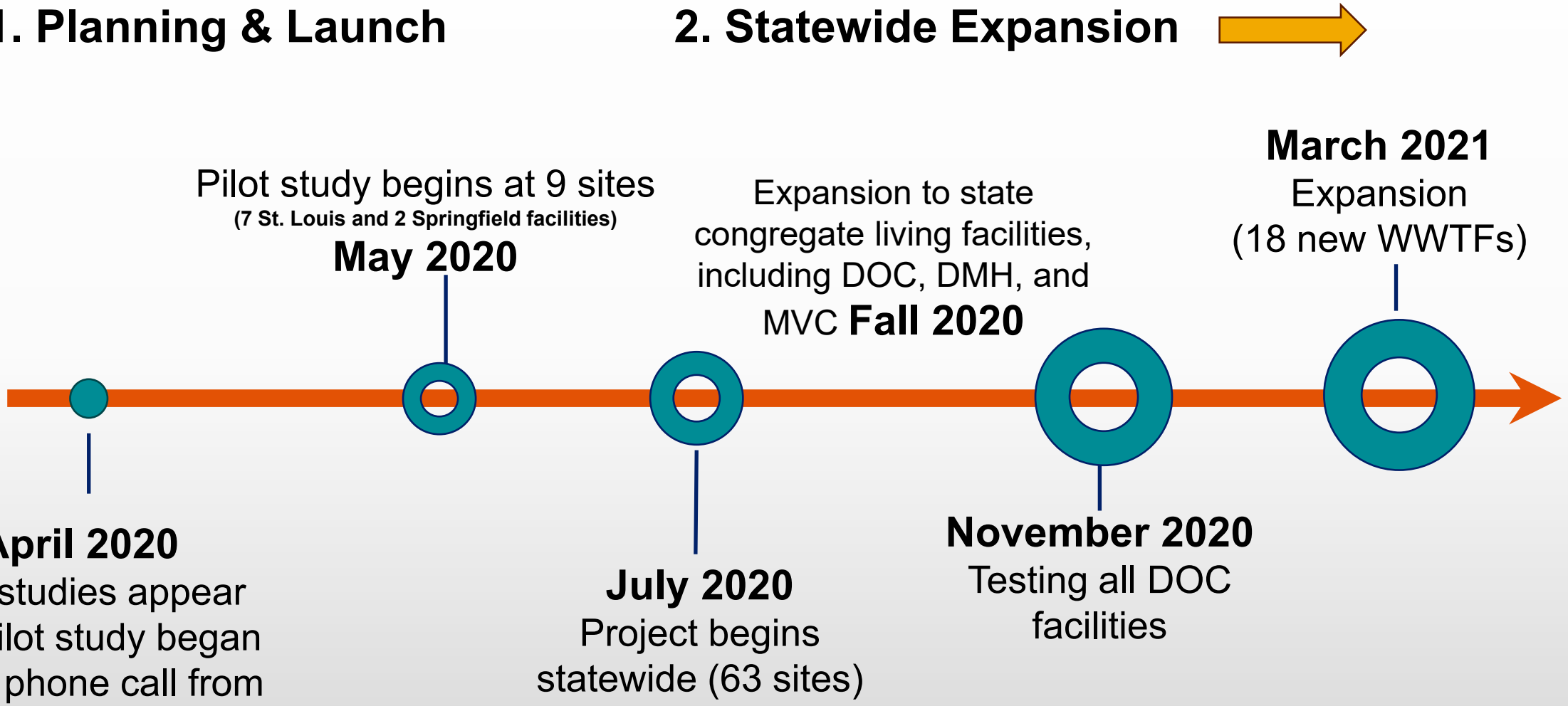
An early warning system for coronavirus infections could be found in your toilet

From the U.S. to Europe to Australia, scientists have detected the virus in wastewater ahead of spikes in local cases

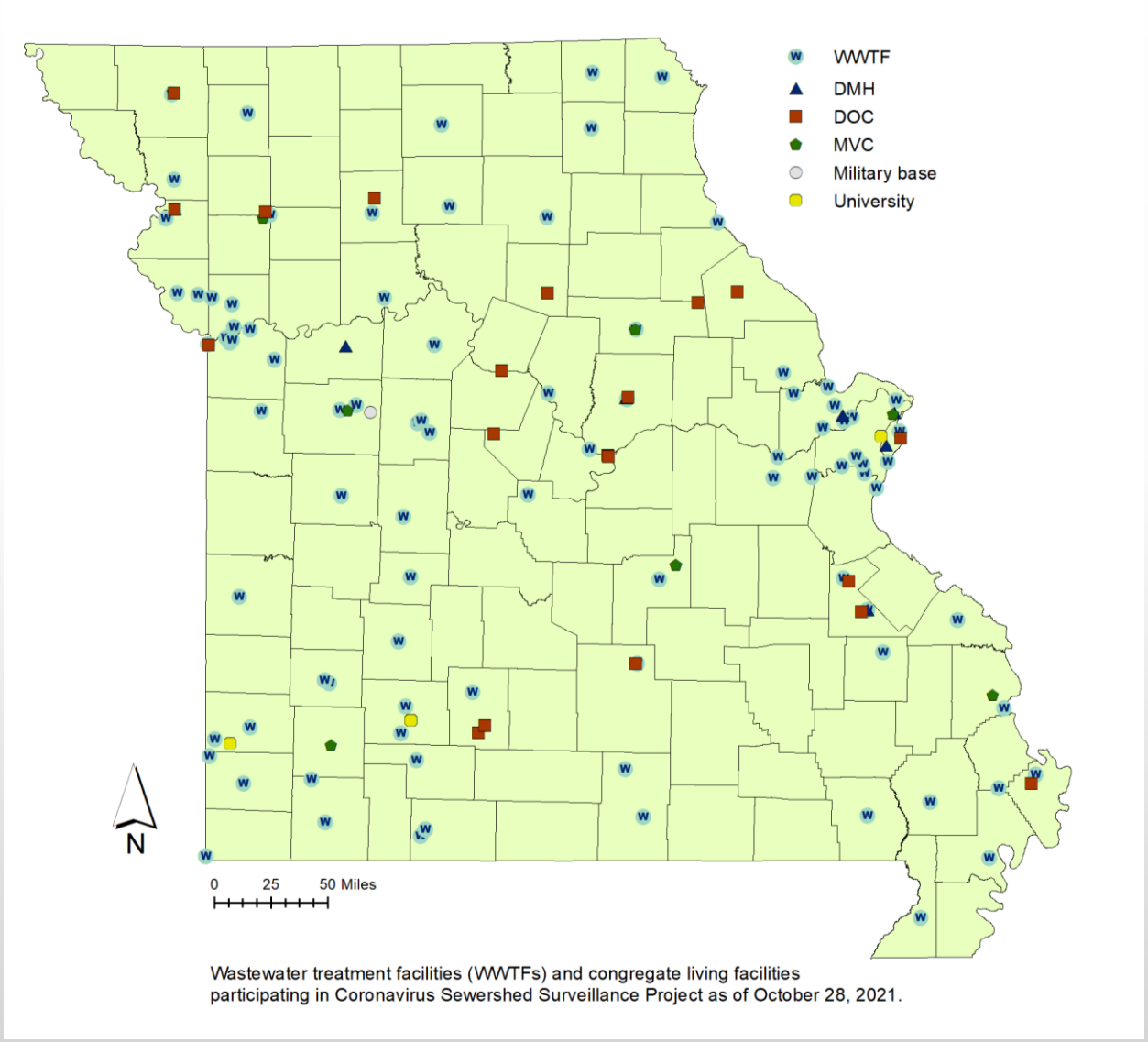
Project Timeline: From Pilot to Statewide Surveillance

1. Planning & Launch

2. Statewide Expansion



2 – Statewide Expansion Map

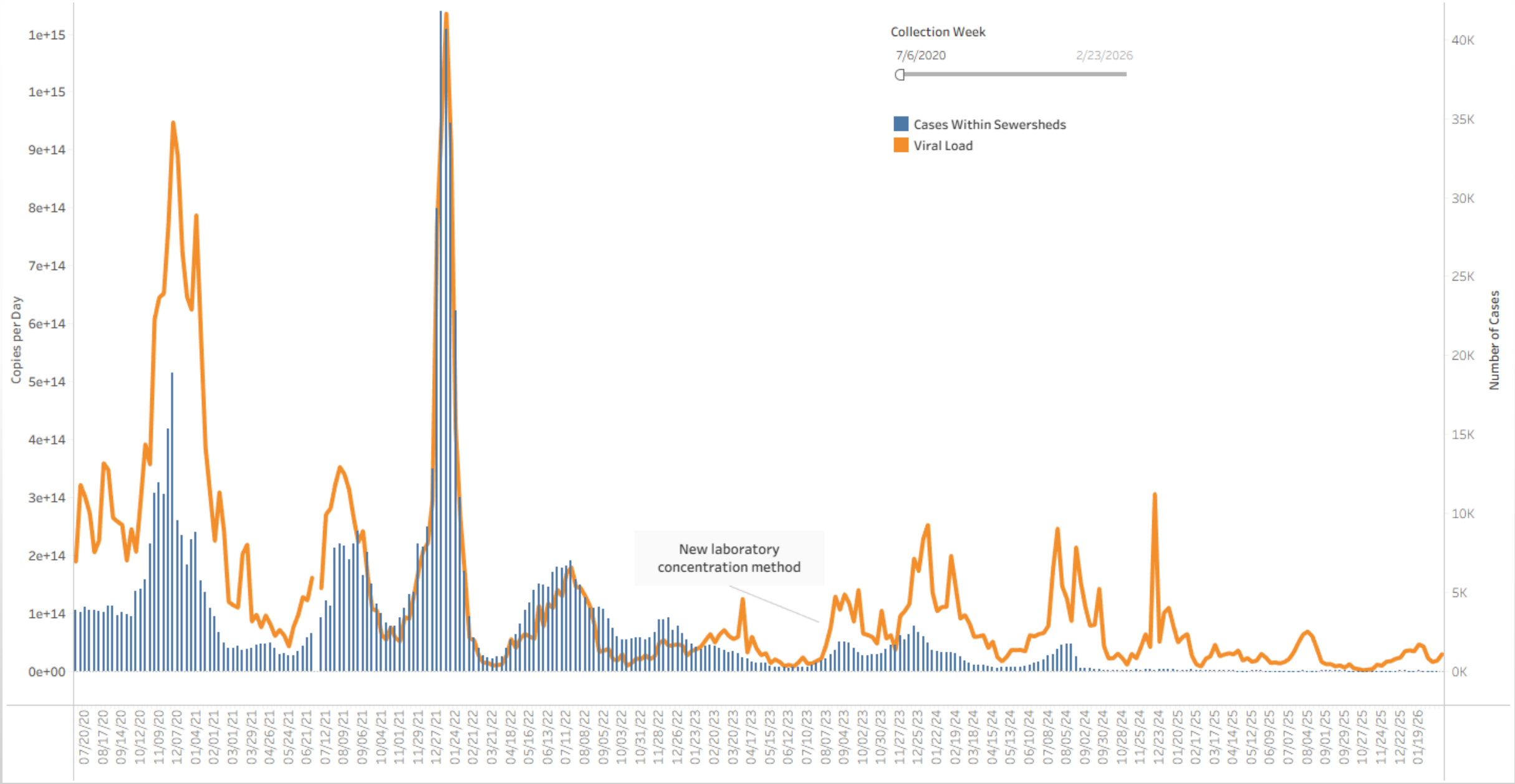


Wastewater treatment facilities (WWTFs) and congregate living facilities participating in Coronavirus Sewershed Surveillance Project as of October 28, 2021.

Once per week: 105 communities
~ 60% of population

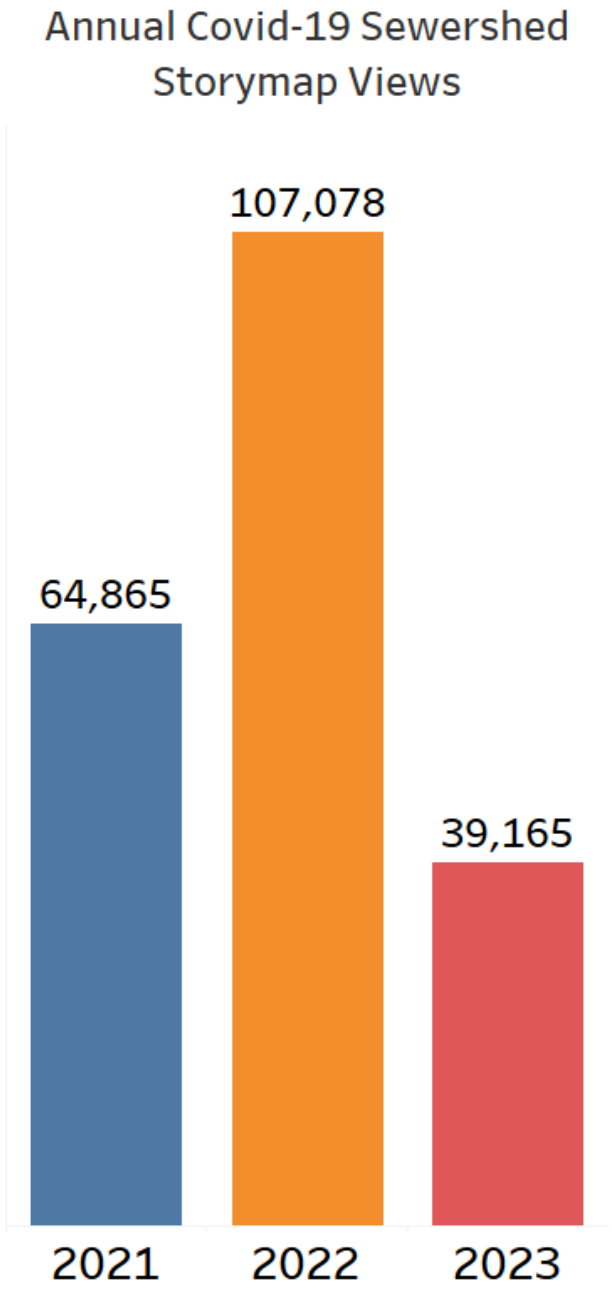
Twice per week: 36 state facilities –
20 prisons,
7 veterans homes
8 mental health facilities
6 colleges during the school year.

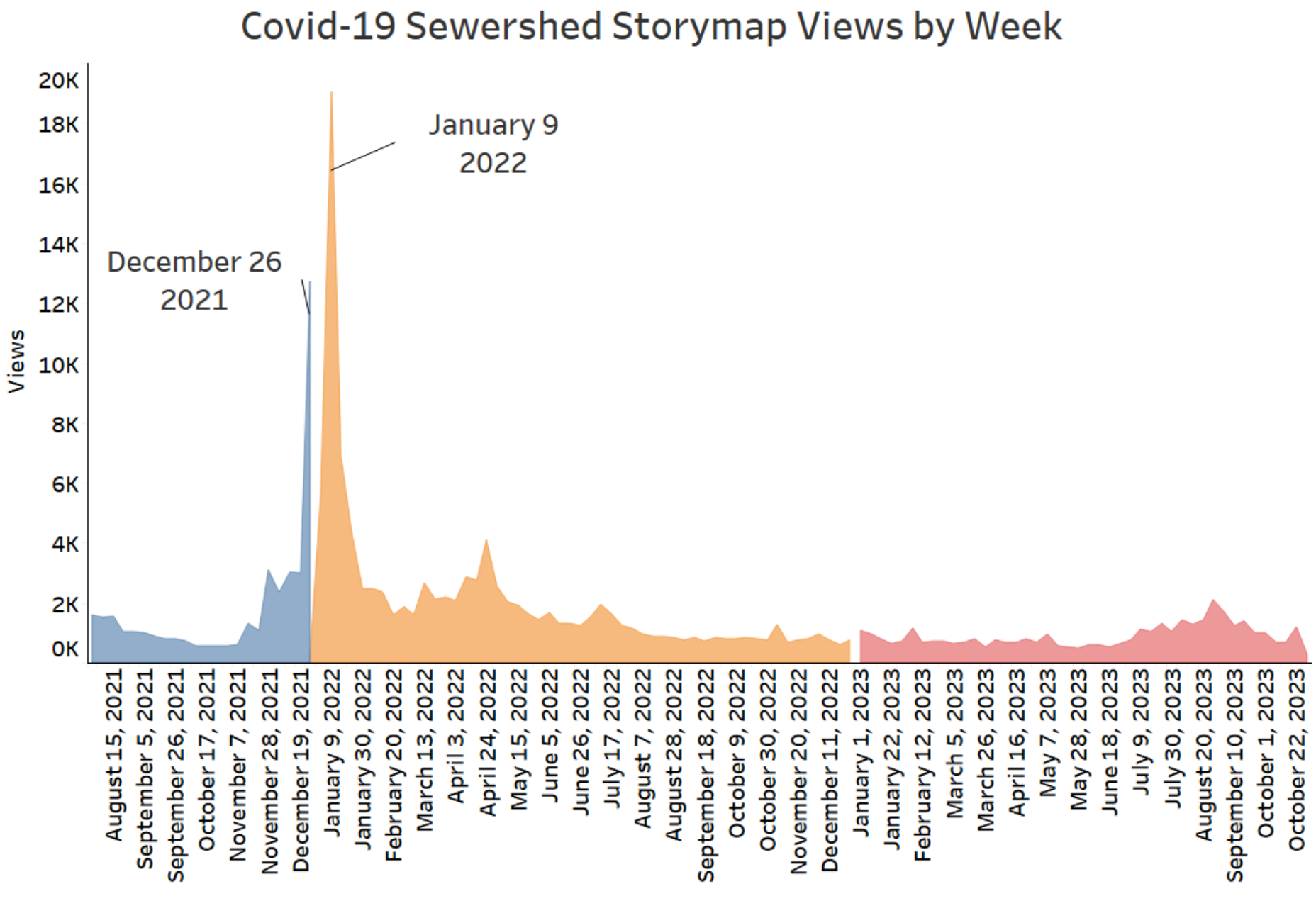
COVID-19 Clinical Cases and Wastewater Viral Load, Missouri



Sewershed Surveillance Storymap




Annual Covid-19 Sewershed Storymap Views
107,078
64,865
39,165
2021
2022
2023


Covid-19 Sewershed Storymap Views by Week
Views
20K
18K
16K
14K
12K
10K
8K
6K
4K
2K
0K
January 9
2022
December 26
2021
August 15, 2021
September 5, 2021
September 26, 2021
October 17, 2021
November 7, 2021
November 28, 2021
December 19, 2021
January 9, 2022
January 30, 2022
February 20, 2022
March 13, 2022
April 3, 2022
April 24, 2022
May 15, 2022
June 5, 2022
June 26, 2022
July 17, 2022
August 7, 2022
August 28, 2022
September 18, 2022
October 9, 2022
October 30, 2022
November 20, 2022
December 11, 2022
January 1, 2023
January 22, 2023
February 12, 2023
March 5, 2023
March 26, 2023
April 16, 2023
May 7, 2023
May 28, 2023
June 18, 2023
July 9, 2023
July 30, 2023
August 20, 2023
September 10, 2023
October 1, 2023
October 22, 2023

2021 Governor's Award

Pinnacle Award

The Missouri Coronavirus Sewershed Surveillance Project

Department of Natural Resources and Department of Health and Senior Services

In conjunction with:

Department of Corrections, Department of Mental Health,
Department of Public Safety/MVC, and the University of Missouri



Building the Science Behind Wastewater Surveillance

Suppression of Wastewater Signals

- Compounds such as detergents and surfactants in wastewater suppressed the wastewater signals.

Normalization

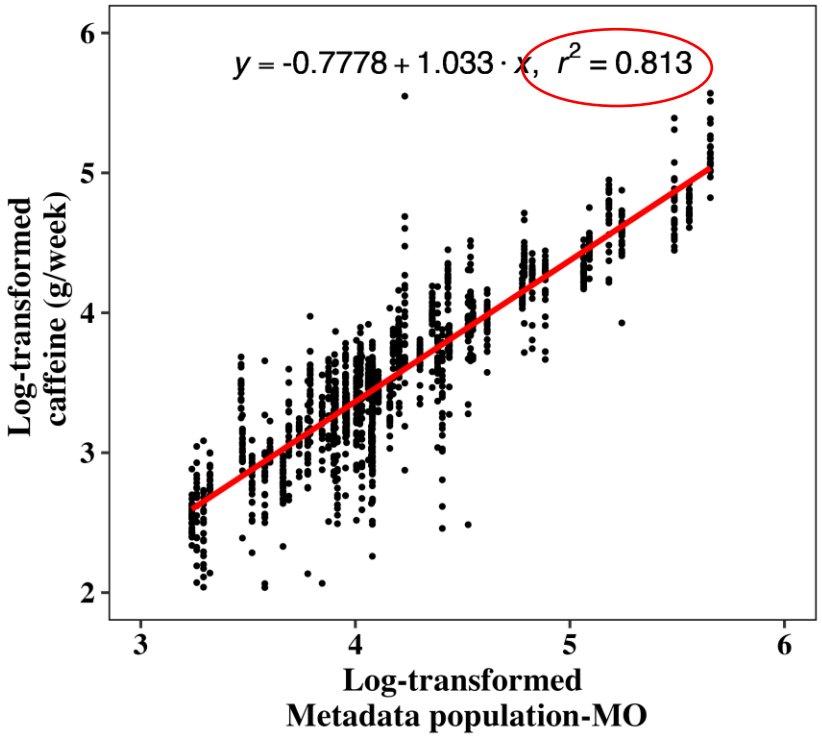
- Accounting for differences in wastewater conditions and population contribution.

Population Biomarkers

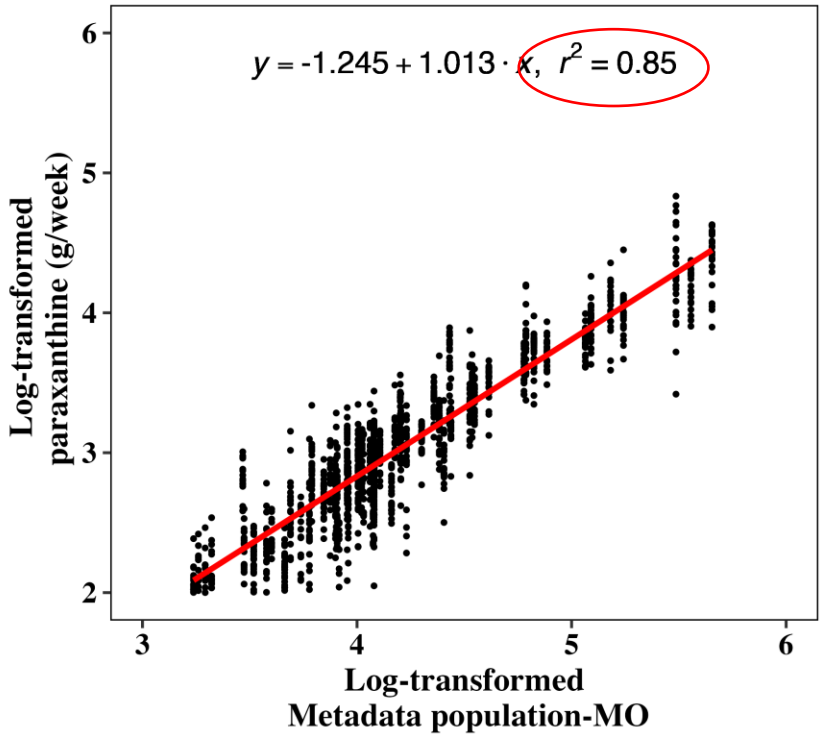
- Exploring caffeine/paraxanthine to better understand the population contributing to a sewershed

Caffeine and Paraxanthine are better biomarkers than PMMoV for assessing population contributing wastewater

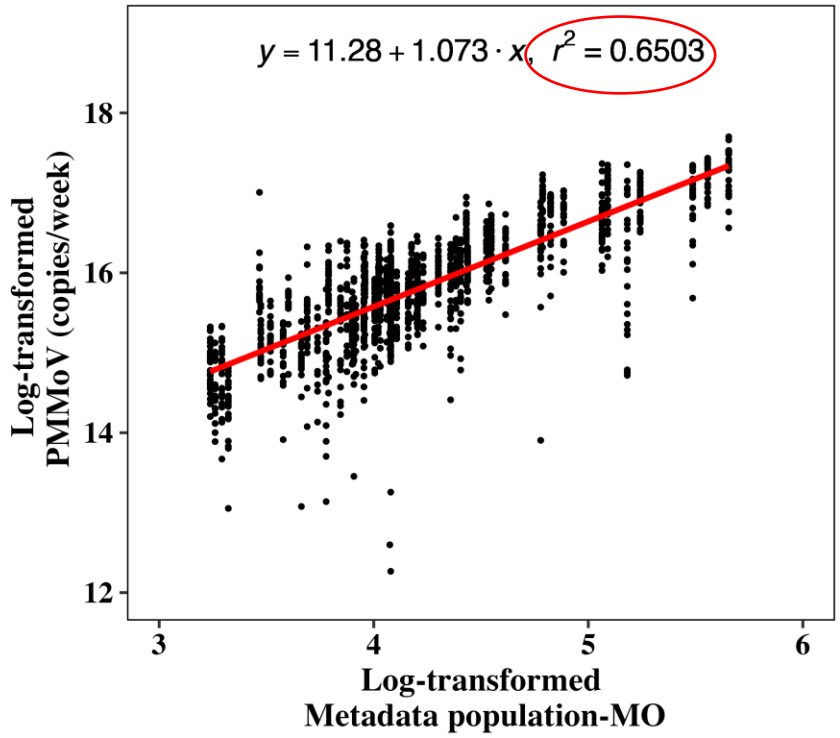
Caffeine



Paraxanthine (Caffeine metabolite)



PMMoV

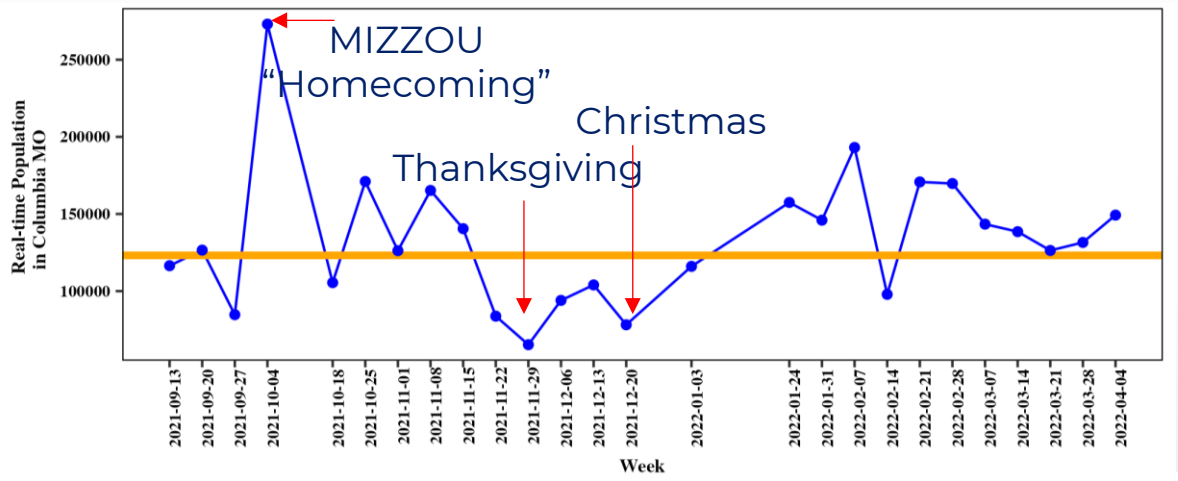


Weekly results from the 64 WWTPs across MO for over 7 months (1540 data points)

Estimation of real-time population using biomarker paraxanthine (caffeine metabolite)

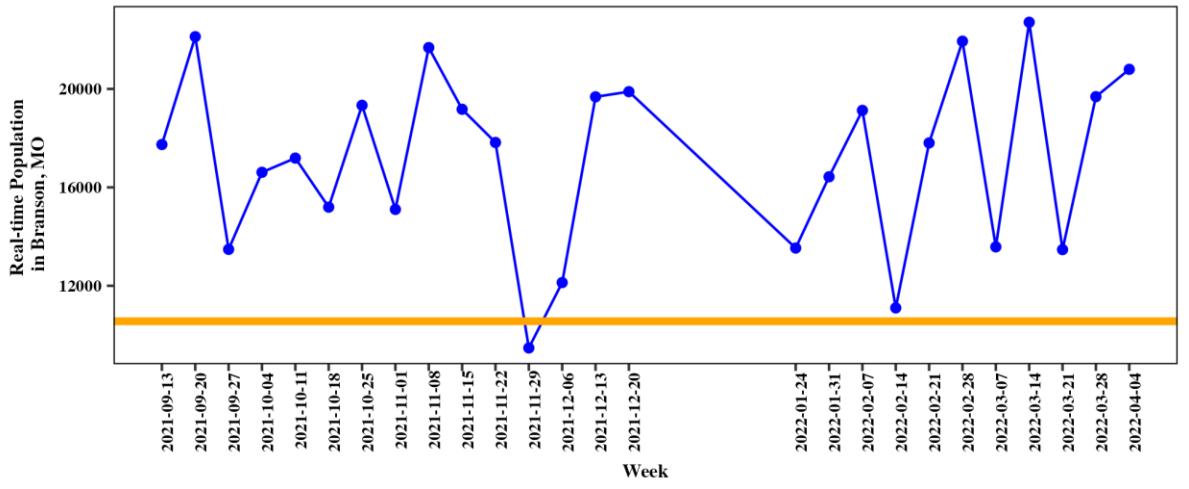
Columbia, MO- college town

- Real-time Population fluctuates along with the school semesters



Branson, MO- tourist town

- Real-time population is higher than the census population for most of the time

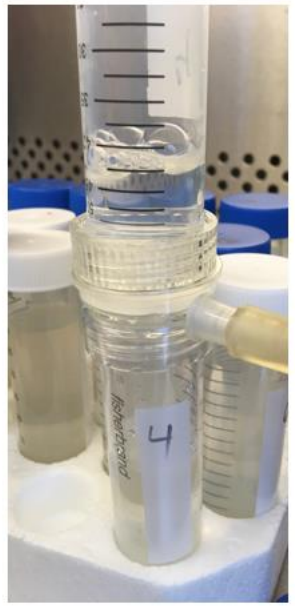






Testing Methods-Constantly Improving

Filter



0.22 µm pore size, polyethersulfone membrane, 12% PEG 8,000.

Matrix Spike and Spin



Spike with lentivirus with engineered RNA genome. Spin 2 hr.

Extract



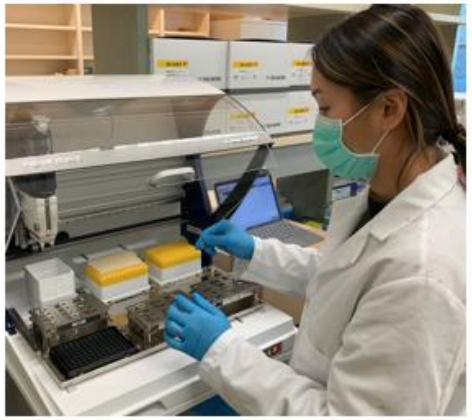
QIAamp viral RNA extraction, designed for low RNA samples.

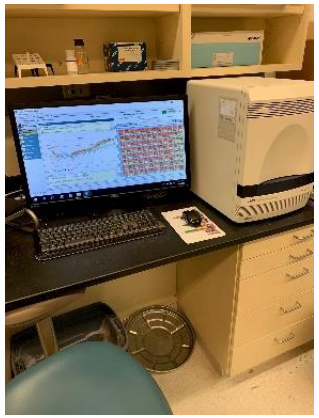
August 2023



Kingfisher high throughput extraction utilizing Ceres beads.

qPCR

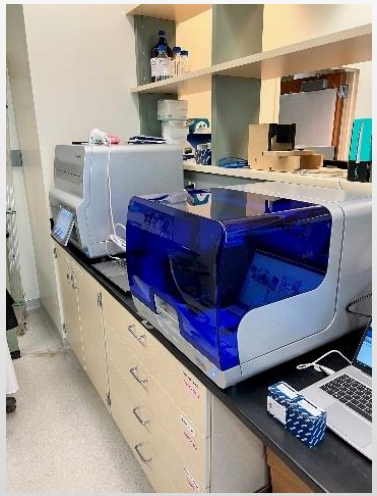




Applied Biosystems 7500 fast. CDC N1 and N2 probes, multiplexed with matrix control probes. Standard curve on every plate.

March 2023

dPCR

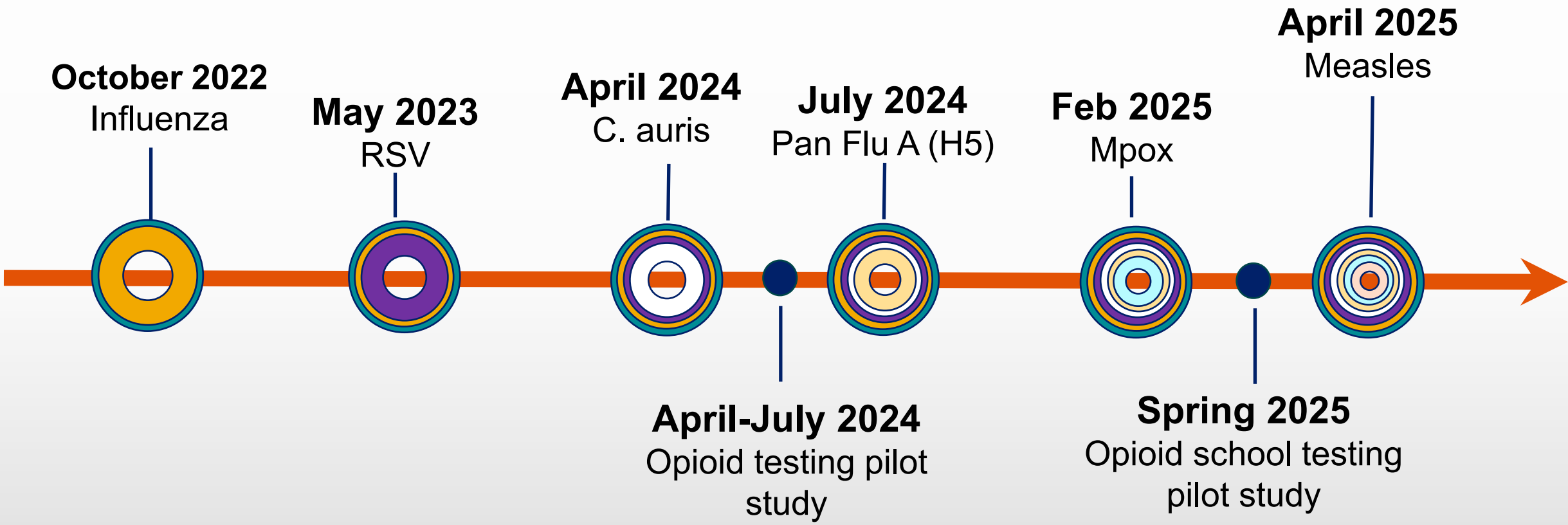




Qiagen QIAcuity Four Platform "Digital PCR" System (Left)
Applied Biosystems QuantStudio Absolute Q Digital PCR System (Right)

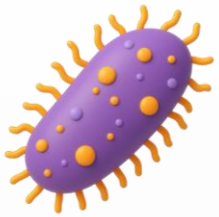
Project Timeline

3. Beyond SARS-CoV-2



Wastewater Surveillance

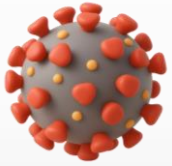
RSV



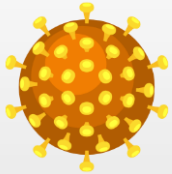
Influenza



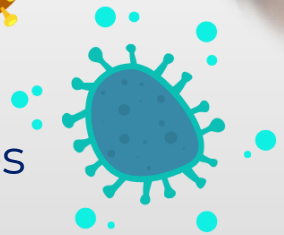
SARS-CoV-2



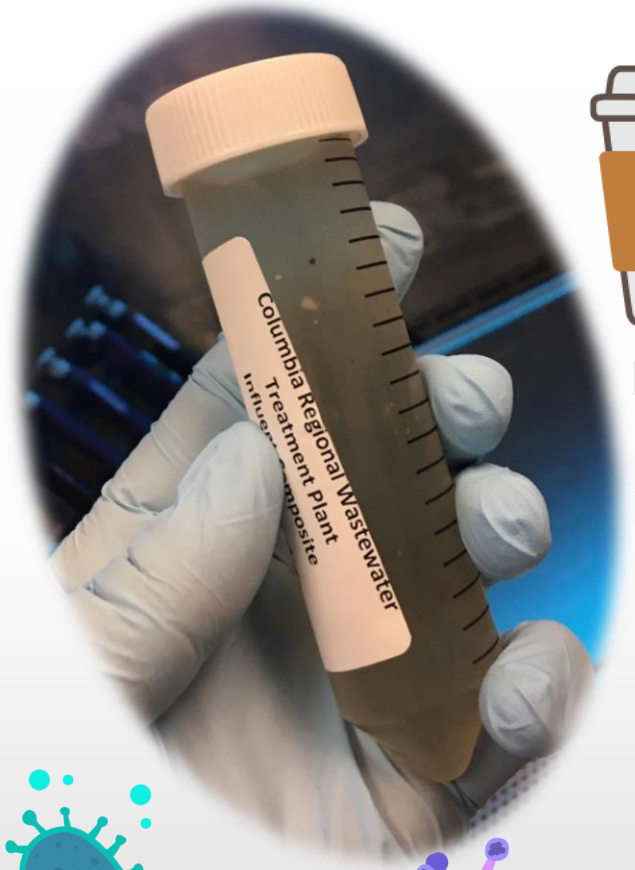
Mpox



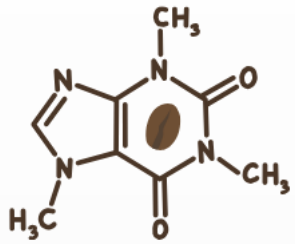
Measles



C. auris







Population biomarkers



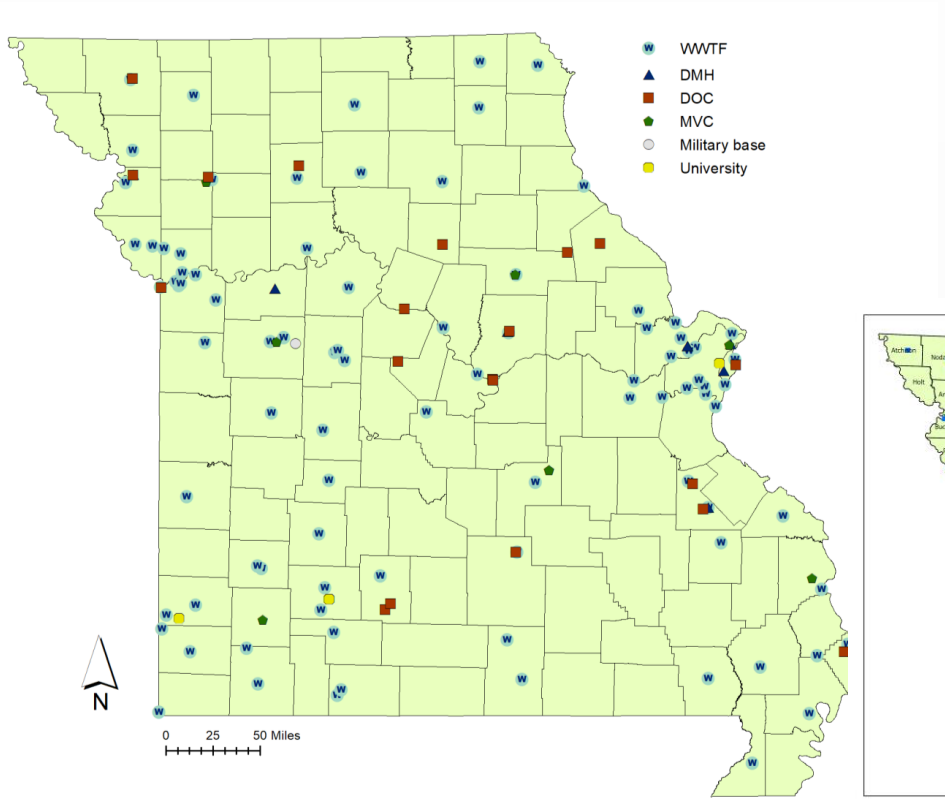
Illicit drugs
Stimulates

Virus/Bacteria/Fungi

Chemicals

Project Timeline

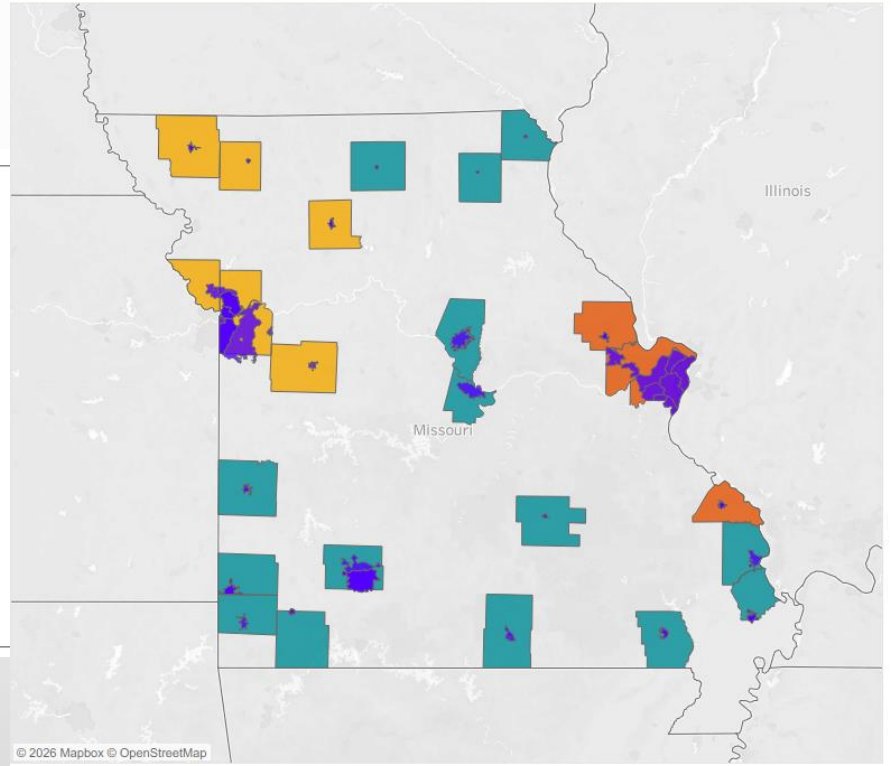
4. Downsizing



Wastewater treatment facilities (WWTFs) and congregate living facilities participating in Coronavirus Sewershed Surveillance Project as of October 28, 2021.



Current Sewersheds and Counties
40 Facilities Cover 49% of the Missouri Population

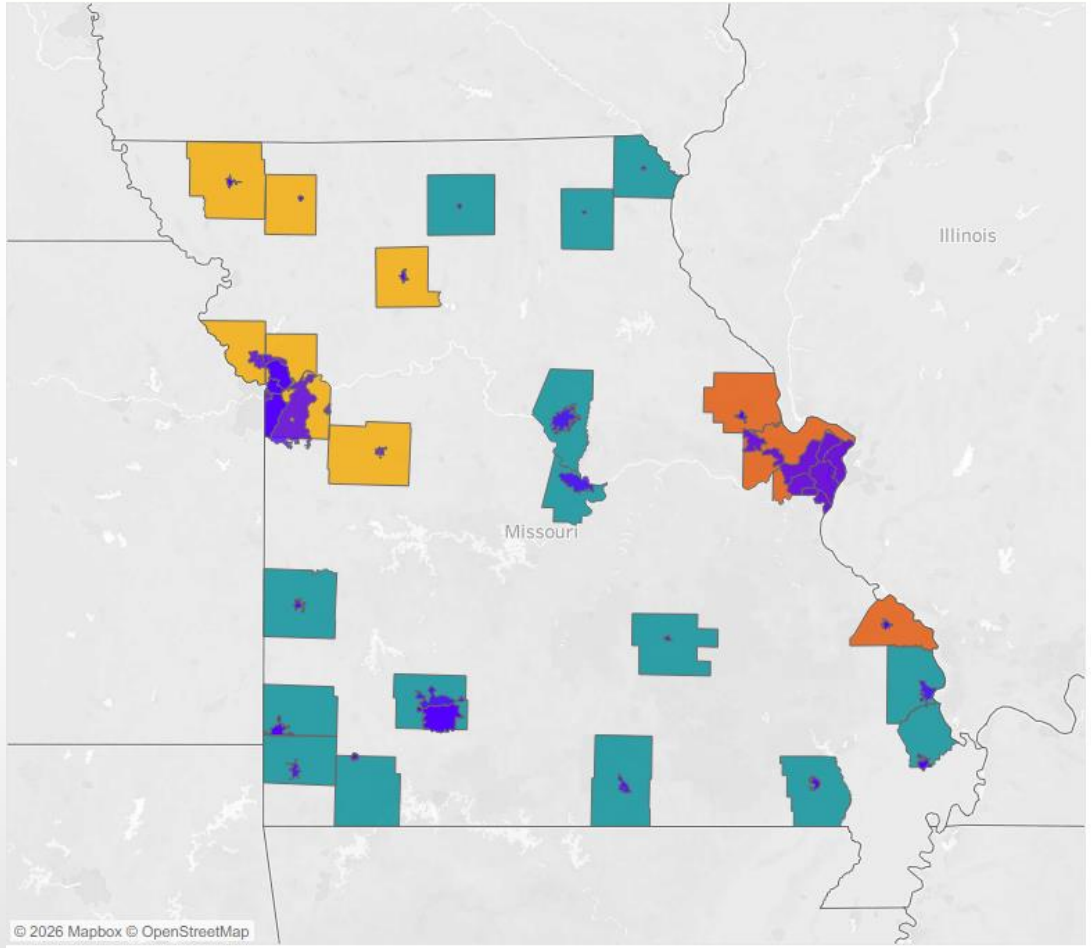


Three Regions
- Eastern
- Northwest
- Outstate

Home Page

Current Sampling Sites and Analyses

Current Sewersheds and Counties
40 Facilities Cover 49% of the Missouri Population



- **Influent**
- **24 hr composite**
- **Weekly/bi-weekly**

Home Page

Targets:

- All sites:
  - SARS-CoV-2
  - Influenza
  - RSV
- Select sites:
  - C. Auris
  - Mpox
  - Measles

2020	2021	2022	2023	2024	2025	Start from 11/1/2025
2112 Samples 9-92 sites ~59% population 36 state facilities	7555 Samples ~105 sites ~60% population 36 state facilities	6549 Samples ~103 sites ~60% population 36 state facilities	4801 Samples ~90 sites ~59% population 1 state facilities	4291 Samples ~84 sites ~58% population 1 University	3827 Samples ~85 sites ~58% population 1 University 1 Hospital	~40 sites ~49% population 1 Hospital

Data Sharing

- **Public Dashboard for COVID, Flu, and RSV–**
- https://health.mo.gov/living/environment/wastewater-surveillance/public-wastewater.html
- **Email updates to participating Wastewater Operators, Local Public Health Agencies (LPHAs), and partners for important findings**
- **Raw data for partners**
- **CDC's Wastewater Monitoring Program (NWSS)**

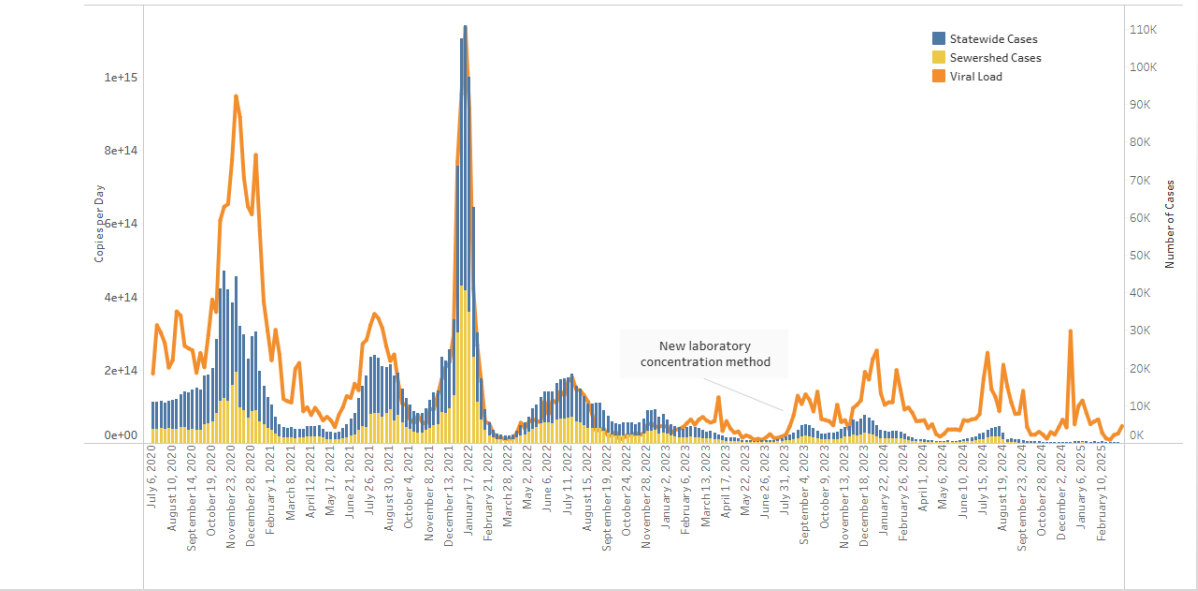
Evolution of Wastewater Data Analysis

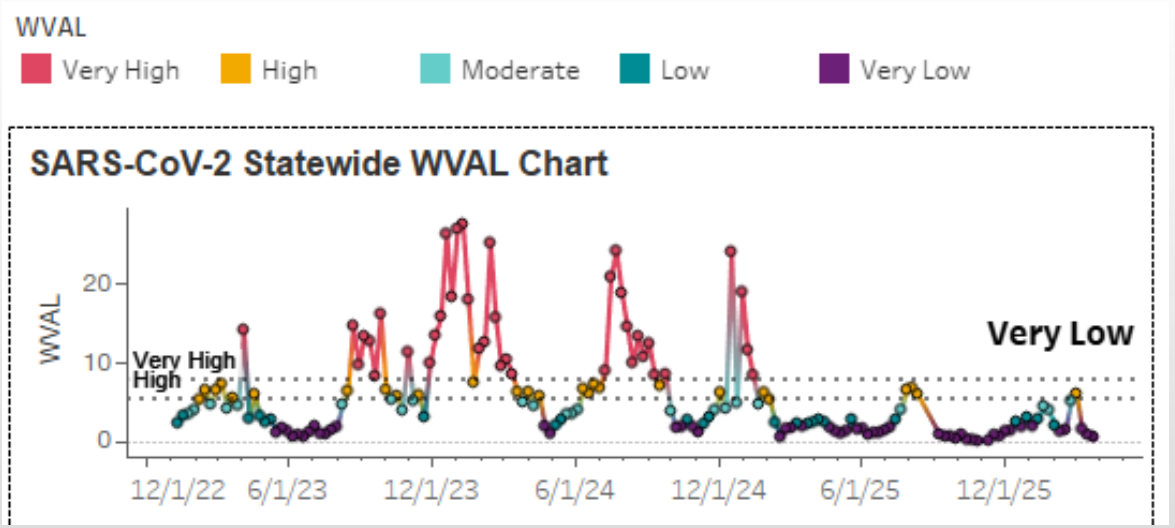
Before-Continuous Trends

- Viral Load
- Difficult to interpret magnitude across time

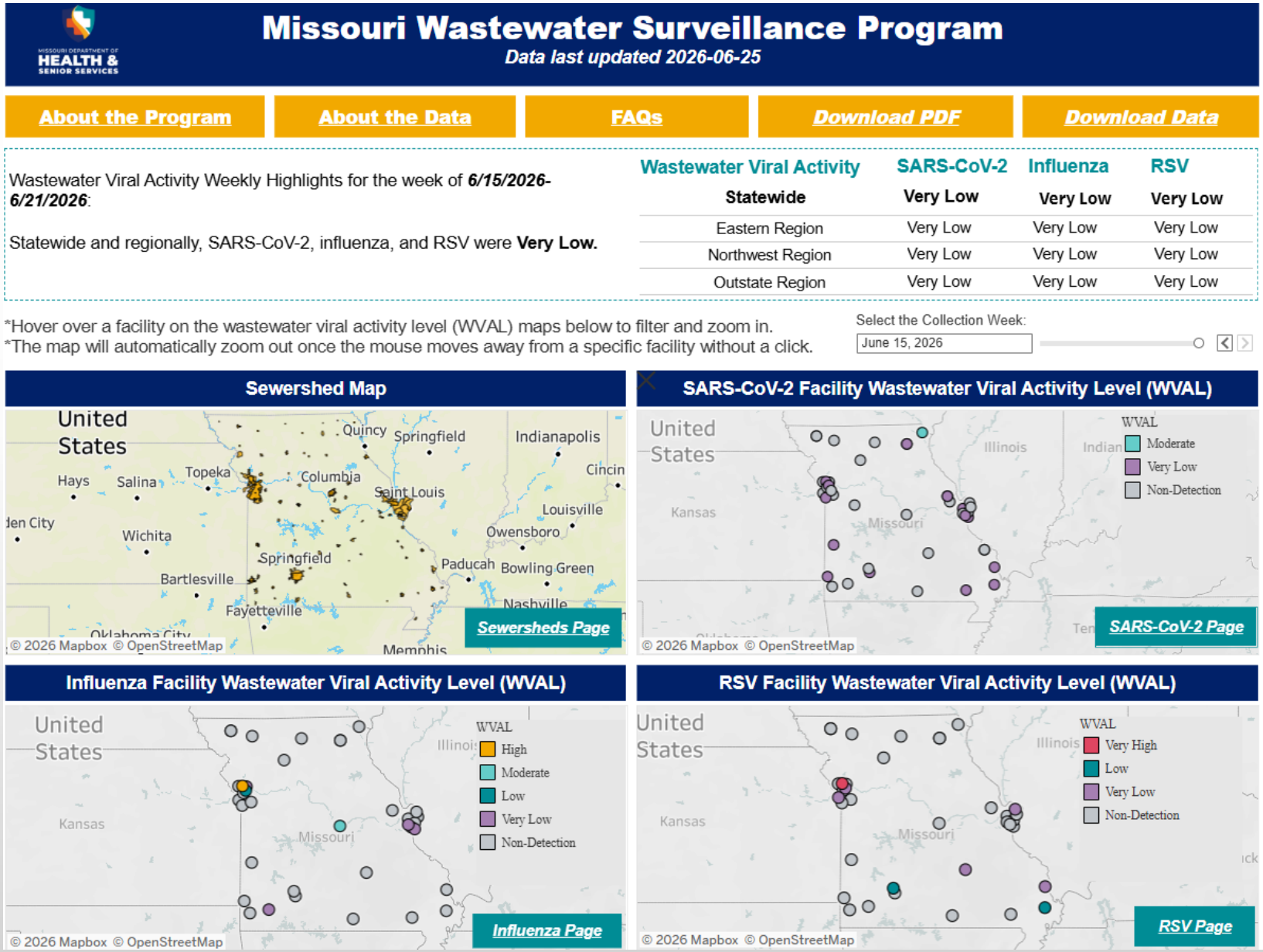
Now-WVAL Categories

- Baseline-adjusted activity
- Very Low→ Very High
- Easier interpretation and communication
- Consistent with CDC





The new dashboard launched in March 2026



3/10-10/1
24686
views

Wastewater Viral Activity	SARS-CoV-2	Influenza	RSV
Statewide	**Very Low**	**Low**	**Very Low**
Eastern Region	Very Low	Low	Very Low
Northwest Region	Low	Low	Very Low
Outstate Region	Very Low	Low	Very Low



SARS-CoV-2 Wastewater Surveillence

Home Page

WVAL

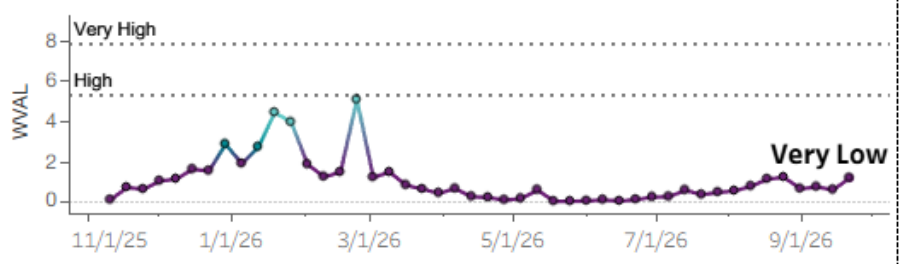
Moderate Low Very Low

Select the Time Range:

Last 12 months

Download PDF

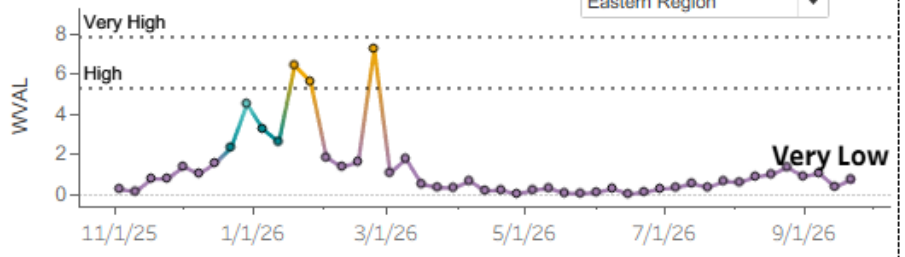
SARS-CoV-2 Statewide WVAL Chart



SARS-CoV-2 Regional WVAL Chart

Select Region:

Eastern Region



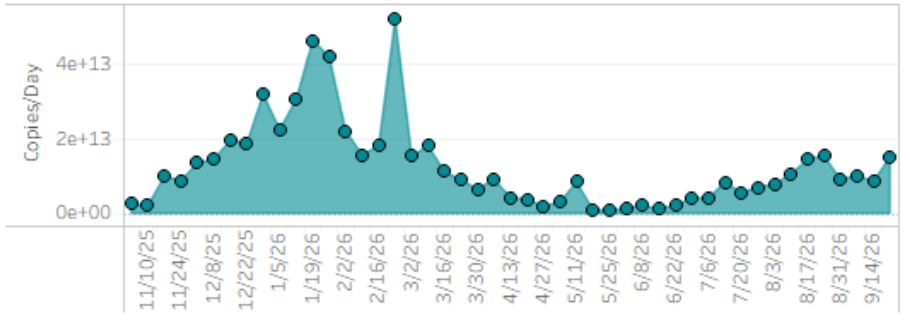
Select County:

(All)

Select Facility:

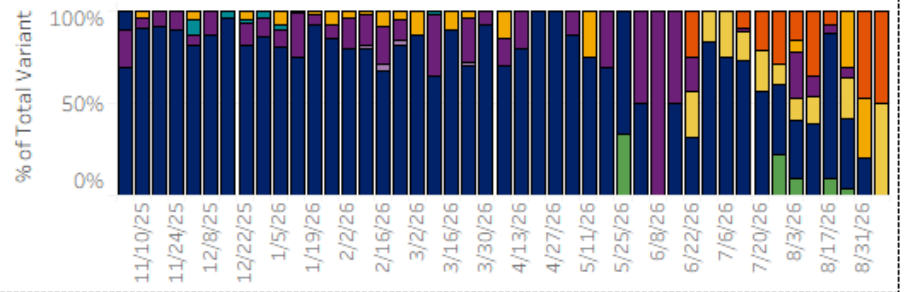
(All)

SARS-CoV-2 Viral Load



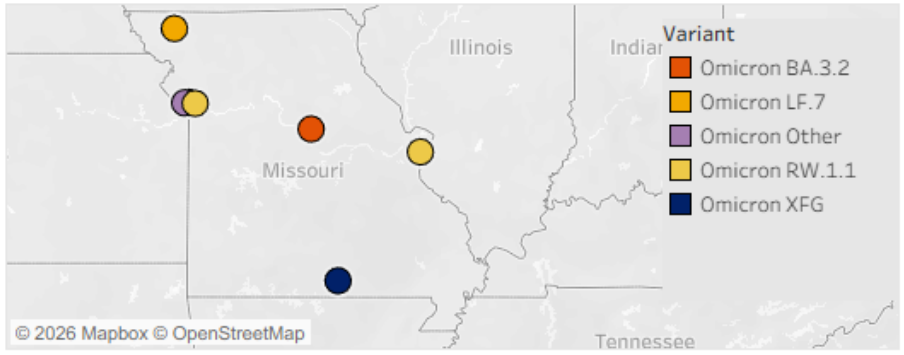
SARS-CoV-2 Variants

*Hover over a specific week to see the name of the variant and the percentage.



Variant Map- September 7, 2026

Select Week: September 7, ...



*Select the time range at the top to view the WVAL charts, viral load, and variants over time.
*Select a region on the Regional WVAL chart to view regional WVAL over time.
*Select the county and facility to view the viral load and variants over time for that facility.
*Select a week to review the variant spatial distribution across the state during that week on the variant map.
*Hover over a facility on the map to view variant information.
*Click on a variant in the legend on the map to view the spatial distribution of that variant.

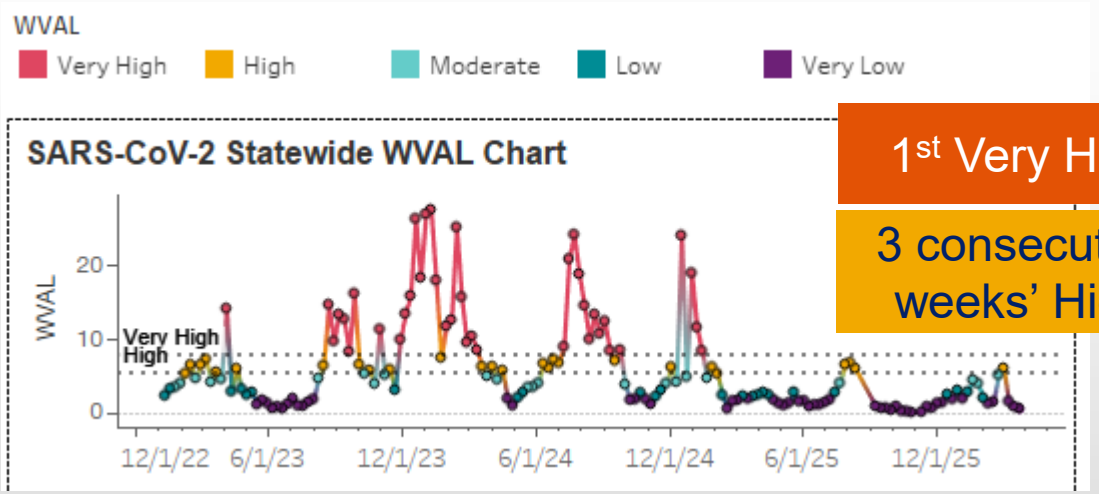
Public Health Action Decision Tree for Wastewater Monitoring of COVID-19, Flu, and RSV

Missouri Wastewater Surveillance Program

Process #1	Process #2	Process #3
DHSS Wastewater Surveillance Program	DHSS Internal Review	DHSS Work with Local Partners.

Monitoring Wastewater Viral Activity (WVAL) across three tiers:

- ❑ Statewide
  - ❑ Three Regions
    - ❑ Facility-level



1st Very High

3 consecutive weeks' High

A new highly contagious COVID-19 variant, or Flu/RSV subtypes

Work with internal partners, including BCDCP and the State Epidemiologist, to review human surveillance and wastewater data:

- Are clinical cases of during also increased?
- Consider if sequencing is needed
- Consider if a broader area needs to be repeated.
- Consider recommendations for public health actions.

Work with internal partners including BCDCP to notify:

1. LHPAs and WWTP in affected sewershed(s) with recommendations for public health actions.
2. The public via LPHA or press release.

*Period of interest as established by the epidemiologist

Abbreviations:
LPHA=Local Public Health Agency
BCDCP=DHSS Bureau of Communicable Disease Control and Prevention,
WWTP=Wastewater Treatment Plant

World Cup Surveillance



- **2026 FIFA Kansas City Matches: June 16, June 20, June 25, June 27, July 3, and July 11, 2026.**
- **2026 FIFA Fan Festival™ Kansas City: June 11th-July 11th, 2026.**
- **8 Wastewater Treatment Plants in the Kansas City area**

❑ **Sample Collection Strategy:**

Baseline	FIFA World Cup	Post Event
7 weeks (4/20/26-6/7/26)	5 weeks (6/8/26-7/12/26)	4 weeks (7/13/26-8/6/26)

❑ **Routine During the FIFA World Cup:**

WWTFs (24hr)	MU labs (<48hr)	DHSS WSP (2hr)	DHSS
Composite Sample Collection twice/week	Pathogen /Drug Testing	Data Analysis & Internal Dashboard	Situation Report (SitRep)

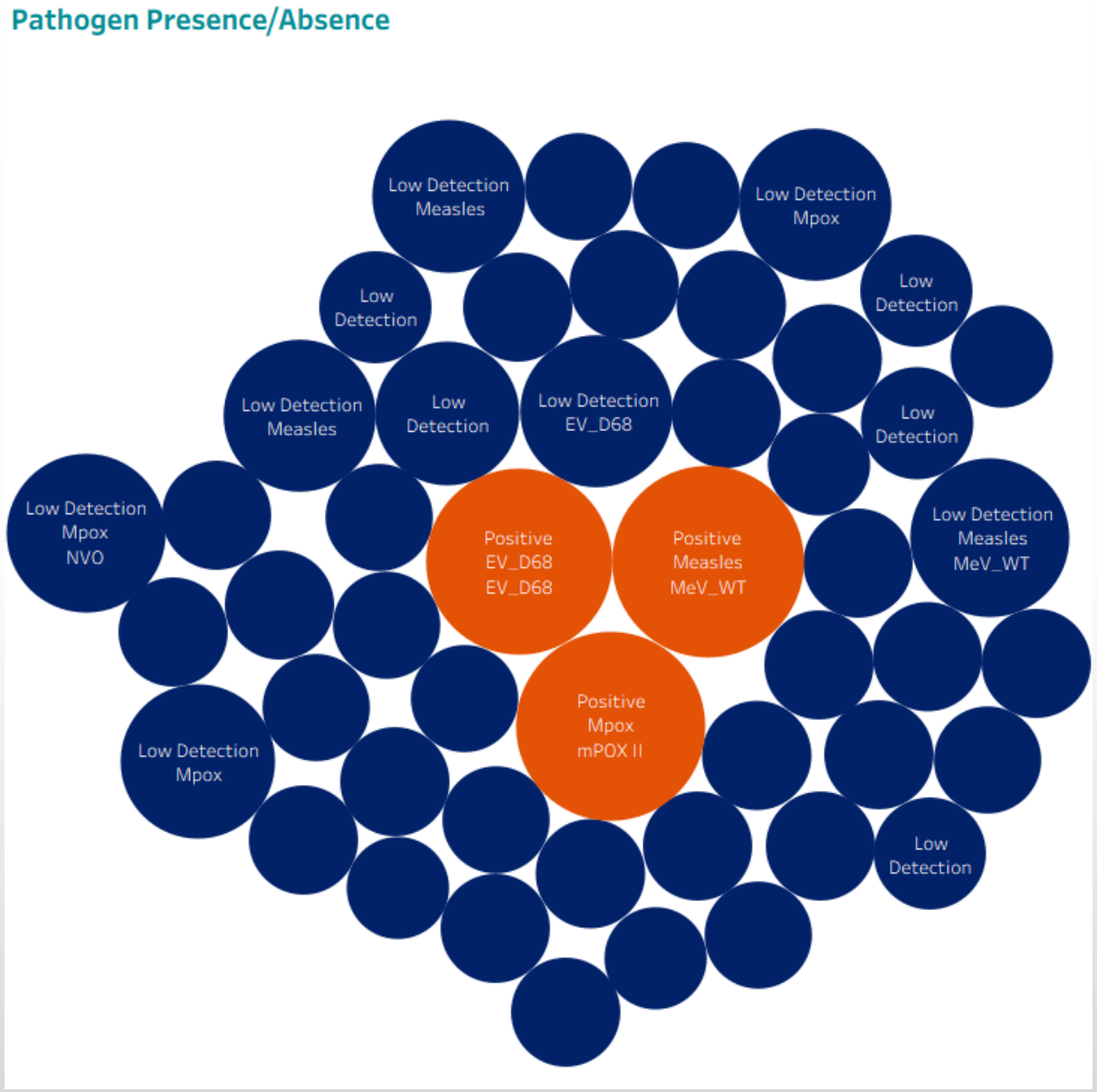
❑ Pathogen Surveillance:

- Respiratory
  - ➢ COVID-19,
  - ➢ Influenza A (Pan A, H1N1, H3N2, and H5)
  - ➢ Influenza B
  - ➢ RSV A, RSV B
  - ➢ MERS
- Enteric
  - ➢ Norovirus
  - ➢ Hepatitis A
  - ➢ Enteroviruses (EVD68)
- Other Emerging/High-Priority pathogens
  - ➢ Measles
  - ➢ Mpox
  - ➢ C. auris

❑ Drug Surveillance:

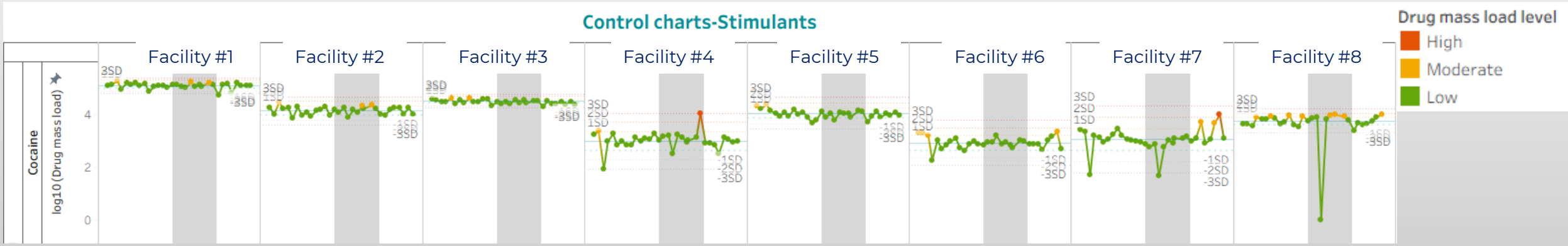
- Opioids
  - ➢ 4 Brorphine-related opioids & metabolites
  - ➢ 4 Fentanyl-related opioids & metabolites
  - ➢ 4 Nitazene-related opioids & metabolites
  - ➢ 2 Opioid-related medications
  - ➢ Heroin & metabolite
  - ➢ Hydrocodone
- Sedative
  - ➢ Xylazine & metabolite
- Stimulants
  - ➢ Cocaine & metabolite
  - ➢ Methamphetamine
- Mitragynine (Kratom)
  - ➢ Mitragynine & metabolites
- Tobacco
  - ➢ Cotinine (Nicotine's metabolite)

- **Pathogen surveillance showed generally low activity across the Kansas City World Cup region during the monitoring period.**
  - SARS-CoV-2 remained at Low levels regionally, with only two Moderate facility-level incidences observed.
  - Influenza showed more variability, including two regional High incidences and 13 Moderate incidences.
  - RSV and other monitored pathogens remained generally low or were detected infrequently.



Drug Surveillance did not indicate a broad, region-wide increase in the monitored drugs during the World Cup period.

- Mostly **facility-specific trends**, with some nearby sites showing **late-period increases**.
- These increases occurred **near the end of the World Cup monitoring period**; wastewater data **cannot confirm** whether they were linked to World Cup activity.
- **Opioid and other high-risk substances** were rarely detected, with **no consistent presence** across facilities.
- **No region-wide increase** in monitored drugs was observed, though **localized changes** warrant continued monitoring.



World Cup Lessons Learned

- Wastewater surveillance provided near real-time situational awareness during the FIFA World Cup.
- Existing statewide wastewater surveillance systems were successfully leveraged for enhanced event monitoring.
- Daily World Cup SitReps improved cross-program communication and situational awareness.
- Monitoring multiple pathogens and drugs from a single sample provided broad public health situational awareness.
- The framework developed for the World Cup can be applied to future mass gatherings and public health emergencies.

Measles Wastewater Surveillance Decision Tree

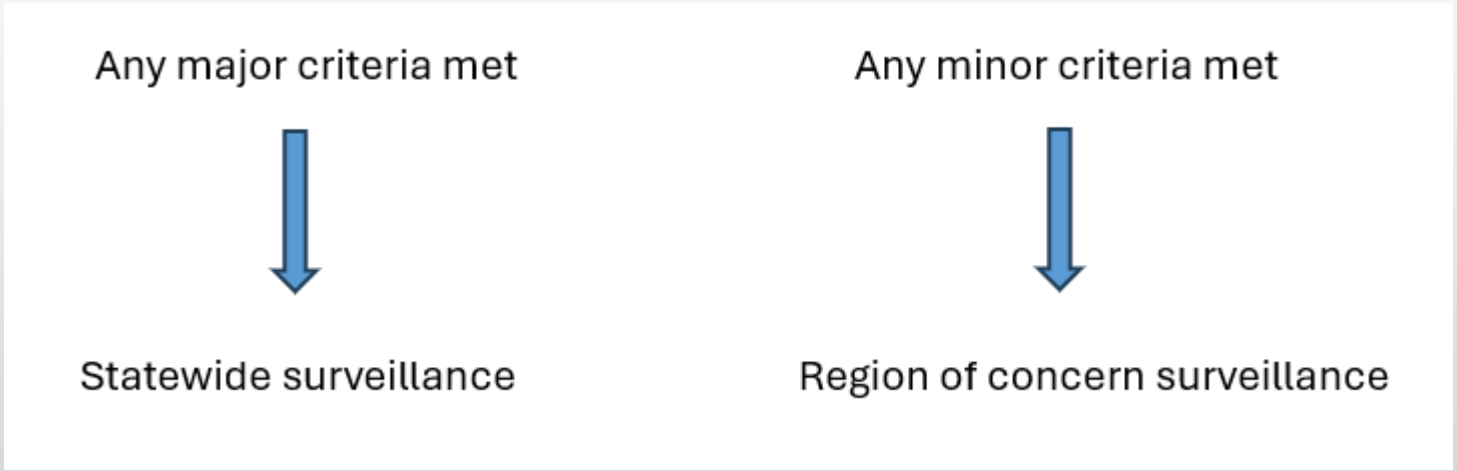
Major criteria

1. Declaration of measles outbreak in the state
2. CDC requesting wastewater measles surveillance in every state

Minor criteria

1. Measles outbreak in other state(s) with shared state line
2. Measles cases in the region sharing a border with another state with measles outbreak
3. Case of measles in the state in under-vaccinated community

Implement wastewater surveillance until epidemiological situation resolved



Other major events
e.g., World Cup 2026

Site-specific surveillance

Wastewater Surveillance: Challenges Over time

Early Challenges
- Developing laboratory methods
- Engaging facilities and establishing participation
- Establishing contracts and agreements
- Managing logistics from sample collection to data sharing

Program Development Challenges
- Data analysis and interpretation
- Communicating trends and lineage information to agencies and the public
- Integrating wastewater results into public health decision-making
- Retaining facilities as public concern about COVID-19 declined
- Improving processes and data interpretation
- Expanding surveillance to additional targets of interest

Current Challenges
- Program sustainability amid changing funding
- Right-sizing participating facilities
- Maintaining flexibility as public health priorities evolve
- Balancing breadth of surveillance with available resources

The challenge has evolved from building the infrastructure to sustaining a flexible, actionable surveillance system.

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