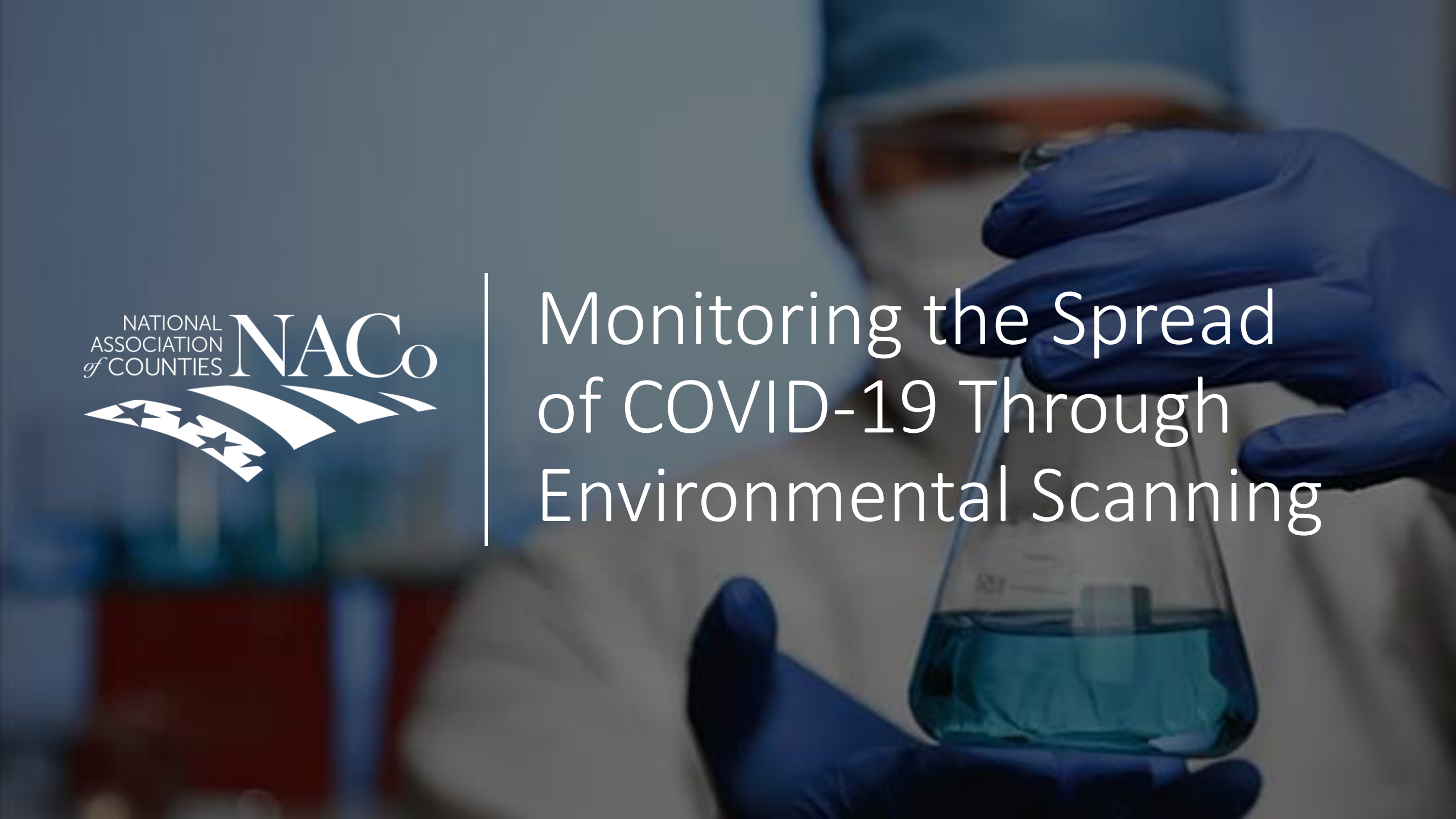


NATIONAL ASSOCIATION of COUNTIES NACo

Monitoring the Spread of COVID-19 Through Environmental Scanning

SPEAKERS

Newsha Ghaeli
President & Cofounder,
Biobot Analytics

Dr. Rekha Singh
Wastewater Surveillance Manager
Virginia Department of Health

Michael Harris
Stormwater and Environmental Programs Manager,
Department of Works
New Castle County, Delaware

NOW SPEAKING:

Newsha Ghaeli

President & Cofounder,

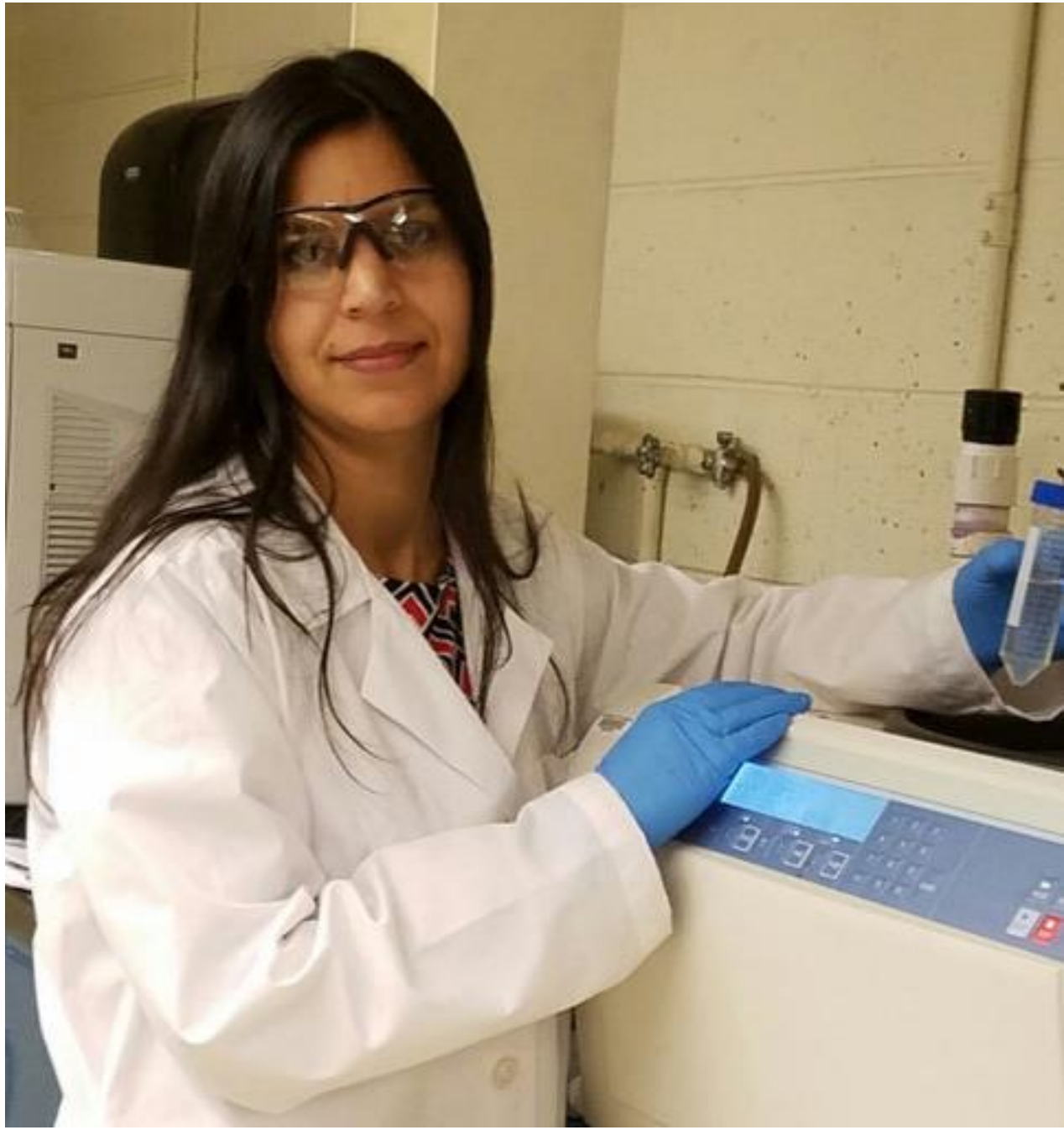
Biobot Analytics

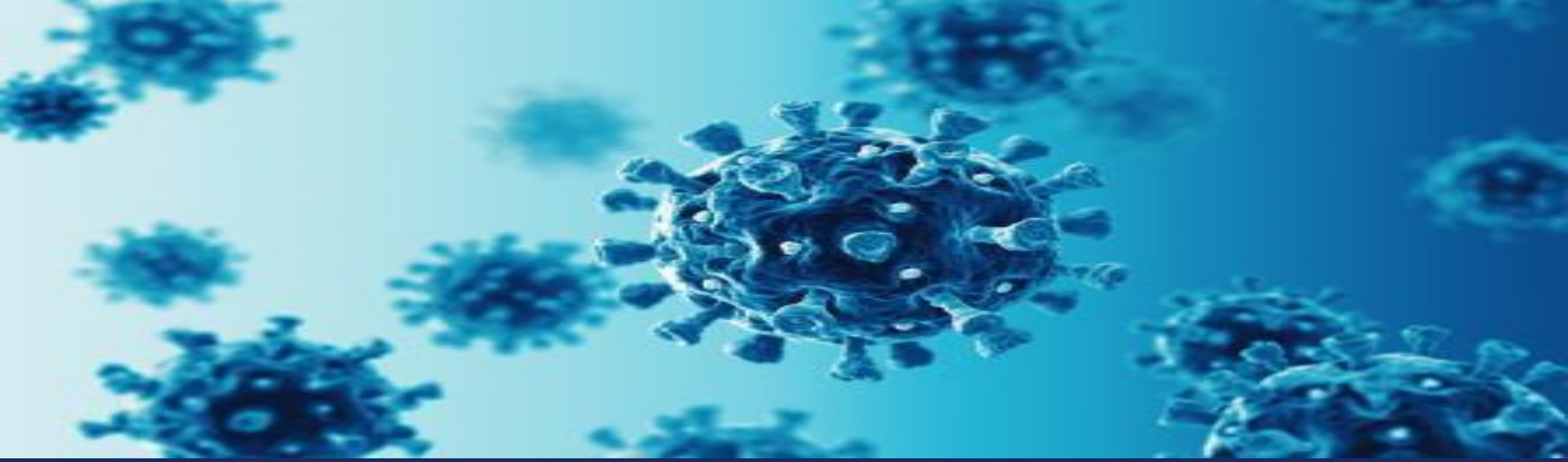
NOW SPEAKING:

Dr. Rekha Singh

Wastewater Surveillance Manager,

Virginia Department of Health





Wastewater Surveillance in Virginia

Presentation to: National Association of Counties (NACo)

Rekha Singh, PhD, MPH | VDH-OEHS

April 20, 2021

VDH VIRGINIA DEPARTMENT OF HEALTH

VDH WWS Team Members

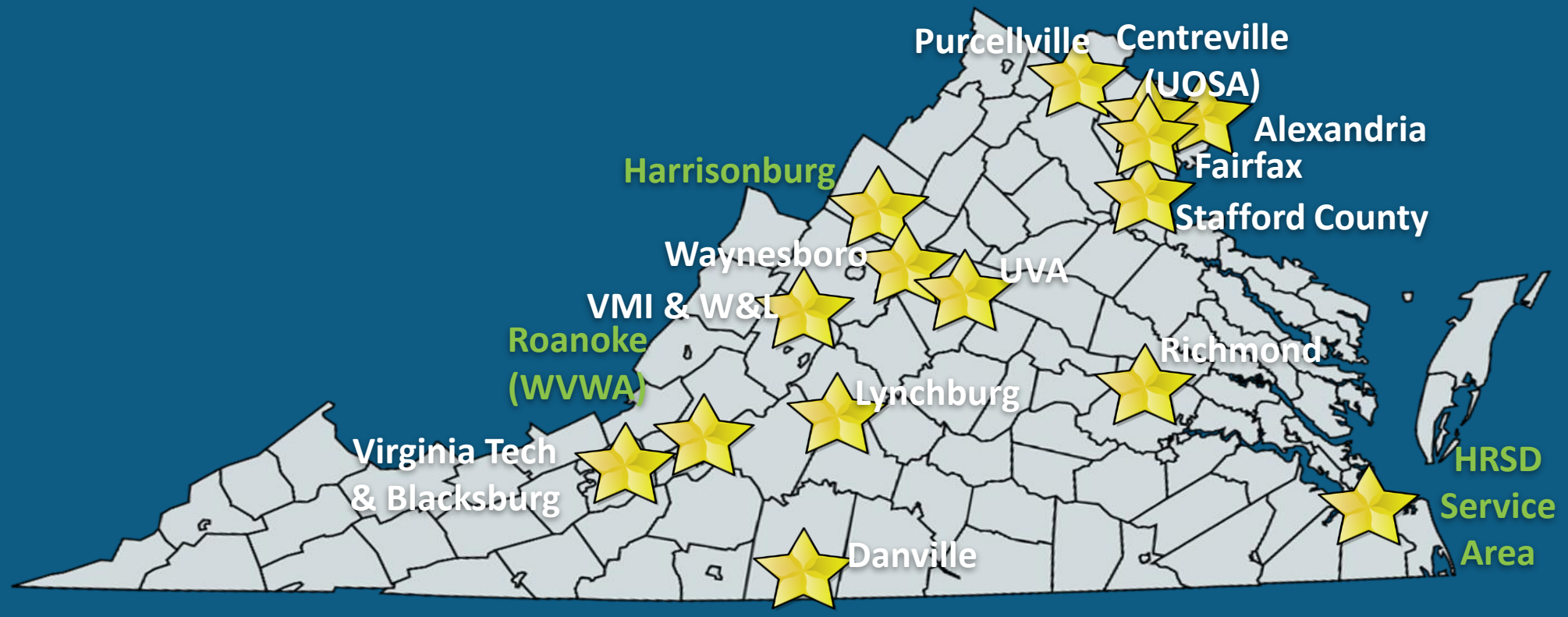
Marcia Degen, PhD, PE
Project Coordinator

Rekha Singh, PhD, MPH
Wastewater Surveillance Manager

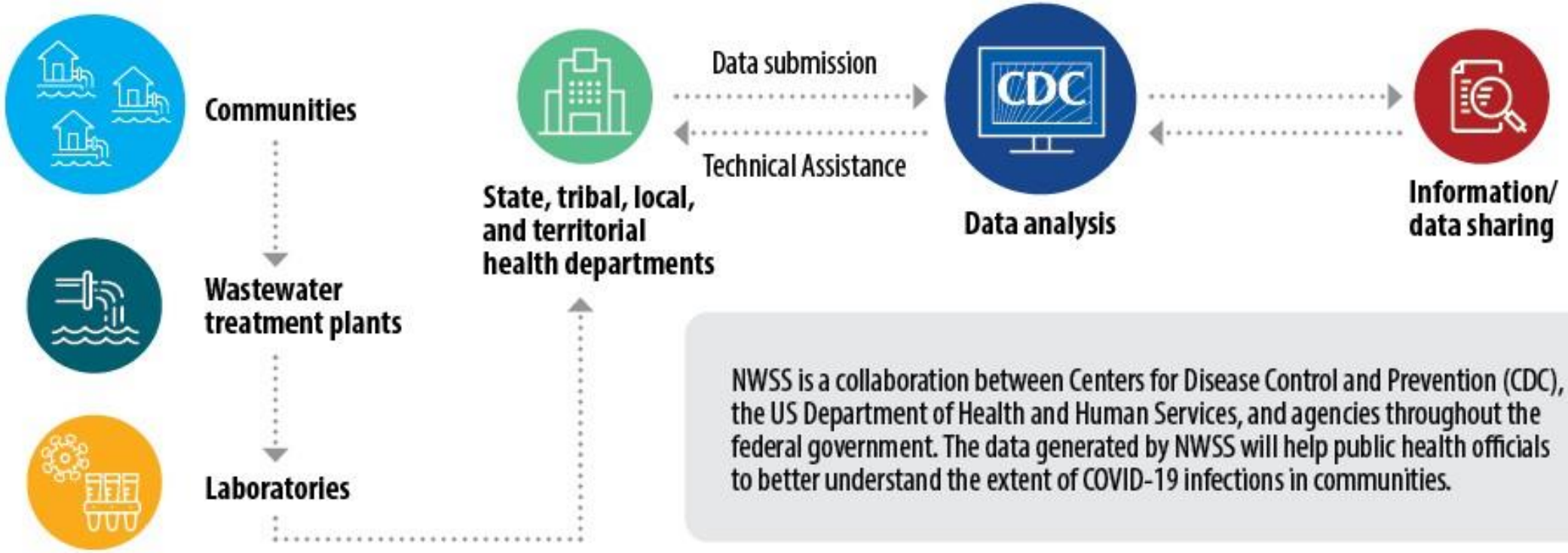
Michelle Yancey, MPH
Wastewater Surveillance Data Analyst

Haniyyah Majeed, MS
Wastewater Surveillance Data Manager

Wastewater Surveillance in Virginia



NATIONAL WASTEWATER SURVEILLANCE SYSTEM (NWSS)



NWSS is a collaboration between Centers for Disease Control and Prevention (CDC), the US Department of Health and Human Services, and agencies throughout the federal government. The data generated by NWSS will help public health officials to better understand the extent of COVID-19 infections in communities.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

cdc.gov/coronavirus

CS319450-A

Goals of Virginia Surveillance Program

Goal 1. Data Collection

- Optimize **data transfer**
- Develop **core standards**
- Create **training materials** on core standards

Goal 2. Data Analysis and Visualization

- Overlay **case data** onto **sewersheds**
- Provide training on **data use**
- Create **visualizations** with interpretation
- Improve **data analysis/reporting**

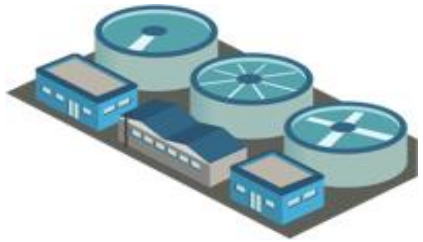
Goal 3. Community of Practice

- Facilitate **participation**
- Improve **data collection** and **methods**
- Resolve **issues** around reporting
- Create a **channel** for **feedback**

Partner Contributions

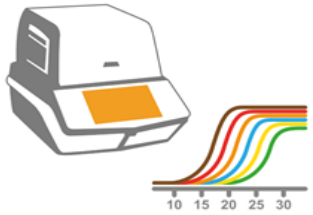
Utilities

- Sampling methods
- Operational factors
- Data sharing



Laboratories

- Testing methods
- Data comparability
- QA/QC



Other Partners

- Surveillance efforts
- Field expertise
- Public health action

Active Workgroups in VA

SOUTHWESTERN VA

VDH VIRGINIA DEPARTMENT OF HEALTH

RUC RADFORD UNIVERSITY CARILION

VIRGINIA TECH

WESTERN VIRGINIA WATER AUTHORITY

UNIVERSITY of VIRGINIA

EASTERN VA

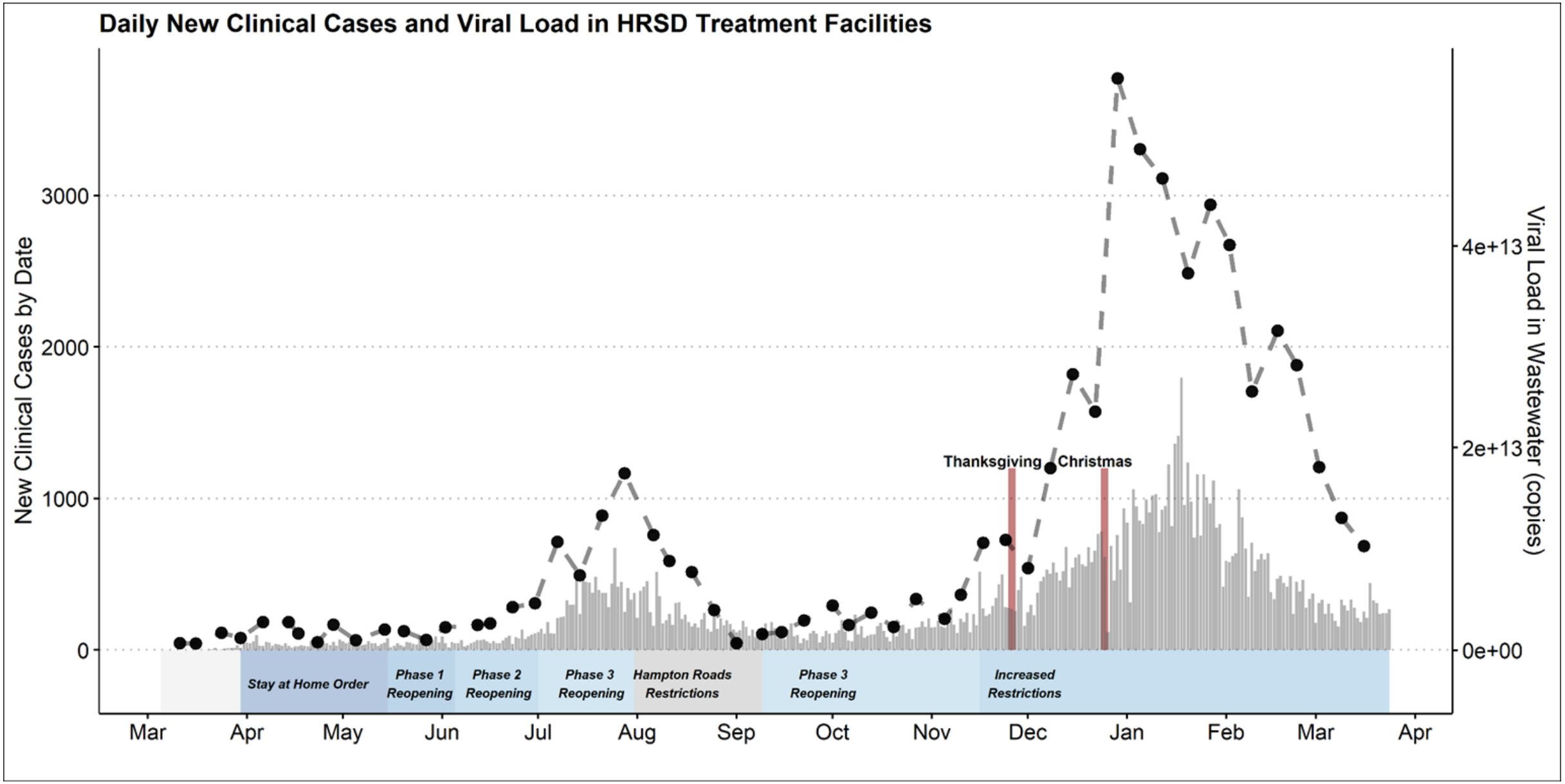
VDH VIRGINIA DEPARTMENT OF HEALTH

HRSD

OLD DOMINION UNIVERSITY

Chesapeake VIRGINIA

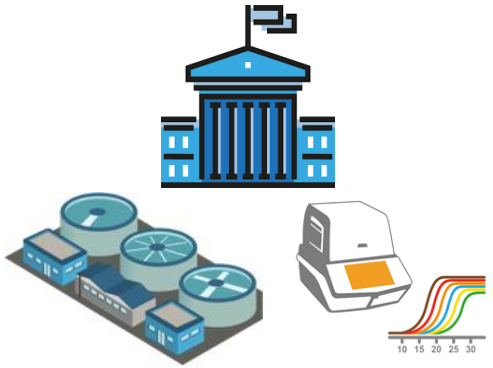
HRSD SARS-CoV-2 Surveillance Data



Program Challenges

- **Allocation of funding**
  - Initial funding for staff only
  - All sampling done voluntarily (no funding for sampling)
- **Our challenge**
  - Communicate the need clearly
  - Simplify data sharing process
  - Keep open lines of communication
  - Demonstrating the usefulness of data to public health professionals

ELC Funding -
New Project Proposal: August 2021



- **Enhance surveillance in Virginia**
  - Sentinel monitoring, localized projects, etc.
- **Develop or enhance partnerships**
  - Support data collection/reporting to NWSS
- **Participate**
  - NWSS Public Health Community of Practice
- **Collaborate**
  - Other health departments/jurisdictions

Questions?

Thank you!

rekha.singh@vdh.virginia.gov

marcia.degen@vdh.virginia.gov

haniyyah.majeed@vdh.virginia.gov

michelle.yancey@vdh.virginia.gov

NOW SPEAKING:

Michael Harris
Stormwater and Environmental Programs Manager,
Department of Works
New Castle County, Delaware

Looking Down the Drain: How The Sewer Became An Emerging Public Health Resource

About New Castle County

- Northernmost of 3 Delaware Counties
- Population 560,000
- NCC Government provides police and paramedics service plus manages parks, libraries, buildings, land use, stormwater management and operation of the sanitary sewer.
- Operate 3 wastewater treatment plants and 1,600 miles of sanitary sewer.

Facing a public health crisis

- Spring of 2020–
  - Changing information and knowledge of SARS-CoV-2
  - Lack of federal guidance and leadership
  - Lack of adequate testing

Wastewater Epidemiology

- Looks for biomarkers or chemicals in wastewater to assess health of population
- Equivalent to obtaining fecal and urine sample from everyone in the sewered population.
- 2013 Wastewater Epidemiology detected re-emergence of Polio in Israel
- More recently, used for detecting Opiods
  - Biobot Analytics study in Cary, NC
  - Helped direct resources – 40% reduction in overdoses
- Vast Potential- SARS-CoV-2 and beyond

Evolution of Our Program

- NCC entered one sample in the Biobot pro bono study
- Wilmington WWTP Influent tested on a weekly basis starting April 15th (450,000+ residents)
- Added 11 additional sites a few weeks later for better identification of the magnitude and extent of the outbreak. 12 sites in paid study
- Moved testing to UD Center for Environmental Wastewater Epidemiology Research (CEWER)
- Assembled team of experts from UD, Christiana Care, Delaware Data Innovation Lab, and Duffield Associates to review data and steer efforts

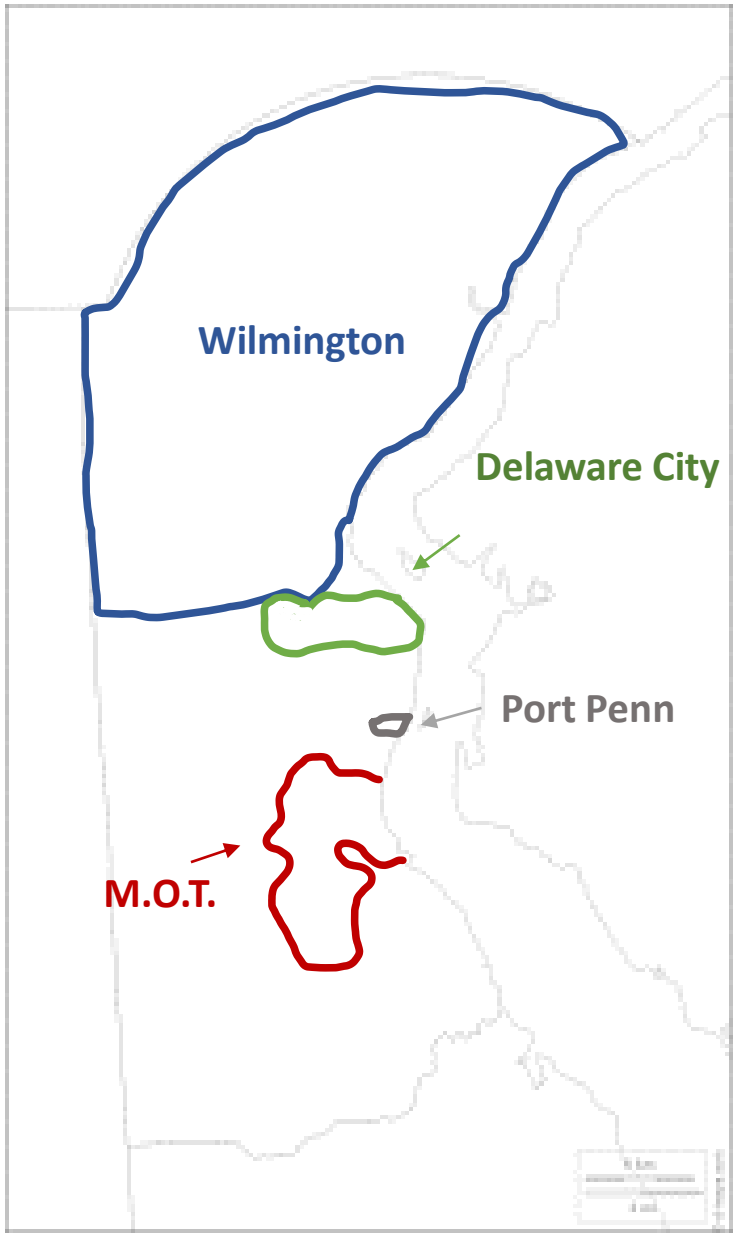
What This Wastewater Data Provides

An estimate of the scope of the outbreak independent from patient testing or hospital reporting, and inclusive of data from asymptomatic individuals,

Decision support for officials determining the timing and severity of public health interventions to mitigate the overall spread of the disease,

A means of tracking the effectiveness of interventions and measure the wind-down period of the outbreak, and

An early warning. Data acts as a “leading indicator” of more clinical cases.



CEWER analysis of SARS-CoV-2 across the county includes analysis of samples twice a week at 4 wastewater treatment plants of varying sizes

Wilmington	~500,000 People
Delaware City	~2,500 People
Port Penn	~400 People
M.O.T.	~17,000 People

COVID19 sewage sampling
Report provided: May 22, 2020

Wilmington Wastewater Treatment Plant

Sample collection date: **May 6, 2020**

SARS-CoV-2 virus in sewage

DETECTED

Virus concentration per liter of sewage
25,733 copies

Reported COVID19 cases in New Castle County, DE

New cases	Cumulative cases
108	2,087

On May 6, 2020, as reported by USAfacts.org

Biobot COVID19 case estimate

9,700 cases
(1.9% prevalence rate)

Using a reported flow rate of 72 MGD

Biobot prevalence rate estimates in context

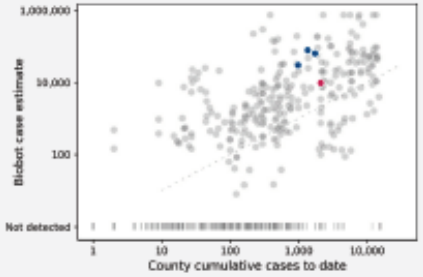
This sample in red, your past samples in blue. Other facilities in gray.

Contextualize COVID19 prevalence in your facility's catchment with other participating facilities, normalized across catchment sizes.

Biobot case estimates in context

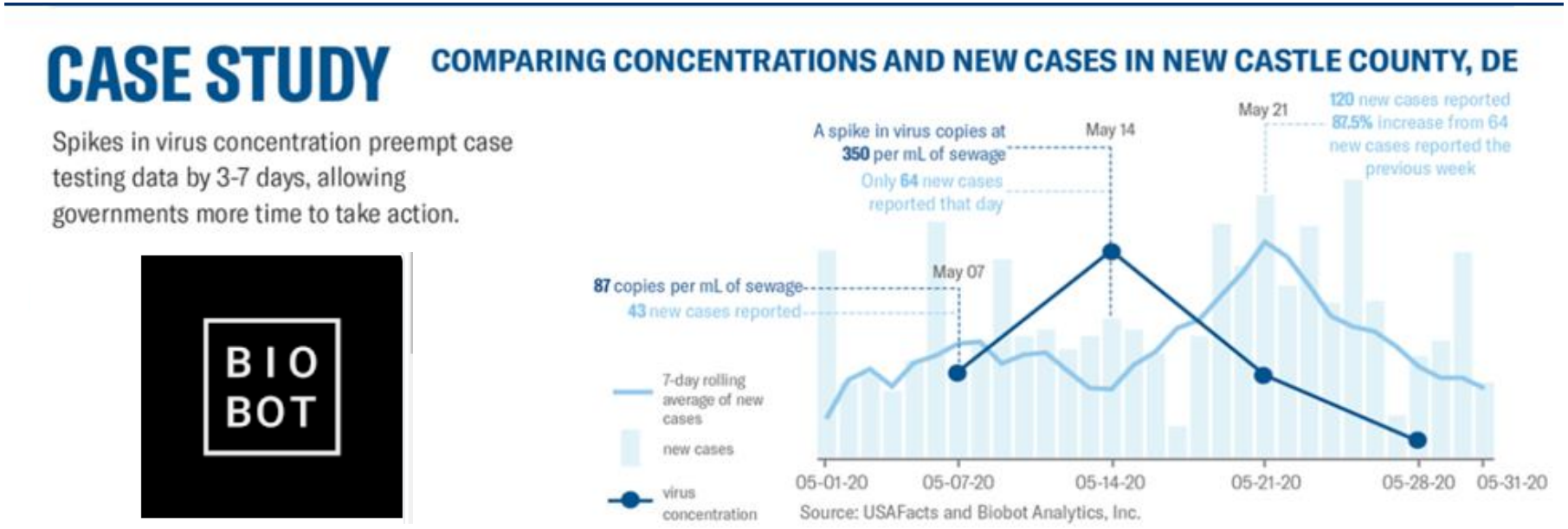
Biobot case estimates are trending with reported cases across all samples to-date.

This sample in red, your past samples in blue. Other facilities in gray.



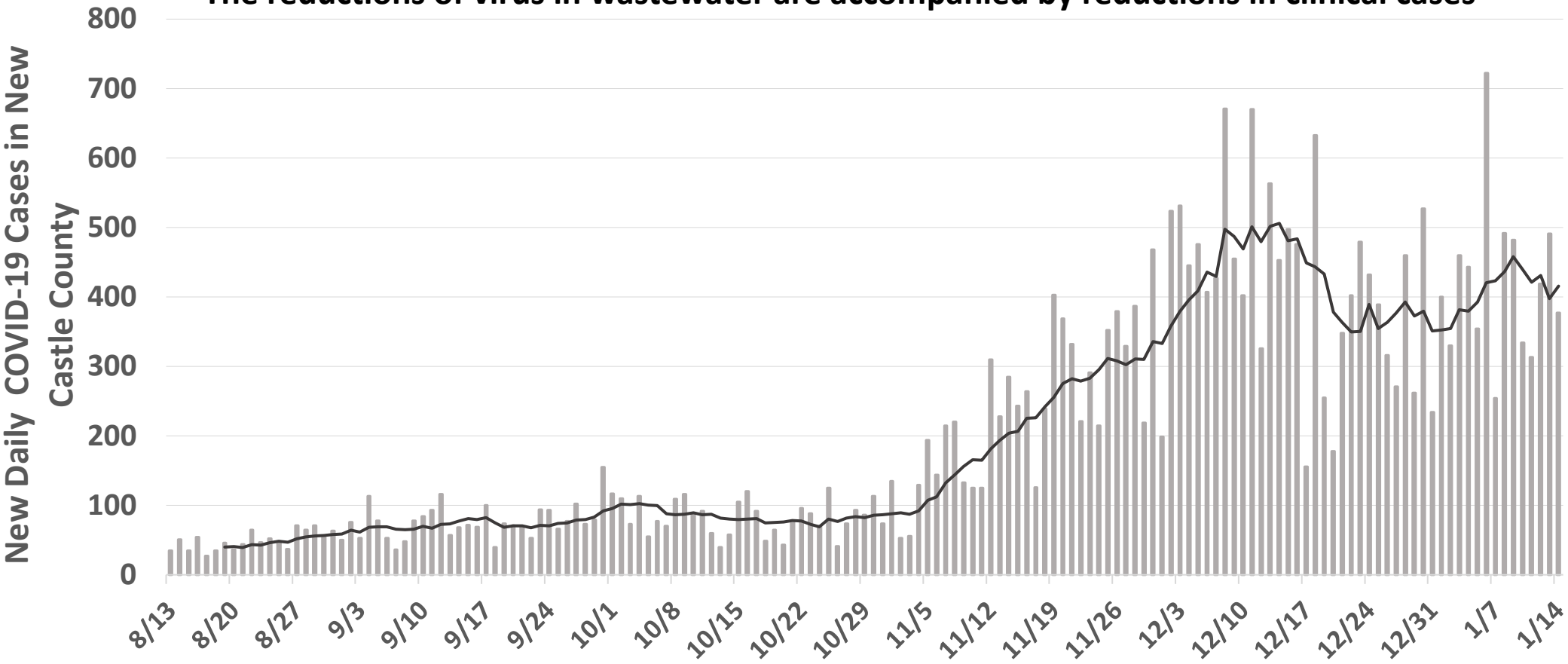
Kit ID: 182.B
Protocols version: v1
Analysis version: v1.1

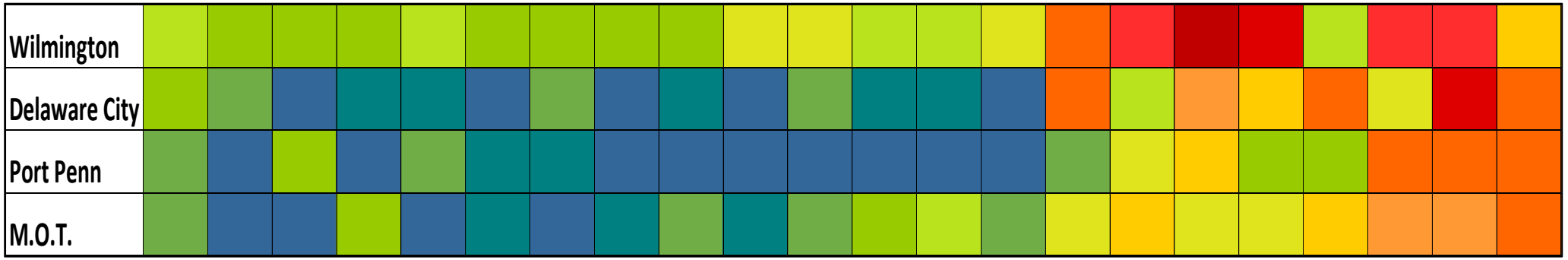
Leading Indicator



Visualizing Virus Levels Detected Over Time

The reductions of virus in wastewater are accompanied by reductions in clinical cases





	Viral Levels Detected
	< 10,000
	10,001 - 18,000
	18,001 - 32,000
	32,001 - 56,000
	56,001 - 100,000
	100,001 - 180,000
	180,001 - 320,000
	320,001 - 562,000
	562,001 - 1,000,000
	1,000,001 - 1,800,000
	1,800,001 - 3,200,000
	3,200,001 - 5,620,000
	5,620,001 - 10,000,000

NCC Dashboard https:/newcastlede.gov/CEWER

NCCo COVID-19 Wastewater Testing | Overview | By Sampling Site | FAQ

View Data by Sampling Site | View County Overview

About this Data

"We will look anywhere and everywhere to collect data to make this invisible enemy more visible."
– County Executive Matt Meyer

Have feedback? Email us at COVID19@newcastlede.org

This data is derived through the science of wastewater-based epidemiology that can be used to detect the level of virus that causes COVID-19 in our wastewater. It can be used alongside clinical testing data to understand the burden of disease in our local population.

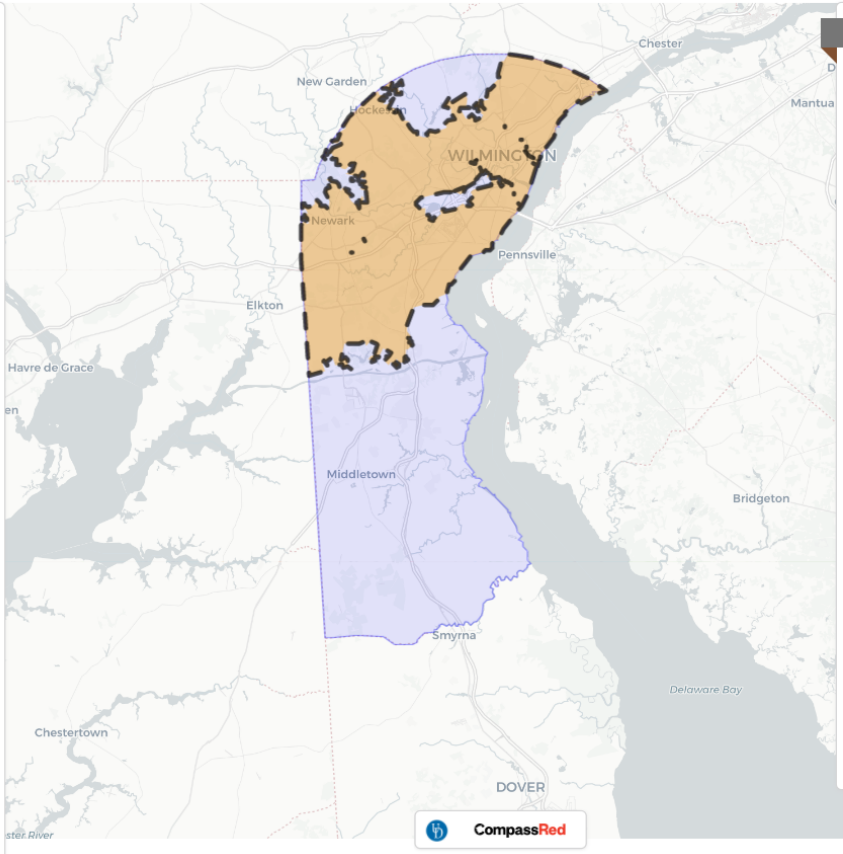
This data is provided through the leadership of **New Castle County Executive Matt Meyer** in partnership with the Center for Environmental and Wastewater-based Epidemiological Research (CEWER) and Biobot Analytics, Inc. The County began wastewater testing in response to the COVID-19 pandemic in April of 2020.

The **Northern New Castle County Aggregate Sewer System** sampling site includes all the wastewater in New Castle County except for Delaware City/St. Georges, South of the Canal (excl. Middletown) and Port Penn. The sampling covers approximately 480K of the 560K residents in New Castle County.

The amount of virus detected in wastewater is shown on a graph with a logarithmic (or log) scale. This is a way of showing a wide range of numerical data in a relatively compact scale. The numbers are shown in increments of a factor of 10.

The log scale chart allows for a better understanding of the coronavirus pandemic over time. Here specifically, the amount of virus detected over multiple areas in New Castle County varies and the log scale helps depict this data most accurately.

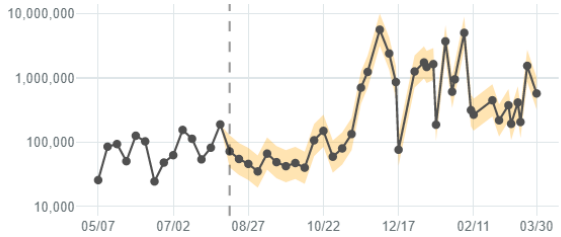
Samples are collected during the middle of the work week



Data as of or before: 2021-04-01

New Castle County Confirmed COVID-19 Cases (Rolling 7-Day Average)
Source: DHHS My Healthy Community

Northern New Castle County Aggregate Sewer System Virus Levels (viral copies/L)
Represents ~85% of the population in New Castle County



08/13/20: University of Delaware begins sampling.

Y-axis represented on a log scale, shading represents 95% confidence interval.

NCCo COVID-19 Wastewater Testing Overview By Sampling Site FAQ NEW CASTLE COUNTY | DE

View Data by Sampling Site View County Overview

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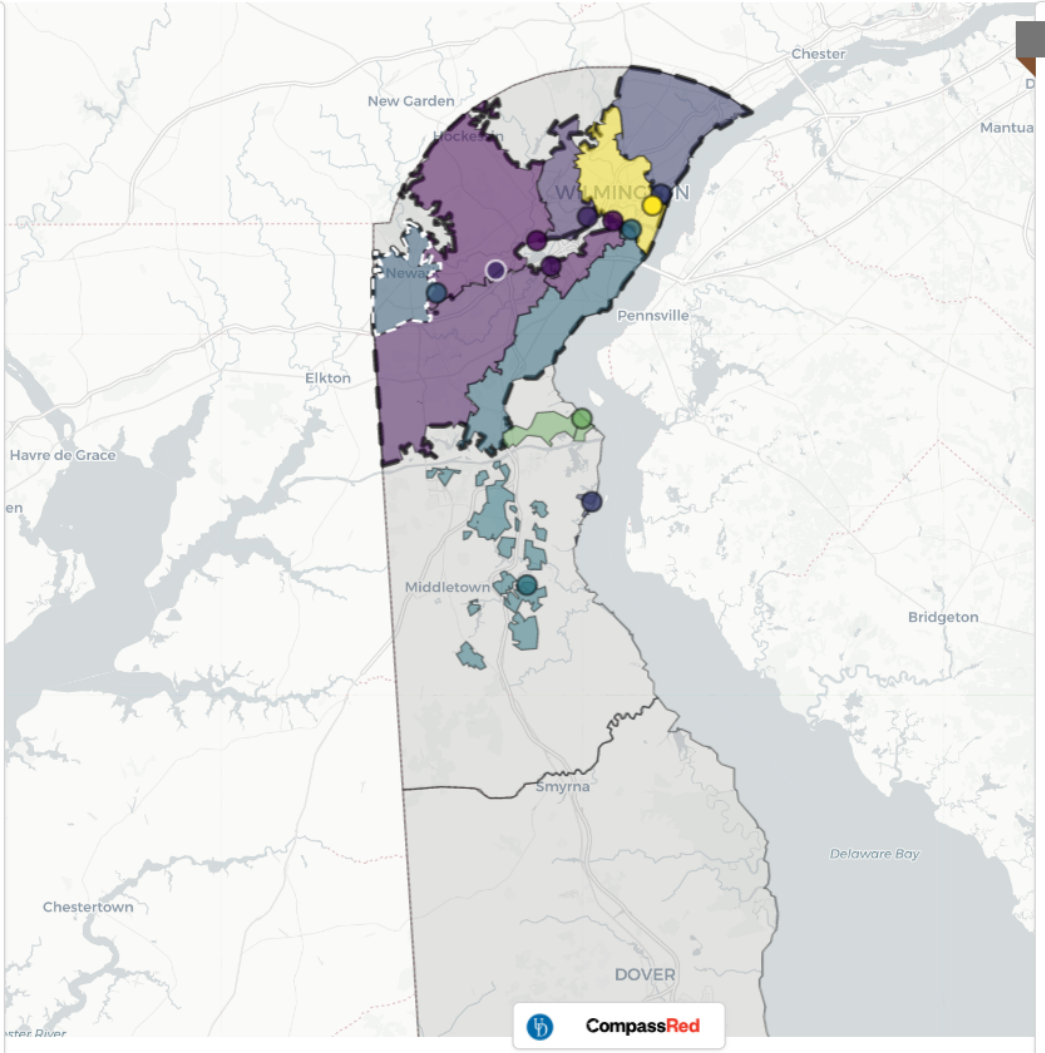
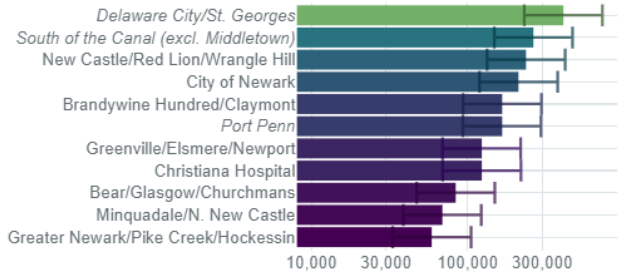


Data as of or before: 2021-04-01

––– Northern New Castle County Aggregate Sewer System
Virus Levels (viral copies/L): 573,000 (ℹ)

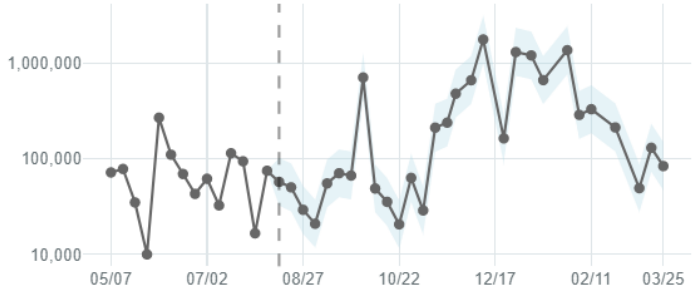
*Delaware City/St. Georges, South of the Canal (excl. Middletown), and Port Penn sampling sites are **not** included in the Aggregate Sewer System*

Latest Virus Levels (viral copies/L) by Sampling Site



Virus Levels (viral copies/L) Trended by Sampling Site

Bear/Glasgow/Churchmans



08/13/20: University of Delaware begins sampling.

Y-axis represented on a log scale, shading represents 95% confidence interval.

Siting Covid Testing Locations

Path Forward

Regular meetings with wastewater epidemiology team:

Christiana Care

Delaware Data Innovation Lab

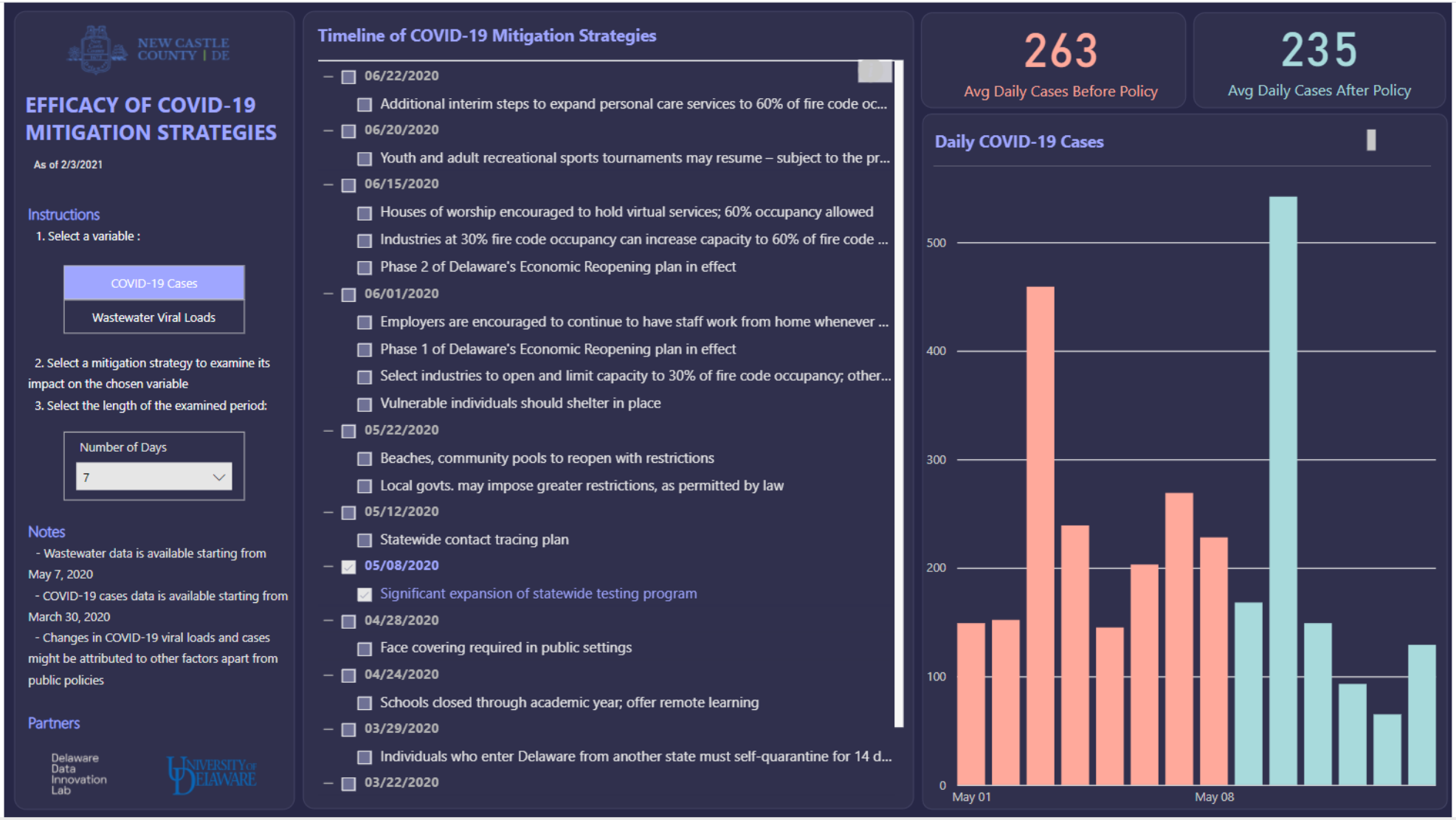
Duffield Associates

University of Delaware Center for Wastewater Epidemiology (CEWER)

Move to smaller sewer catchments

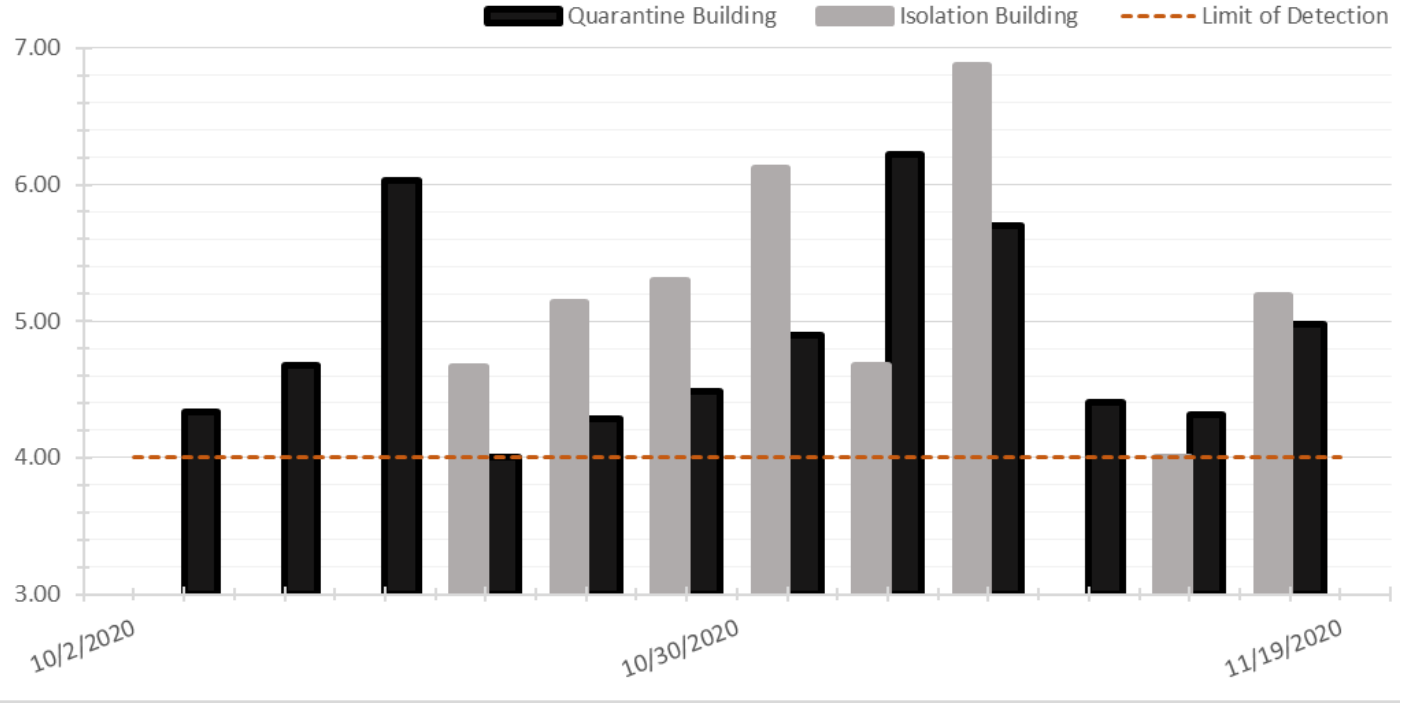
Potentially looking for SARS-CoV-2 variants in wastewater.

Using the data to evaluate public health actions



Small Catchment Areas

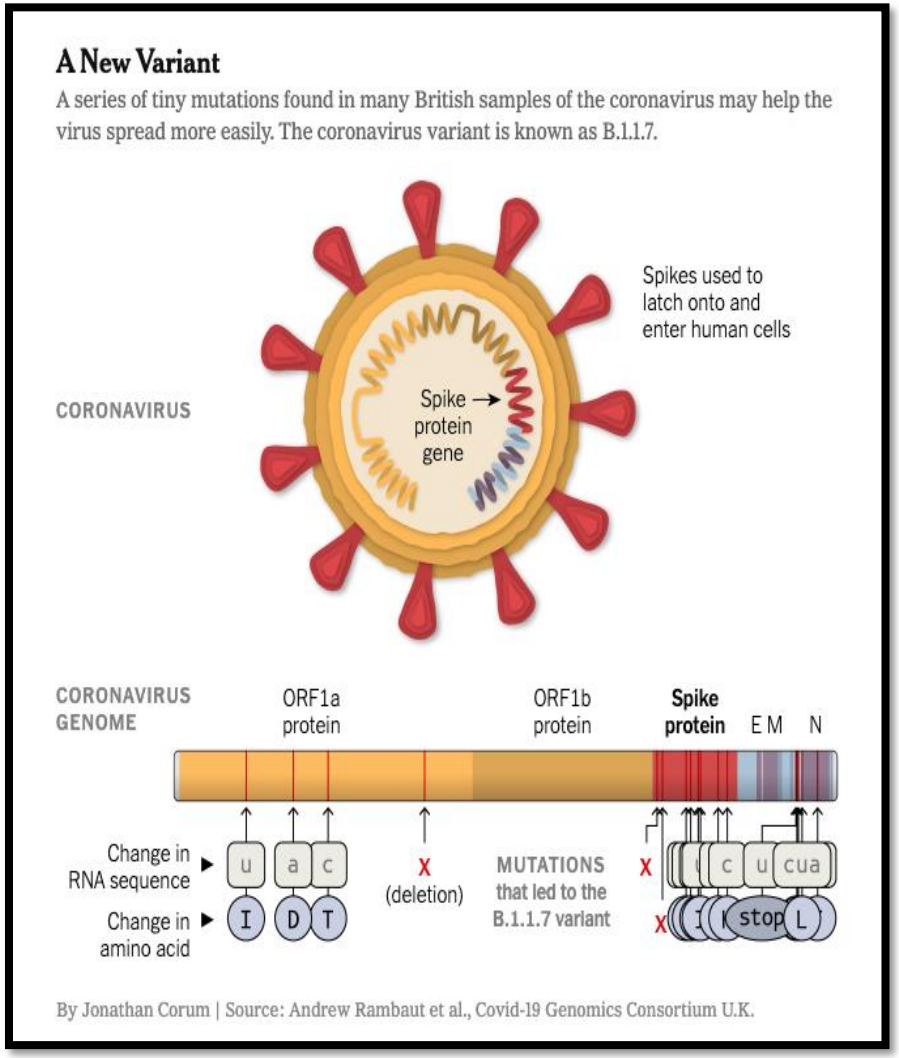
- Scientists do not fully understand shedding rates of SARS-CoV-2 related to positive clinical cases or asymptomatic individuals
- In October and November 2020 our team studied virus detected across six residence halls including where students were isolated (positive clinical cases) or quarantined (exposure). We continue to assess this data.
- Expanding pilot into public and private schools



University of Delaware and Duffield Associates collect samples at a residence hall at UD, Fall 2020

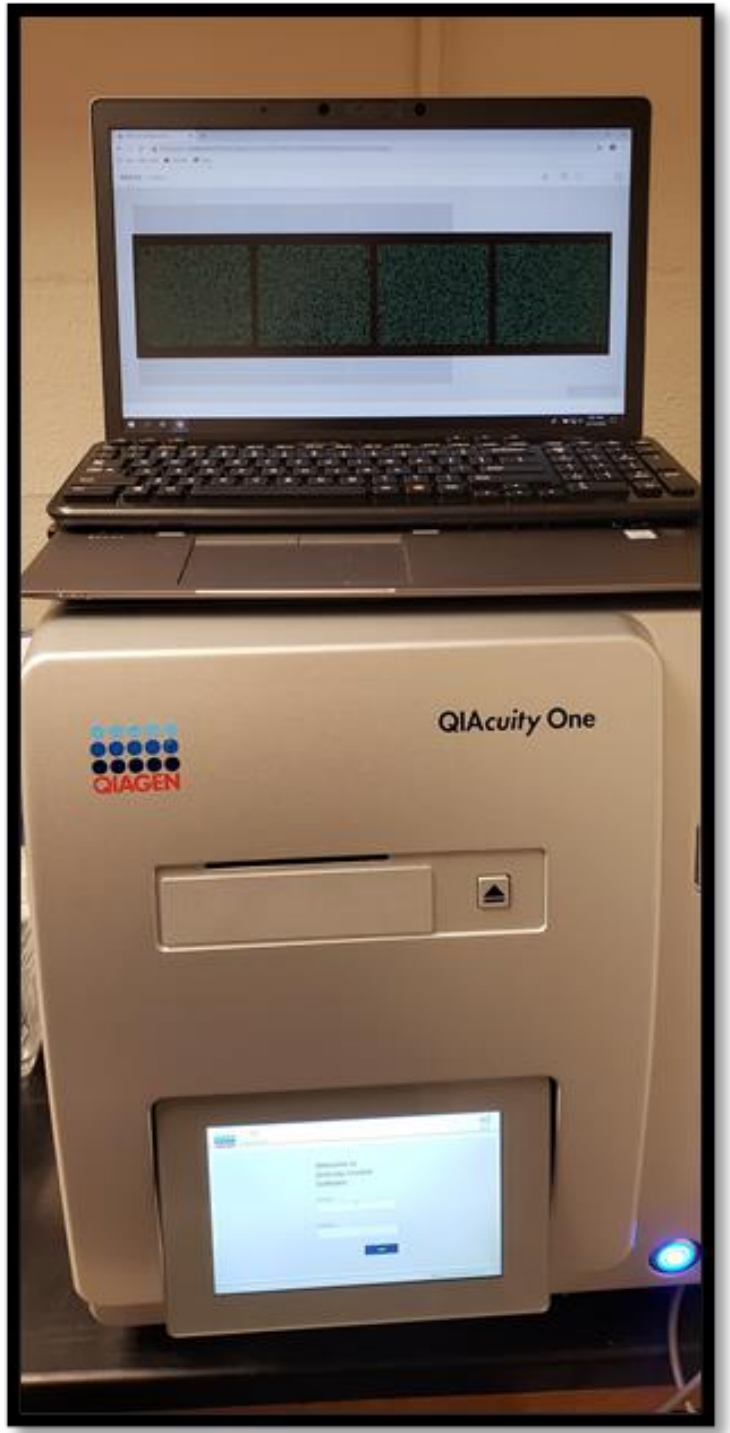
Looking for variants

- Small changes in the virus genome, called mutations, occur naturally as viral genomes are copied
- Some SARS-CoV-2 variants are now being identified around the world
- Our team is investigating sequence analysis of the virus community within the sewershed
  - Not simple due to the relatively low amount of virus in each sample and the high numbers of different virus types, which may include multiple variants of interest



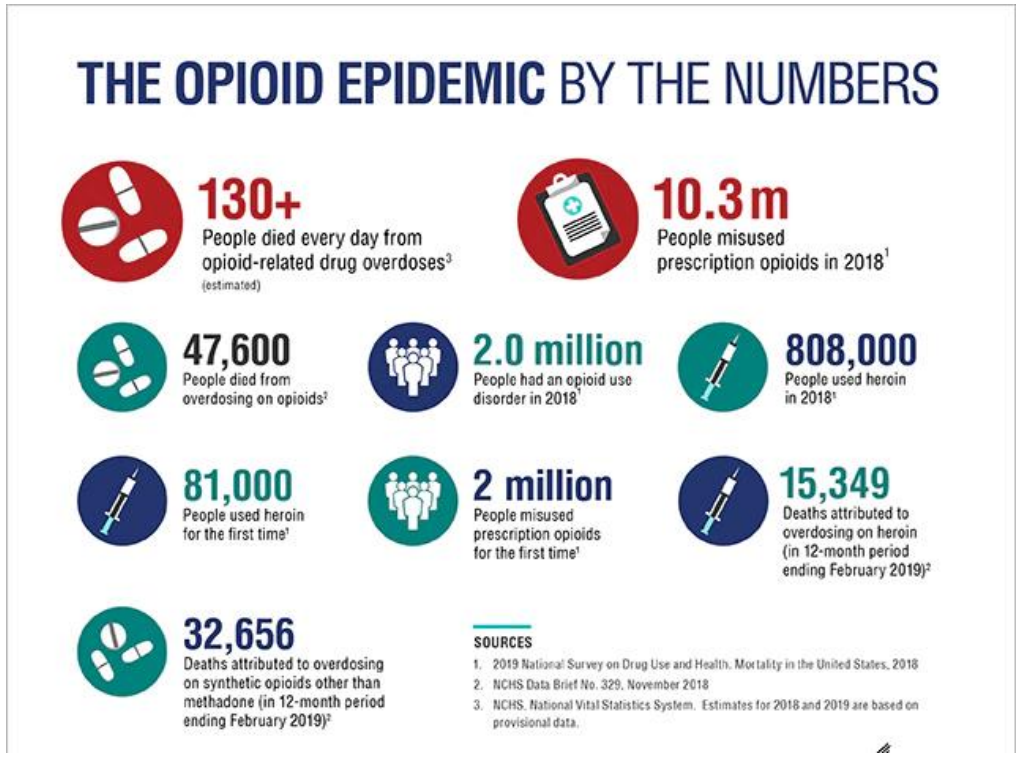
Some Lessons Learned

- Not established textbook science – on leading edge. Methodology and reporting has changed several times throughout our study.
- Case estimate science changed and is more complex.
- Constantly evolving improvements
  - Normalizing viral data by comparison with other viral markers in stool to account for rainwater in sewer.



Thinking beyond SARS-CoV-2

- Wastewater epidemiology infrastructure now in place.
- Ready for the future
  - SARS-CoV-2 re-emergence
  - Opiods
  - Influenza
  - The next pandemic




Stop the Spread of Germs
Help prevent the spread of respiratory diseases like COVID-19.
6 ft
Stay at least 6 feet (about 2 arms' length) from other people.
Cover your cough or sneeze with a tissue, then throw the tissue in the trash and wash your hands.
When in public, wear a mask over your nose and mouth.
Do not touch your eyes, nose, and mouth.
Clean and disinfect frequently touched objects and surfaces.
Stay home when you are sick,
Wash your hands often with soap

In Closing

QUESTIONS?

- *Place your question/comment in the "chat box"*
- *Use the "raise hand" function to be recognized*
- *Unmute when appropriate*

SPEAKER CONTACTS

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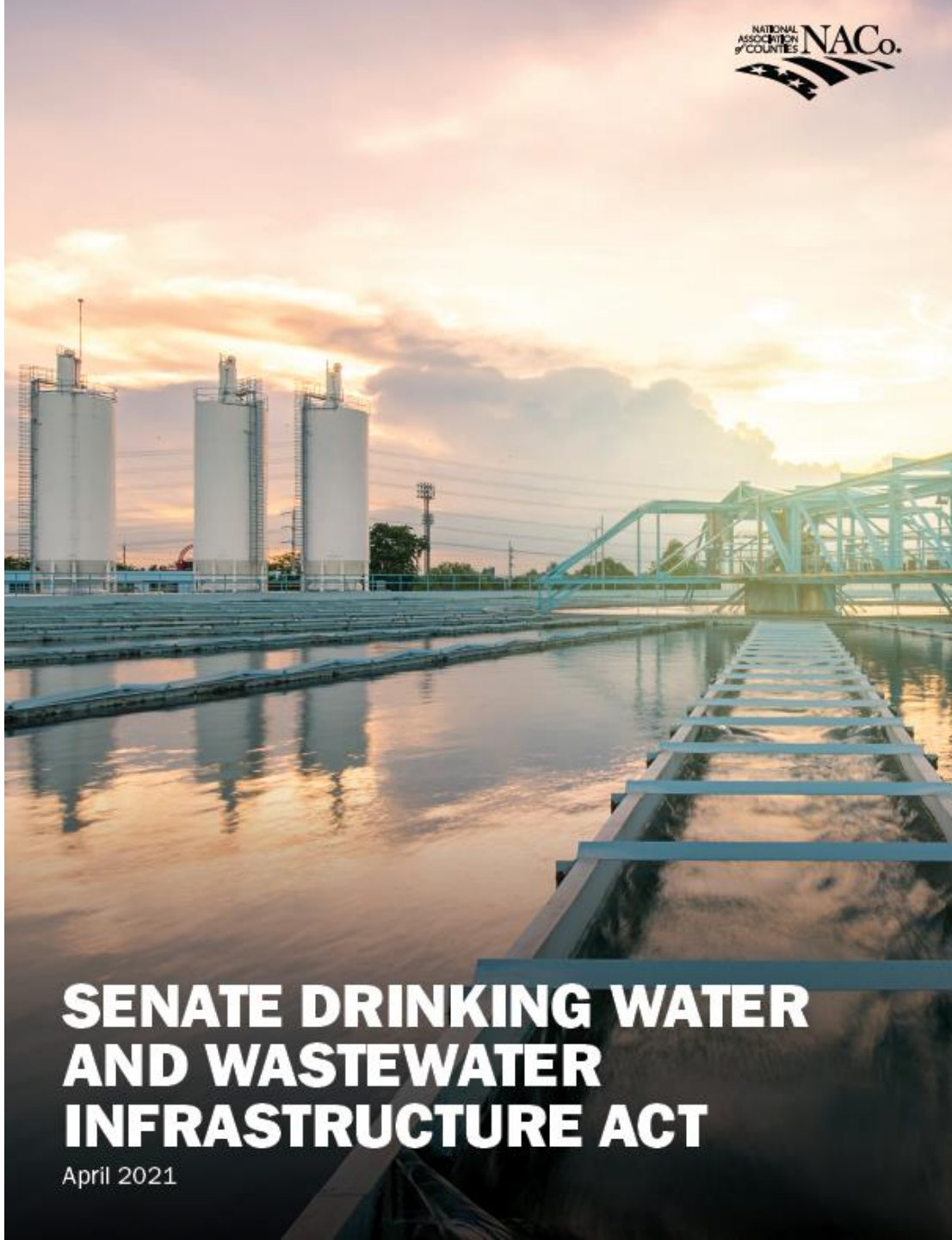
Wastewater Surveillance Manager
Virginia Department of Health
rekha.singh@vdh.virginia.gov

Michael Harris
Stormwater and Environmental Programs Manager,
Department of Works
New Castle County, Delaware
NewCastleDE.gov/PublicWorks



BIO
BOT

Biobot Analytics

We are building early warning health analytics from data available in our sewers.

Newsha Ghaeli
President and Cofounder
newsha@biobot.io

Our wastewater epidemiology platform enables early warning health analytics to combat pandemics.

Predictive

Wastewater data is a leading indicator for new infectious disease cases.

Inclusive

Everyone has a voice in the sewer. Our data includes everyone, not just people who access clinical care.

Versatile

Wastewater is a rich source of health data, including Covid19, influenza, opioids, diet, stress, and others.

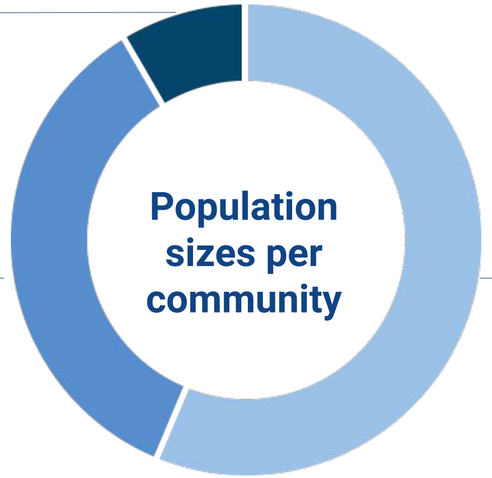
The largest database of its kind.

Metro areas

500k+

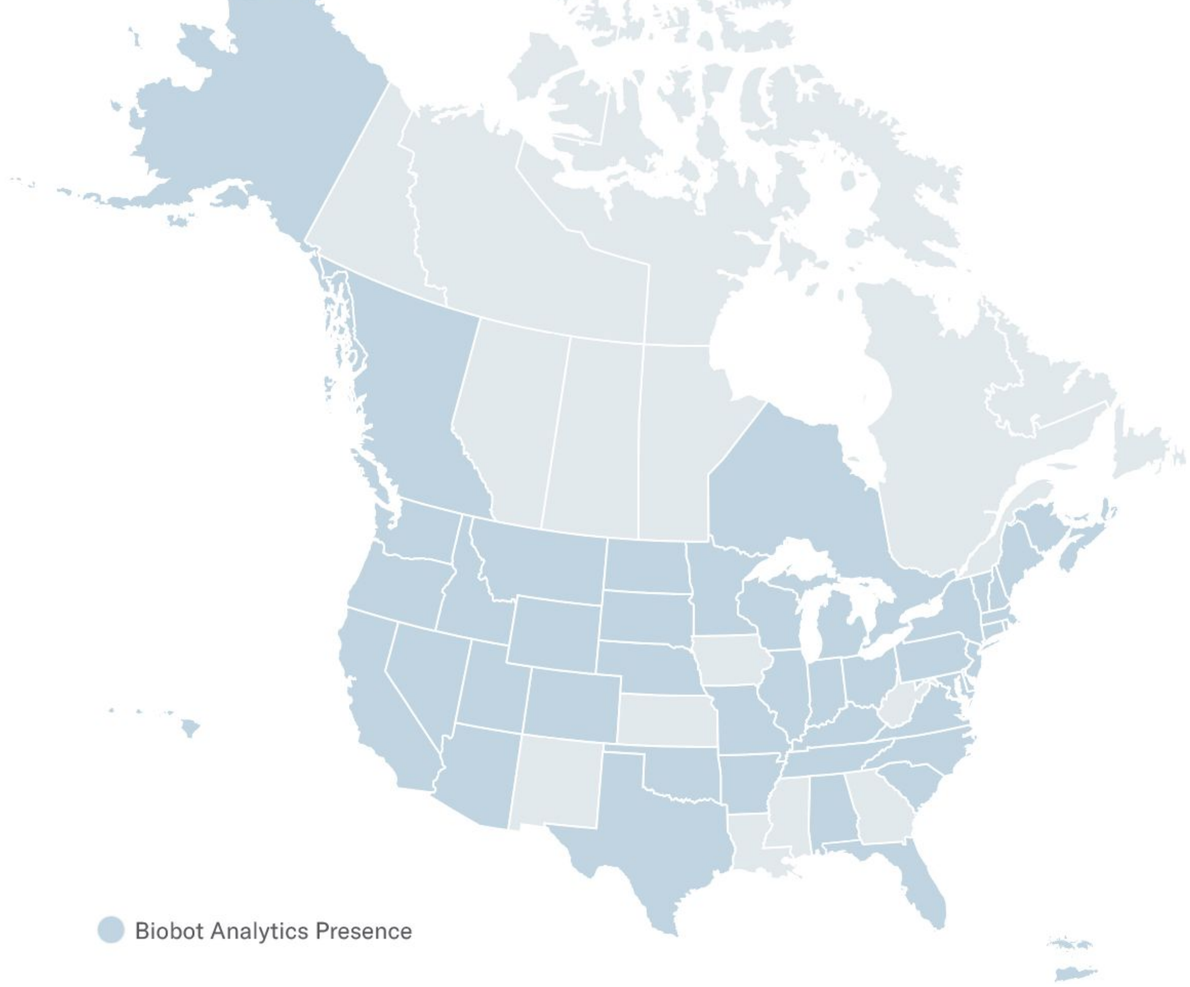
Cities

50-500k



Towns and rural areas

< 50k

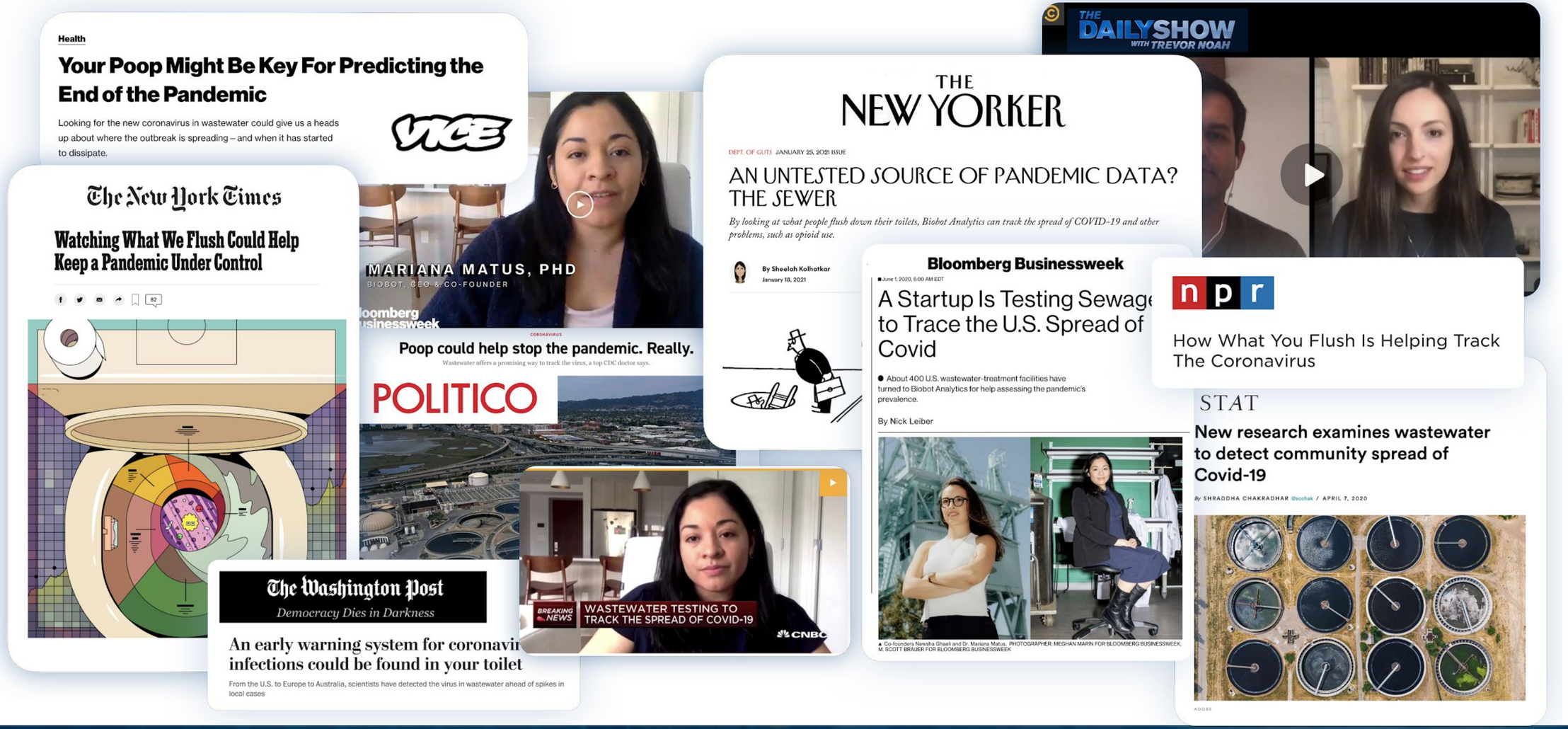


46 states + provinces

8000+ samples tested

13% of U.S. population

We are leading the emerging market of wastewater epidemiology



FastCo biotech award: #3 behind Pfizer and Moderna

Mariana Matus, cofounder and CEO of Biobot Analytics [Photo: Tony Luong]

1. PFIZER-BIONTECH

For being first to market with an effective COVID-19 vaccine

1. MODERNA

For making a COVID-19 vaccine that can travel

3. BIOBOT ANALYTICS

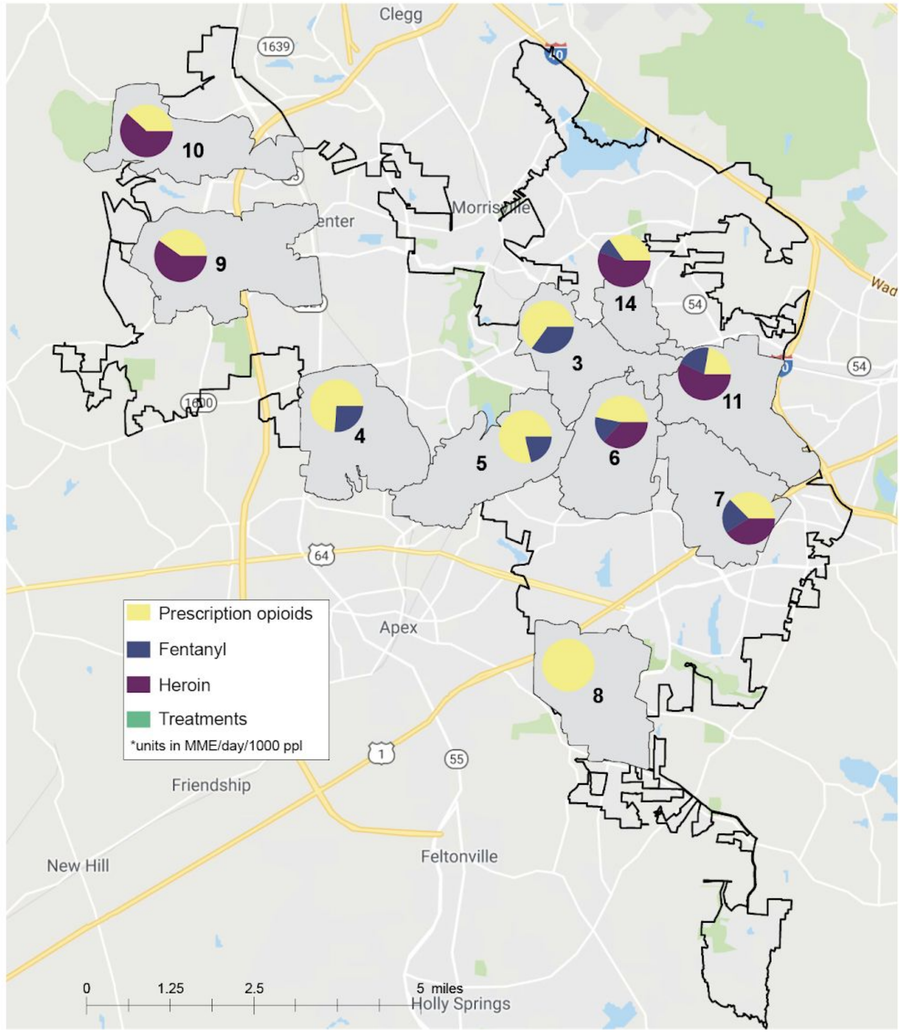
For using sewage to detect the next surge

4. OXFORD UNIVERSITY-ASTRAZENECA

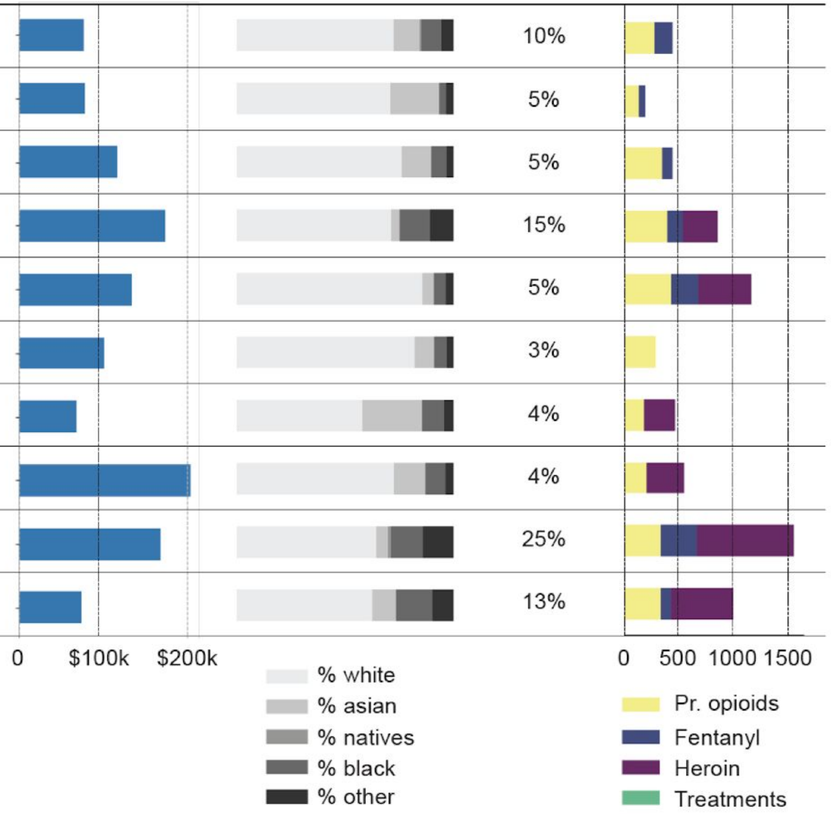
For finding a different path to a COVID-19 vaccine

We started by addressing the opioid epidemic

BIO BOT



Site ID	Population	Median age	Median HH income	Demographic breakdown [%]	Hispanic	Total MME
03	6,557	36			10%	
04	7,896	36			5%	
05	8,368	38			5%	
06	10,853	42			15%	
07	6,622	47			5%	
08	5,306	44			3%	
09	9,332	34			4%	
10	5,503	46			4%	
11	7,408	35			25%	
14	4,490	34			13%	



SARS-CoV-2 is shed in the stool of infected patients

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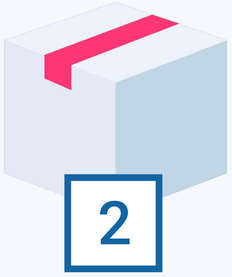
How it works

Online Order Form

Customers sign up and order kits online

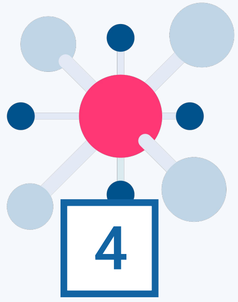


Biobot shipping kit

Next day delivery of sample at 4C.

Lab analysis

Molecular biology and chemistry analyses, applying Biobot's protocol in high-throughput.



Computational biology and data science

We develop models based on wastewater and clinical data.

Report and Dashboard

Data analysis and visualization is then packaged as a report for public health officials.

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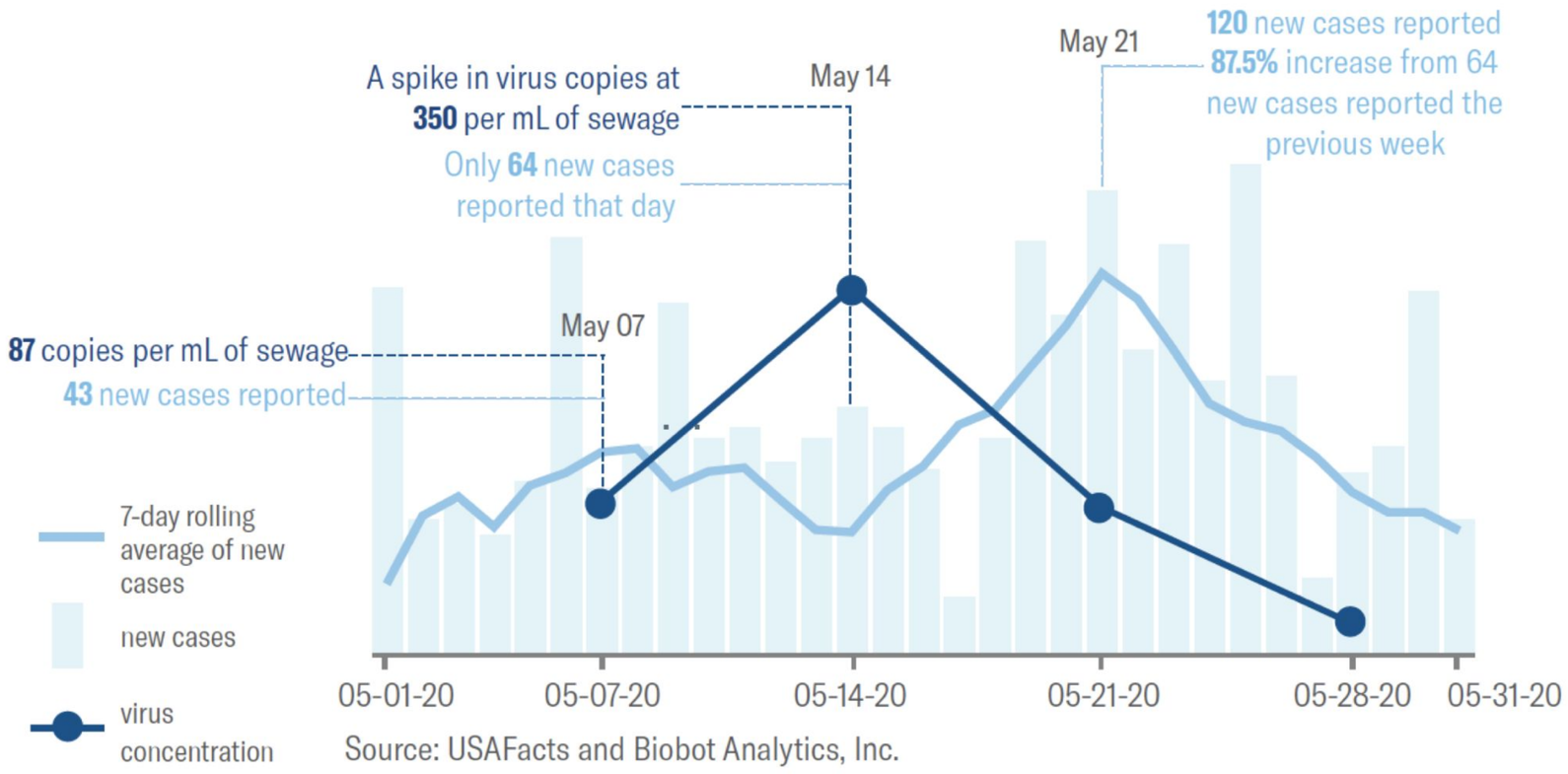

"It's amazing how many residents wait for these numbers and have come to trust these more than [clinical] testing"

— Wastewater treatment plant director
in the State of Massachusetts

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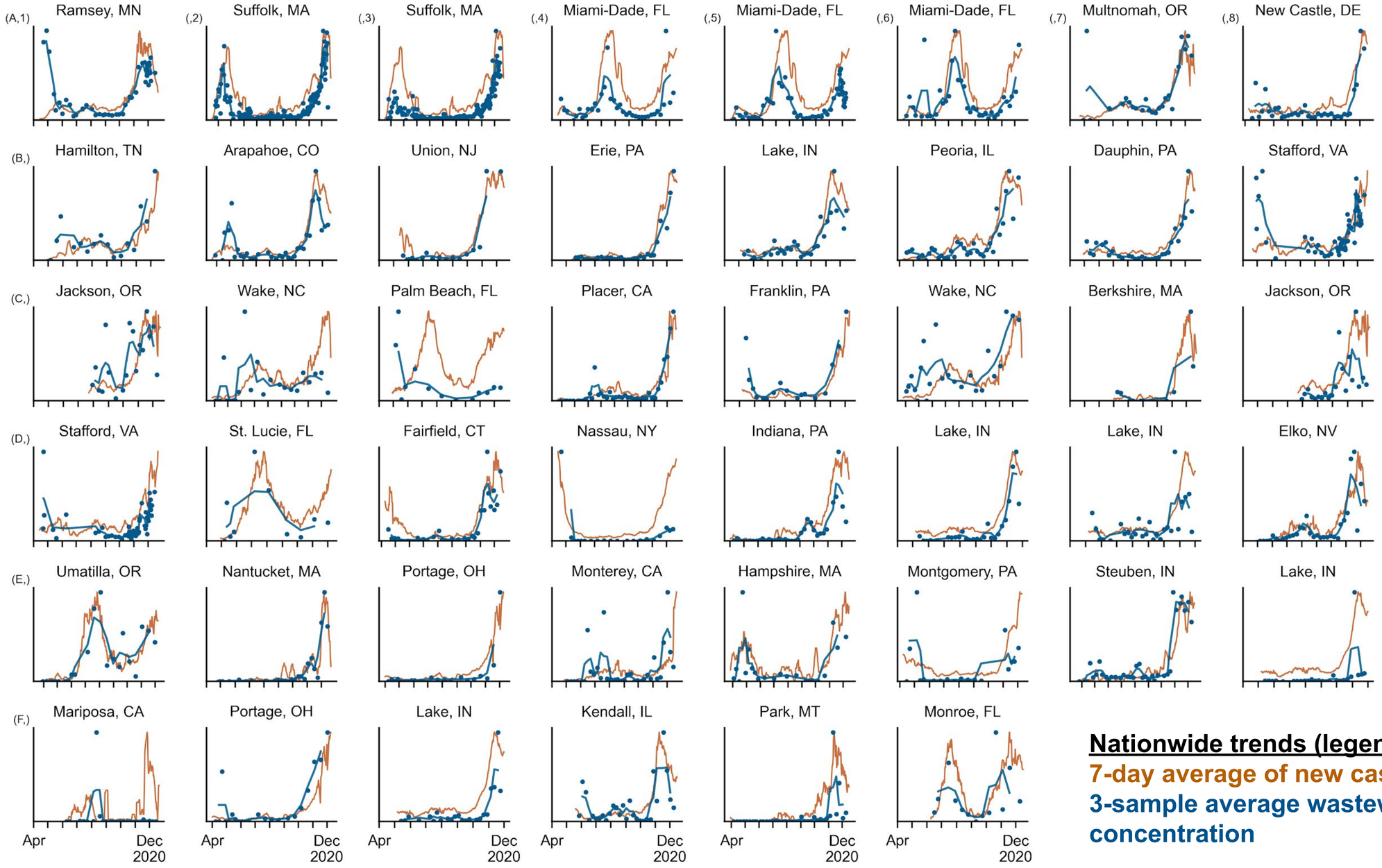
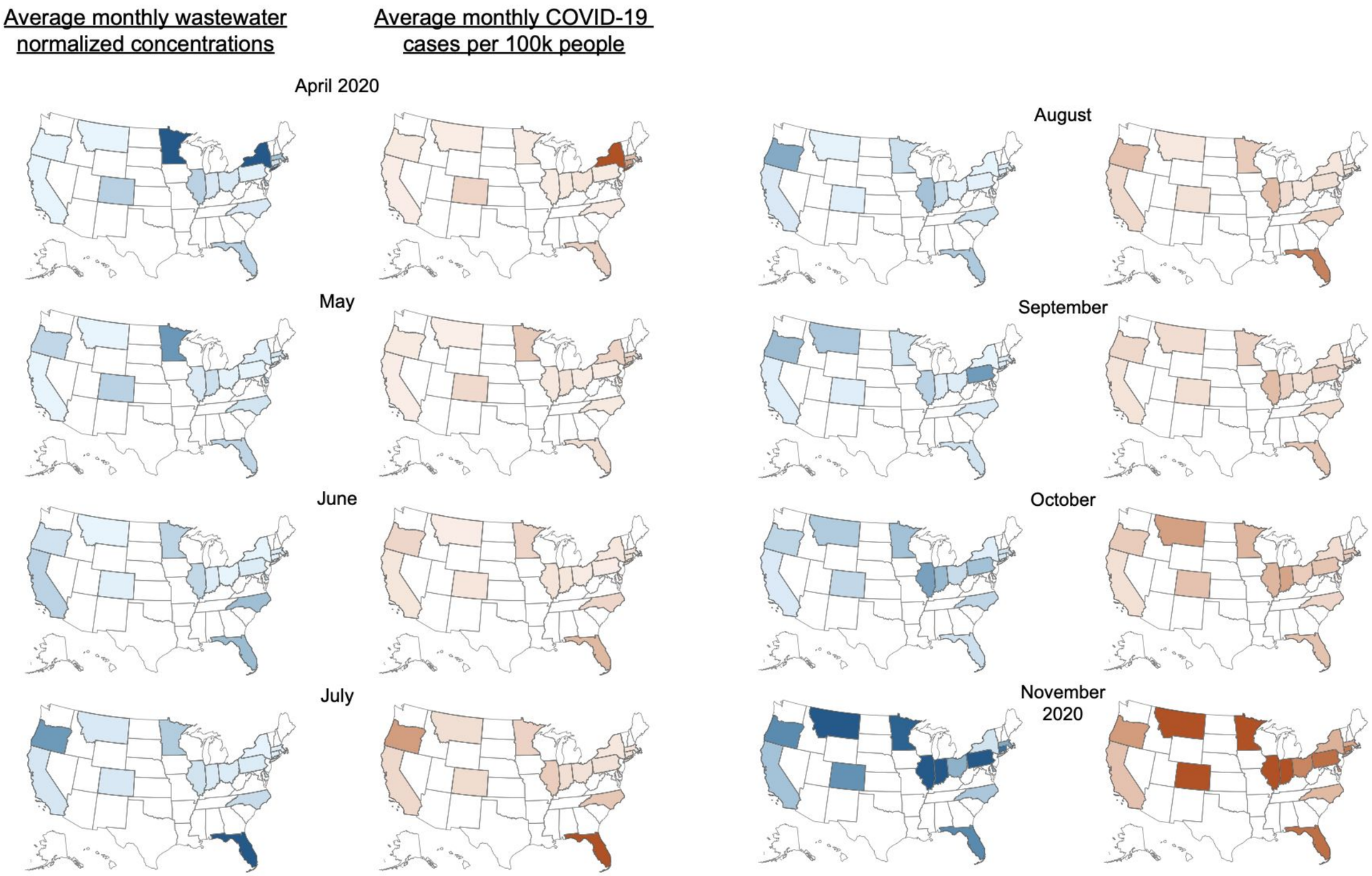
BOT



Nationwide trends (legend)

7-day average of new cases

3-sample average wastewater concentration


Average monthly wastewater normalized concentrations
Average monthly COVID-19 cases per 100k people
April 2020
May
June
July
August
September
October
November 2020

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CAMBRIDGE PUBLIC SCHOOLS

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Cambridge Public Schools / Planning for School Year 2020-21 / COVID-19 Data Dashboard

COVID-19 Data Dashboard

ALERT: The School Committee adopted updated metrics on November 12, 2020. Read Superintendent's message in regards to the adoption of these metrics.

The CPS COVID-19 Data Dashboard is intended to provide the community with transparent and updated information to determine the risk of COVID-19 transmission in CPS schools.

1. Public Health Metrics used to determine CPS opening status
2. Confirmed COVID-19 Cases in CPS
3. Staff COVID-19 Testing Participation Rates

To provide feedback on this dashboard, send a message to cps@cpsd.us. CPS will also launch a daily email newsletter with a metrics update. Opt-in here.

Data is reviewed daily by Cambridge Department of Public Health and CPS.

The metrics used to inform decisionmaking will be reviewed on a regular basis to consider recommendations from scientific advisors based on emerging knowledge. The next planned updates are January 2021 and March 2021.

Questions or feedback about the metrics or this dashboard? Send a message to CPS@cpsd.us. Messages are monitored and routed to the appropriate staff person or scientific advisors for responses. Please refrain from contacting the CPS scientific advisors directly so that we can respect the time they contribute to CPS on a voluntary basis.

CPS will also launch a daily email newsletter with a metrics update. Opt-in here.

Questions or feedback about CPS COVID-19 cases or scenarios?
Details of individual cases will not be shared publicly in accordance with HIPAA privacy laws.

- Media questions about COVID-19 cases or case totals should be directed to both Suzy Feinberg and Josefine Wendel at the Cambridge Public Health Department.
- Staff and families/caregivers should contact their principals with questions about their school.
- If you are the contact of a case, you will be notified by your Local Board of Health or the state's Contact Tracing Collaborate (operated by Partners in Health). If you don't hear from them, you are not a contact!

Questions about what to do in the case of symptoms? Use the *What Should I Do?* Document for guidance.

For each metric below, see the definition, recommended threshold, and current status. If any metric surpasses recommended thresholds it will be displayed as orange. If two or more metrics exceed thresholds, metrics will be displayed as red and learning will shift to remote only.

Metric 1
Daily New Cases

Definition: Weighted average of new confirmed cases per day, per 100,000 people in Cambridge

Threshold: Fewer than 25 new cases per day, per 100,000 people (7-day average)

19.2 new cases per day (As of 11/15/2020)

Metric 2
Test Positivity Rate

Definition: Rate of positive COVID-19 tests in Cambridge

Threshold: Less than 5% of COVID-19 tests are positive

Published by the state weekly. Updates can be expected by the end of the week.

0.32% (As of 11/12/2020)

Metric 3
Wastewater Monitoring

Definition: The level of COVID-19 found in sewage wastewater in MWRA

Threshold: COVID-19 in wastewater detected at less than 100 copies viral genomes/mL

255.5 (As of 11/10/2020)

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Data insights are our core value proposition

Early indicator of spikes for early intervention

Wastewater data is a leading indicator for new Covid-19 cases with 5-10 days of advance.

Estimate COVID-19 incidence

We have built a proprietary model to estimate the number of new Covid-19 infections in a community.

Ranking amongst nationwide database

We contextualize if the level of infection is low or high, by comparing against our nationwide database of communities.

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We can build hundreds of applications with our platform

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Opportunities for WBE

Government
16,000 WWTPs

Assisted Living
32,000 homes

Places of work
900,000 offices

Prisons
5,000 prisons & jails

Universities
5,300 colleges

Schools
110,000 schools

Aircrafts
10 million flights / year

Ships
2,000+ ships

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A permanent pillar of pandemic preparedness

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Thank you!

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