Asia Water Forum 2022
8–11 August 2022 • Online

Focus Area 2: Universal water supply and sanitation services

Session 2B: Innovative tools for awareness raising and decision making

Schedule: 9 August 2022, 3:00 p.m. – 4:30 p.m. (GMT+08)

Wastewater Surveillance: Lessons Learned for Proactive Responses to Outbreaks

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Evolution of Wastewater Surveillance during COVID-19

Spring 2020 – Proof of Concept in University Labs

nature

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.

Source: Nature; Smriti Mallapaty; April 03, 2020

Autumn 2020 – CDC Establishes NWSS

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Waterborne Disease & Outbreak Surveillance Reporting

National Wastewater Surveillance System (NWSS)

A new public health tool to understand COVID-19's spread in a community

Source: CDC NWSS

Spring 2021 – Present - Mainstream Media Attention

The New York Times

From the Wastewater Drain, Solid Pandemic Data

Source: New York Times; Emily Anthes; May 7, 2021

The New York Times

The C.D.C. adds wastewater data to its Covid-19 tracker.

Source: New York Times; Emily Anthes; Feb 4 2022

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Covid-19 wastewater surveillance is promising tool, but critical challenges remain

By Deidre McPhillips, CNN

Updated 8:49 AM ET, Wed May 18, 2022

CNN health

Source: CNN Health; Deidre McPhillips, May 18, 2022

Spring 2022 – WHO Interim Guidance

World Health Organization

Environmental surveillance for SARS-COV-2 to complement public health surveillance – Interim Guidance

14 April 2022 | COVID-19: Infection prevention and control / WASH

Source: WHO Infection prevention and control / WASH; April 2022

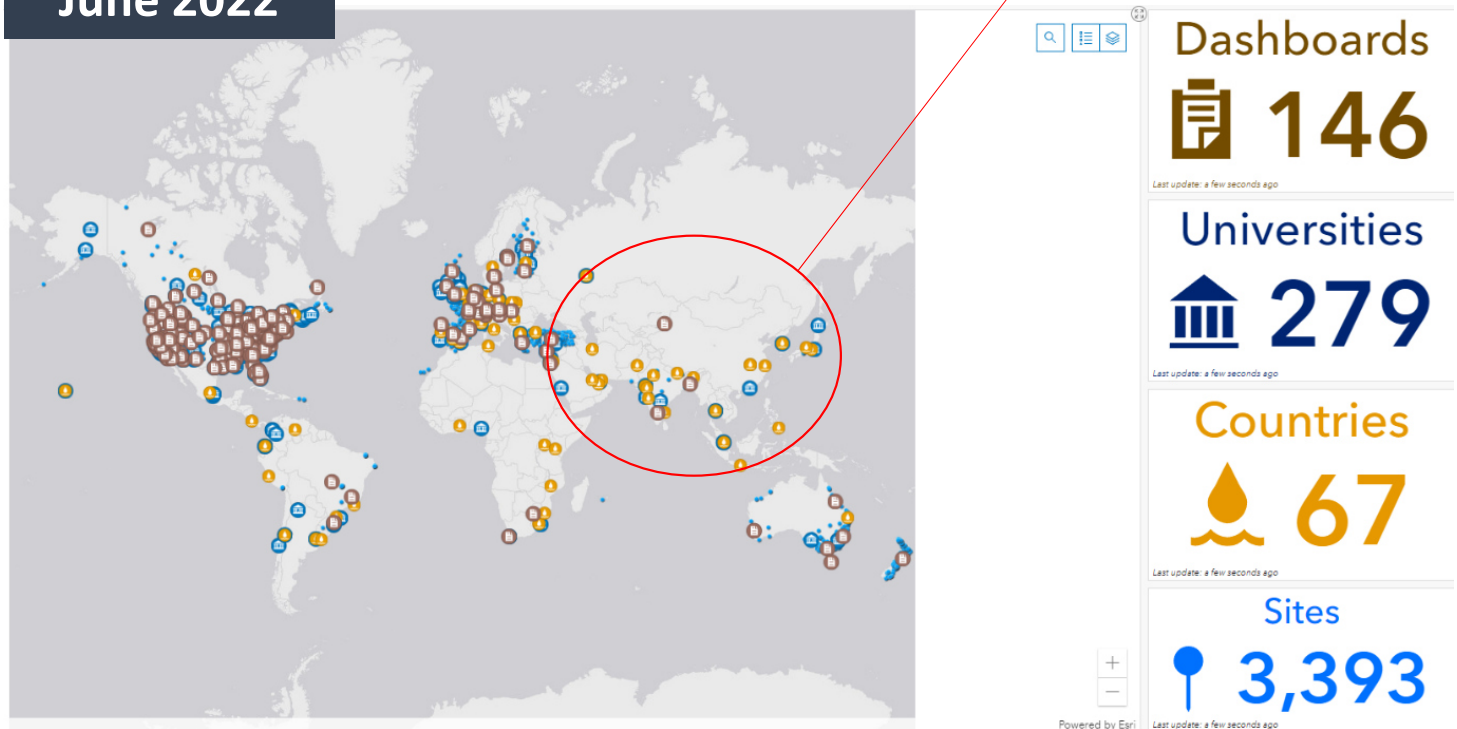
Evolution of Wastewater Surveillance during COVID-19

March 2020

< 10 countries

June 2022

Opportunities in Asia?

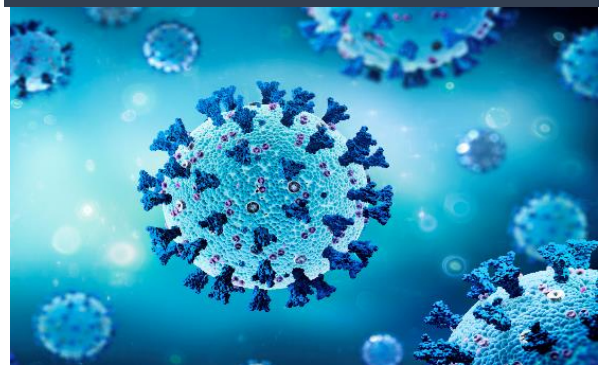


Source: https://ucmerced.maps.arcgis.com/apps/opsdashboard/index.html#/c778145ea5bb4daeb58d31afee389082

Steps to Program Implementation

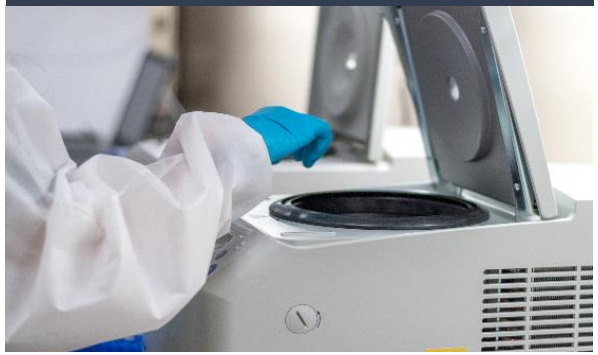
1. Engage with public health agencies

2. Establish approach & objectives



3. Collect wastewater from WRRF, pump station, manhole

4. Pretreat and concentrate sample in laboratory



5. Extract nucleic acid from sample & quantify with PCR

6. Interpret data & incorporate into public health surveillance

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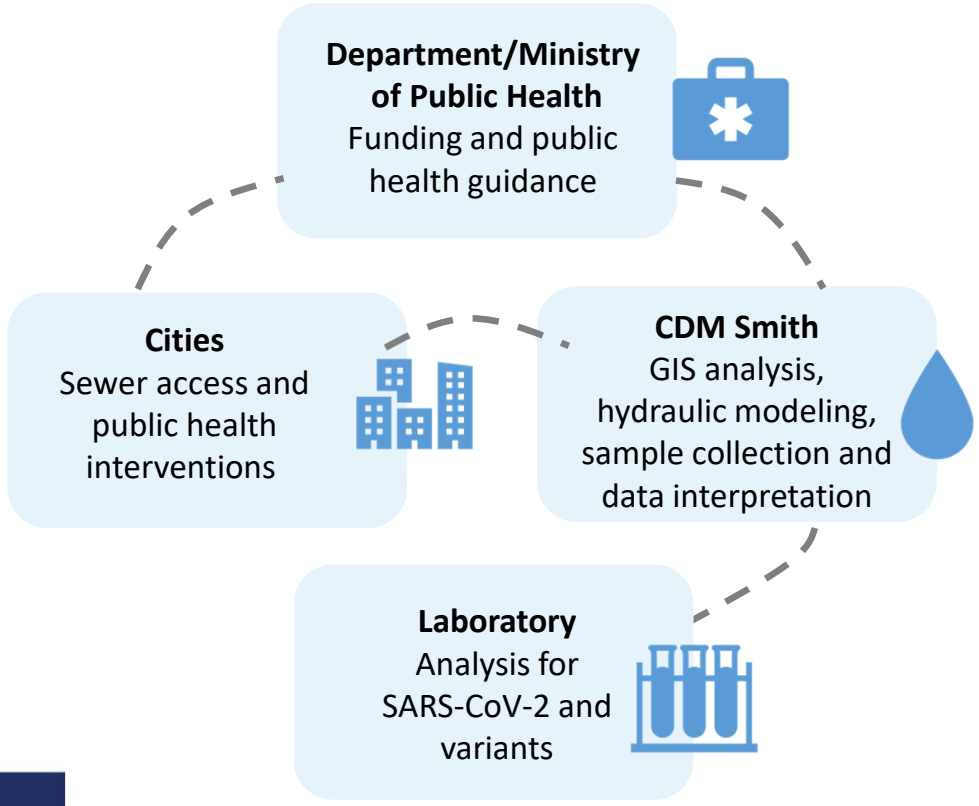
1. Public Health Agency Engagement

Collaboration is Critical!



Agency Collaborators

National

World Health Organization

Ministry of Health
The Hashemite Kingdom of Jordan

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

State (U.S.)

MDHHS
Michigan Department of Health & Human Services

Louisiana Department of Health

Cities

City of Detroit Health Department

2. Establish Approach and Objectives

Public Health Goals

- Social vulnerability
- Urban/Rural
- Geographic Coverage
- Population Distribution
- Defined Success Factors

Sampling Scale

Cities	Neighborhoods	Buildings
		
WWTPs	Manholes	Cleanouts

WW Surveillance Use Cases

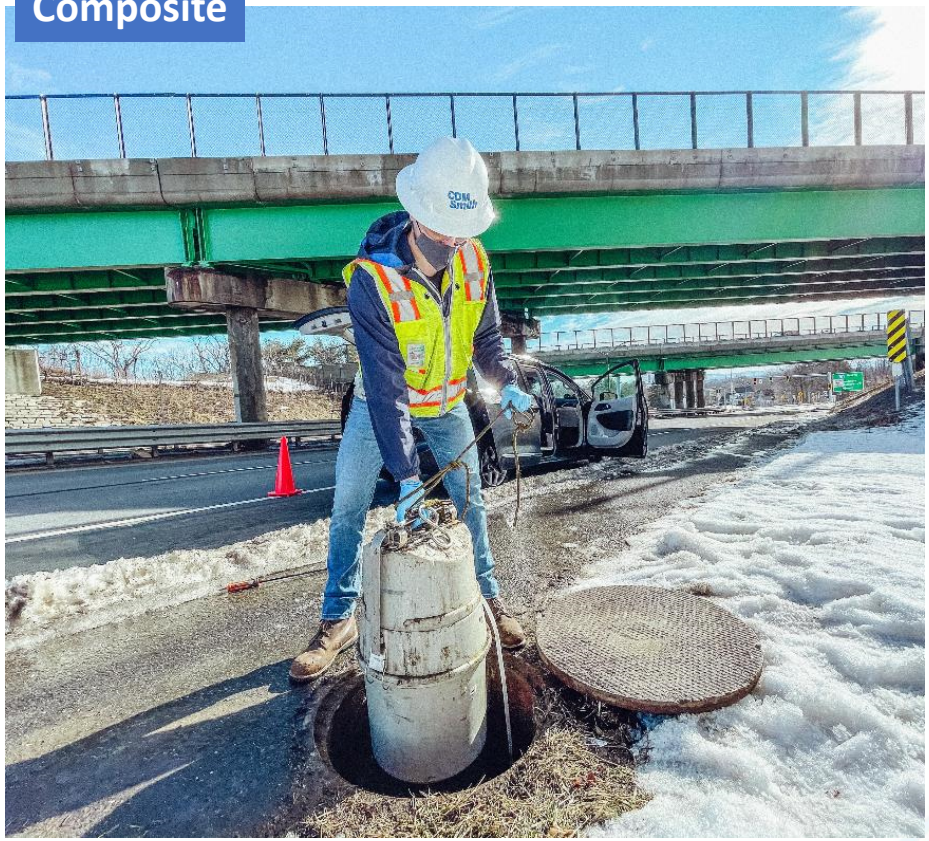
- Confirm trends in clinical data
- Provide early warning for new outbreaks
- Identify hotspots
- Estimate disease prevalence
- Evaluate presence of variants
- Confirm absence of disease

3. Sampling Methods

Grab

Courtesy of Dina Sabbagh

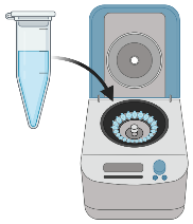
Composite



Courtesy of Kyah Lucky

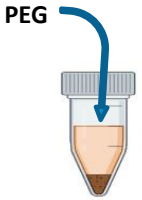
4. Concentration/Extraction

Concentration – Recovery Efficiencies



Direct Extraction
(No Concentration)

0-74%



PEG Precipitation

11-44%

Ultrafiltration

15-48%

Adsorption
(HA Filter)

27-66%

RNA Extraction – Pros and Cons

Manual RNA Extraction

- ✓ Cheaper
- ✗ Slower
- ✗ Lower Yield
- ✗ Cross Contamination

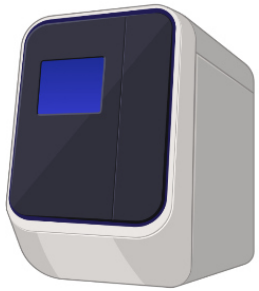
Automated RNA Extraction

- ✗ More Expensive
- ✓ Faster
- ✓ Higher Yield

- **Cost v. Efficiency**
- **Applicable to future pathogens?**
- **Consider Supply Chains**
- **Consistency is Key!**

5. Nucleic Acid Quantification

qPCR

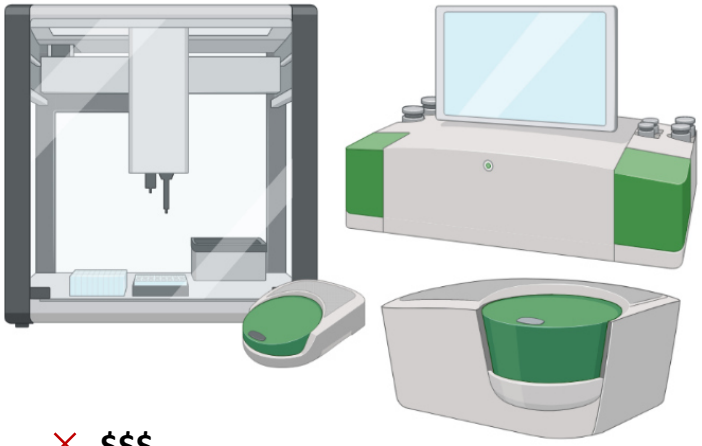


- ✓ $
- ✗ Required Standard Curve
- ✓ Slightly Faster than Others
- ✓ More Developed Assays
- ✓ Multiplexing (4 Channels)
- ✗ Sensitive to PCR Inhibitors
- ✗ Higher Detection Limit (10 GC/RX)

Digital PCR

- ✓ $$
- ✓ Standard Curve Not Required (Direct Absolute Abundance in Nano Partition Plates)
- ✓ Multiplexing (5 Channels)
- ✓ Strong against PCR Inhibitors
- ✓ Lower Detection Limit (3 GC/RX)

Droplet Digital PCR



- ✗ $$$
- ✓ Standard Curve Not Required
- ✗ Slightly Slower than Others
- ✗ Multiplexing (2 Channels)
- ✓ Strong against PCR Inhibitors
- ✓ Lower Detection Limit (1 GC/RX)

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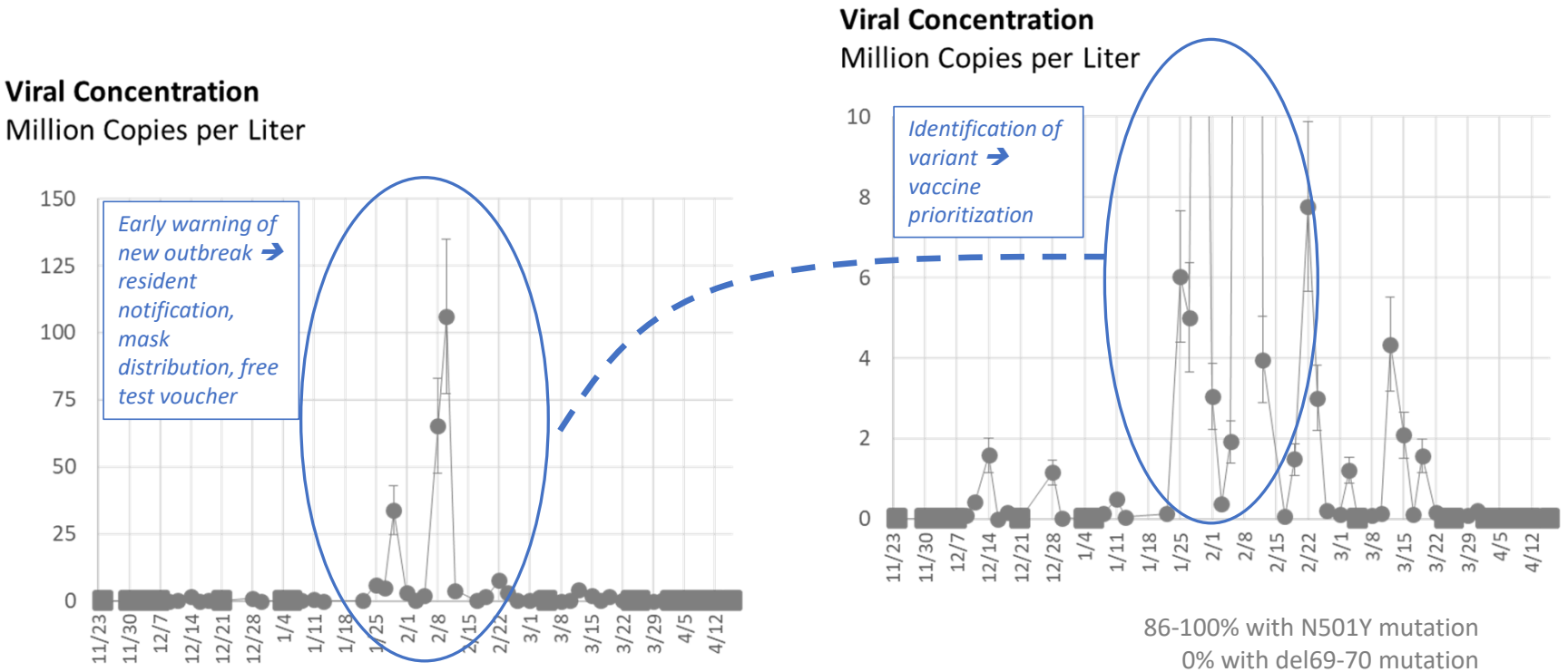
6. Data Interpretation and Use – Small Case Study



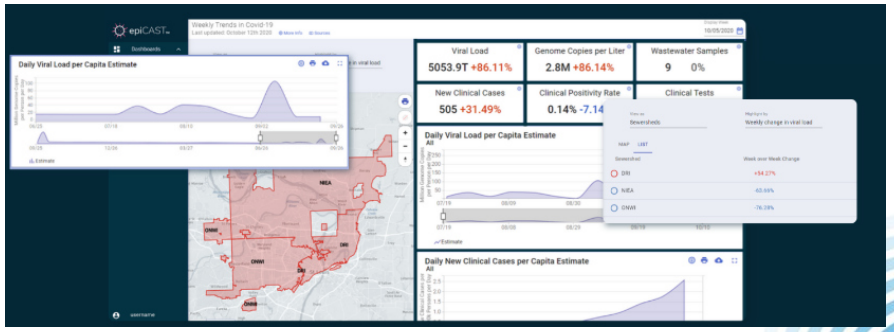
86-100% with N501Y mutation
0% with del69-70 mutation
➔ B.1.351 (Beta) or B.1.429 (California)

Recommendations for Wastewater Surveillance Program Implementation

- Collaborate Early and Often with Public Health Agencies
- Apply Public Health Goals When Developing Sampling and Analytical Strategy
- Consider Wastewater Surveillance Use Cases
- Do not Underestimate Logistical Constraints in Sampling and Analytical Testing
- Compare Costs and Benefits of Sampling and Analytical Steps
- Engage Contractors with Wastewater Infrastructure and Analytical Experience
- Apply Tools for Rapid Data Integration and Interpretation
- Funding Anticipated to Be Provided from International Public Health Agencies (WHO/CDC)

epiCAST™

https://www.trinnex.io/products/epicast



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