NATIONAL ACADEMIES *Sciences Engineering Medicine*

Wastewater-based Disease Surveillance For Public Health Action

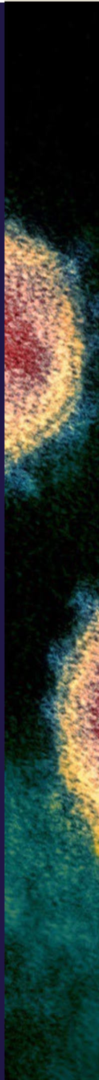
Guy Palmer, Committee Chair

Stephanie Johnson, Study Director

CONSENSUS STUDY REPORT

Statement of Task

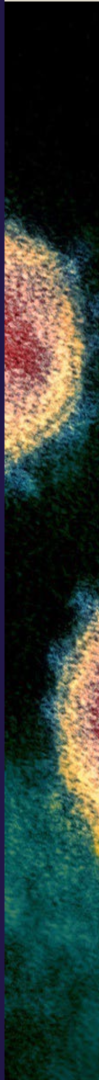
- Describe wastewater-based disease surveillance and how it differs from other disease surveillance.
- Review how wastewater surveillance has been useful in understanding COVID-19 in communities and informing public health decisions.
- Examine the potential value of wastewater-based disease surveillance for understanding and preventing disease and illness beyond COVID-19 and factors that may limit its application in the U.S.
- Describe the general characteristics of a robust, integrated approach for national use of wastewater-based disease surveillance.
- Discuss broad approaches to increase the public health impact of wastewater surveillance in the U.S and the most effective strategies for federal, state, and local coordination.



Study Process: Phase 1

- 2 hybrid information-gathering meetings, 9 virtual meetings over 6 months
- Peer-reviewed consensus report
  - Publicly available 11 AM January 19th

- Phase 2 to begin ~Feb. 2023
  - Define specific characteristics a robust, integrated wastewater-based infectious disease surveillance program and discuss technical constraints and opportunities associated with wastewater sampling, testing, and data analysis
  - Identify significant technical limitations that could impact the feasibility of using wastewater surveillance as a platform for generating data for indicators of public health status and risk.
  - Describe research, development, and information sharing needs.

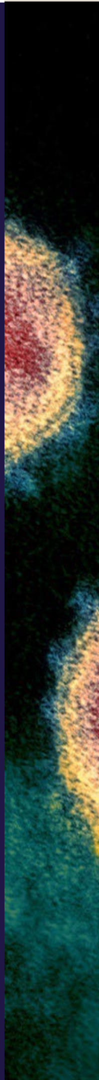


Committee Membership

GUY PALMER (NAM),* Chair, Washington State University, Pullman
AMI BHATT, Stanford University, Palo Alto, CA
MARISA EISENBERG, University of Michigan, Ann Arbor
RAUL GONZALEZ, Hampton Roads Sanitation District, Virginia Beach, VA
CHARLES HAAS (NAE), Drexel University, Philadelphia, PA
LOREN HOPKINS, Houston Health Department and Rice University, Houston, TX
NA'TAKI OSBORNE JELKS, Spelman College, Atlanta, GA
CHRISTINE JOHNSON (NAM), University of California, Davis
ROB KNIGHT, University of California, San Diego
SANDRA MCLELLAN, University of Wisconsin–Milwaukee
MICHELLE MELLO (NAM),* Stanford University, Palo Alto, CA
JOHN SCOTT MESCHKE,* University of Washington, Seattle
REKHA SINGH, Virginia Department of Health, Charlottesville
NEERAJ SOOD, University of Southern California, Los Angeles
KRISTA WIGGINTON,* University of Michigan, Ann Arbor

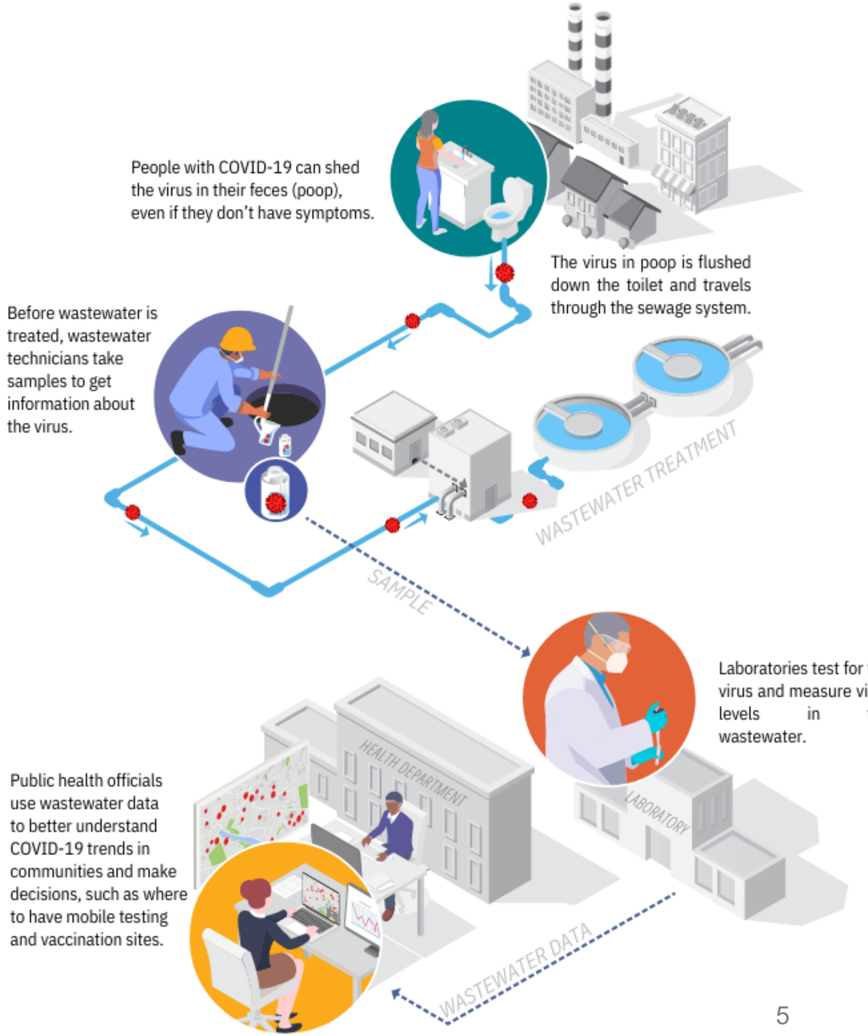
**Attending briefing*

NATIONAL ACADEMIES Sciences Engineering Medicine



What is Wastewater Surveillance?

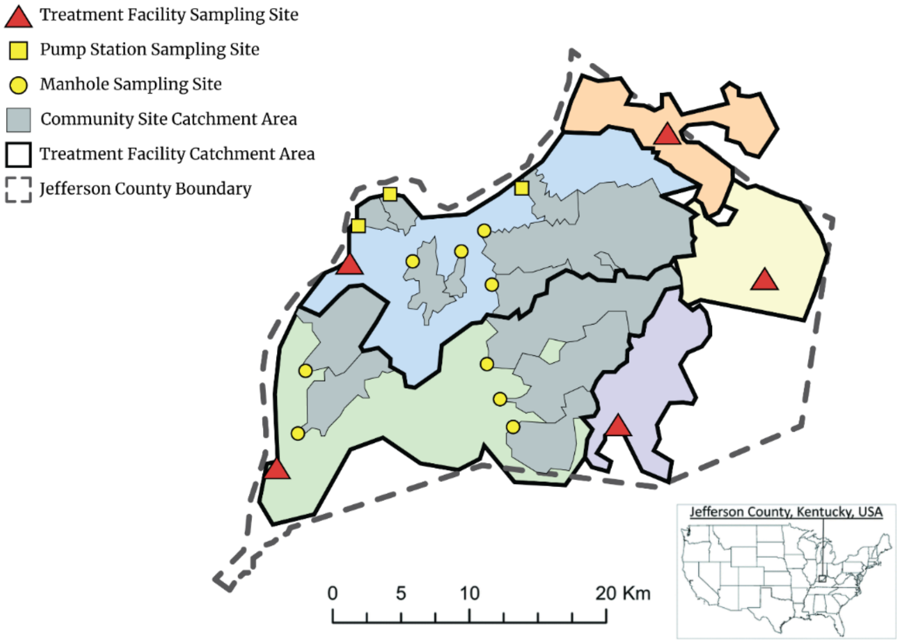
- Collect samples of untreated municipal wastewater
- Analyze for biomarkers of infection shed by infected persons
- Provides aggregate data from community sewershed
- 84% of U.S. households connected to a wastewater treatment plant
- Used in global polio eradication efforts



Diversity of Community Sewersheds

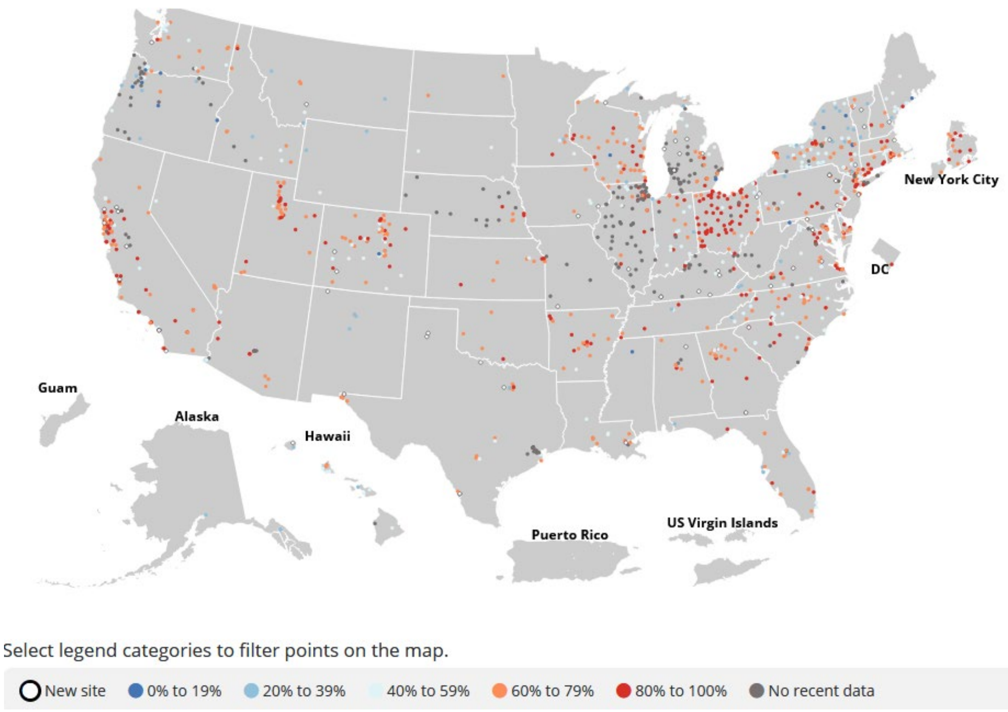
- Wastewater plants range in size from hundreds to millions served
- Sewershed scale influenced by factors including population size, density, geopolitical boundaries, topography
- May be impacted by transient populations
- Spatial detail and precision varies dramatically across sites

Photo by brewbooks, Flikr



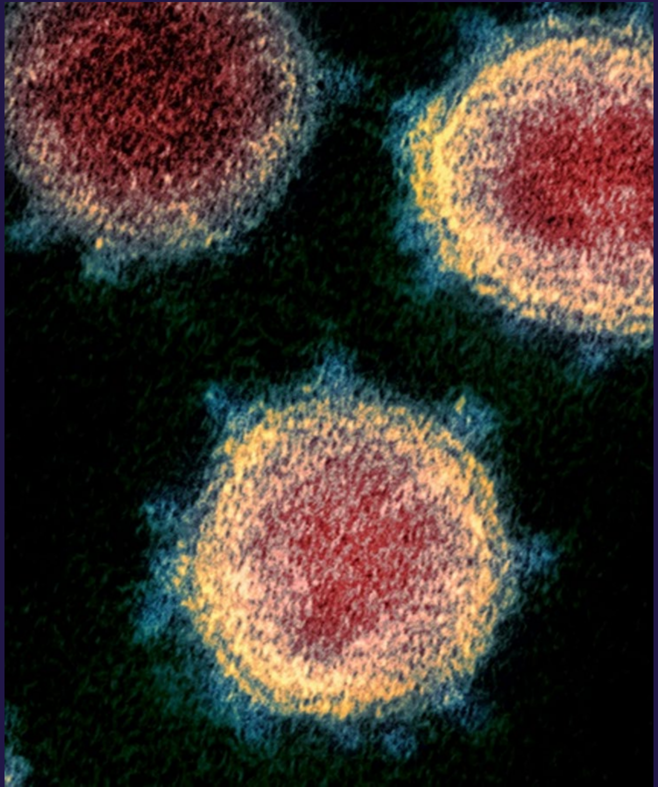
National Wastewater Surveillance System (NWSS)

- CDC piloted in September 2020 in 8 states
- As of Oct. 2022, >1250 sampling sites, covering >133 million people
- CDC and federal govt. provides:
  - Funding (FY22 supported 42 states, 5 cities, and 10 tribes)
  - Data aggregation
  - Coordination/collaboration (Communities of Practice; Centers of Excellence)



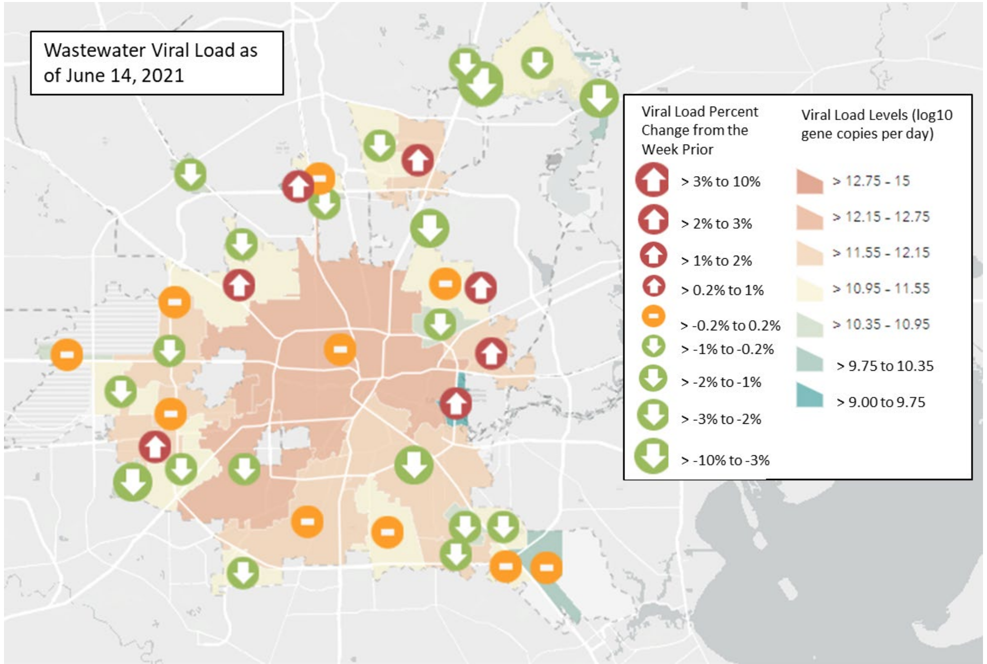
NATIONAL ACADEMIES *Sciences Engineering Medicine*

Wastewater Surveillance for COVID-19



Value of WWS Data for Understanding COVID-19 in Communities

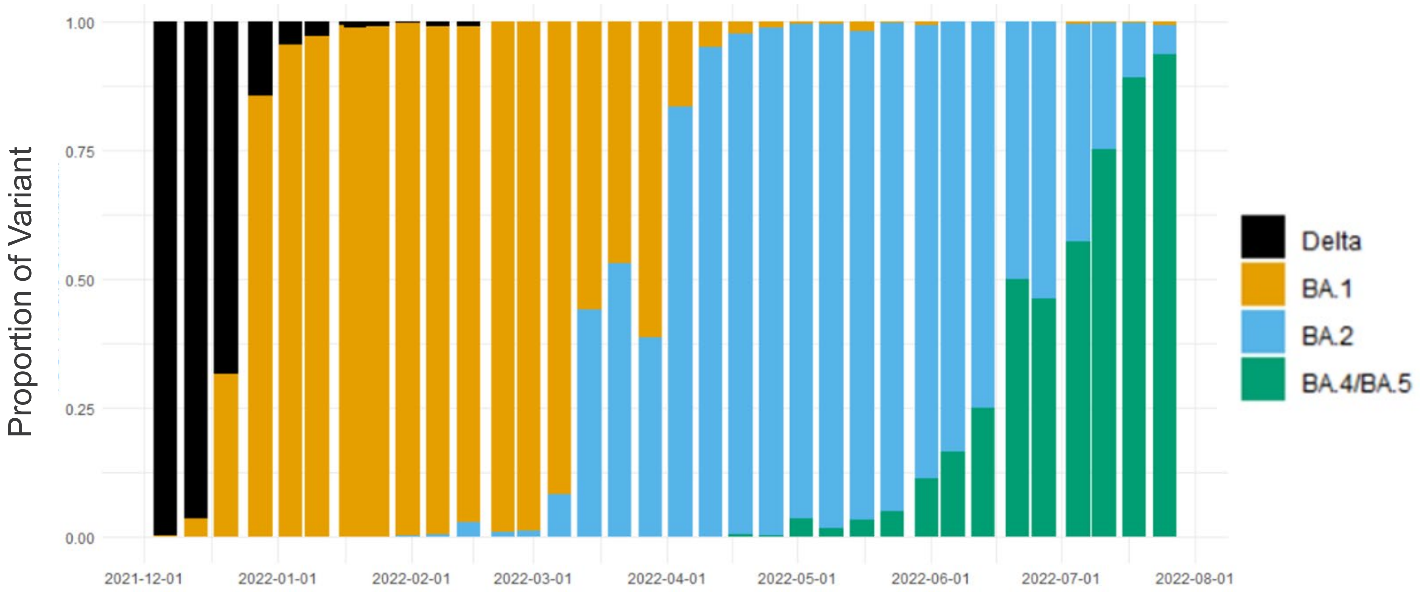
- Useful to assess trends in COVID-19 prevalence
    - Unbiased
    - Increasingly important with more at-home testing
    - Can identify spatial & temporal differences
- Data consistently lead hospitalization data



Monitoring at 39 WWTPs in the City of Houston, TX

Value for Understanding COVID-19 in Communities: Emergence and Spread of SARS-CoV2 Variants

Effective strategy to monitor variants among a large population



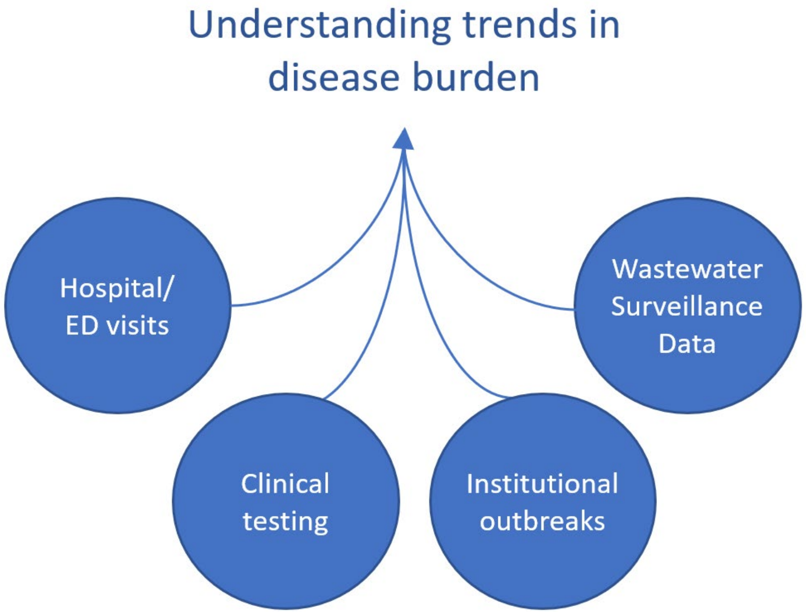
Source: Hampton Roads Sanitation District

NATIONAL ACADEMIES *Sciences Engineering Medicine*

Informing Public Health Actions

Wastewater surveillance data particularly valuable for:

1. Identifying and confirming trends through comparison with other data,



Informing Public Health Actions

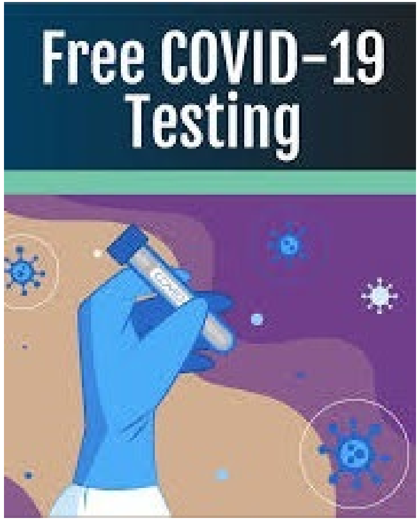
Wastewater surveillance data particularly valuable for:

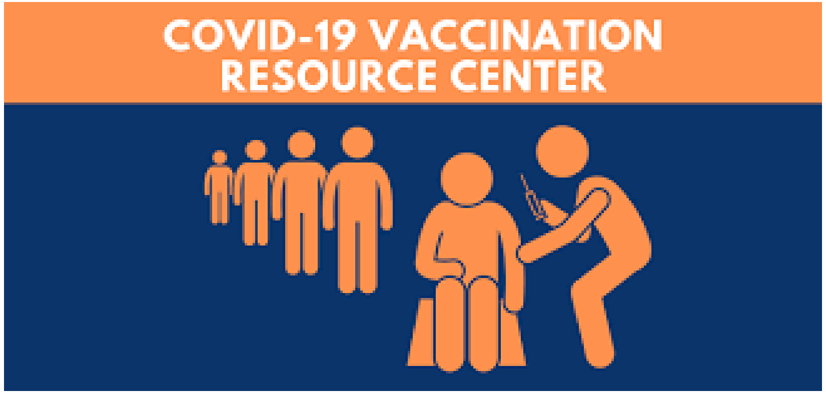
1. Identifying and confirming trends through comparison with other data,
2. Informing masking, social distancing, and stay-at-home policies,

Informing Public Health Actions

Wastewater surveillance data particularly valuable for:

1. Identifying and confirming trends through comparison with other data,
2. Informing masking, social distancing, and stay-at-home policies,
3. Informing public health resource allocations,





Informing Public Health Actions

Wastewater surveillance data particularly valuable for:

1. Identifying and confirming trends through comparison with other data,
2. Informing masking, social distancing, and stay-at-home policies,
3. Informing public health resource allocations, and
4. Informing clinical resource allocations (e.g., beds, staffing).

Wastewater Surveillance for COVID-19

NWSS worthy of further development and continued investment

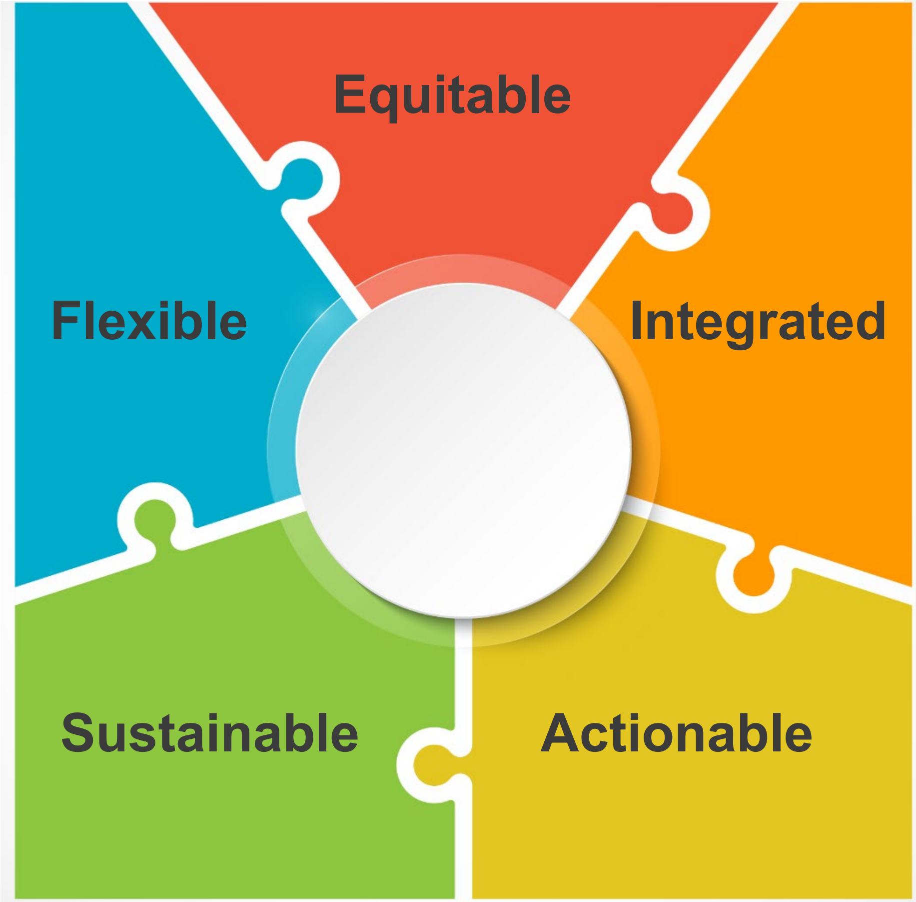
With rapid innovation and implementation. challenge now to:

- unify sampling design, analytical methods, data interpretation
- create representative national system
- maintain innovation

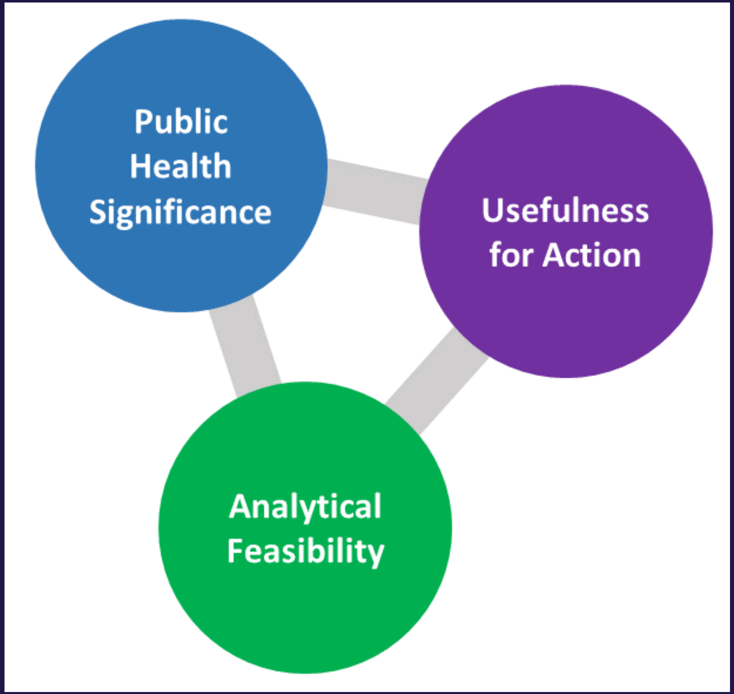
Vision for a National Wastewater Surveillance System

Vision for a National System: Key Characteristics

Community-based wastewater surveillance will continue to be a valuable part of managing infectious disease outbreaks



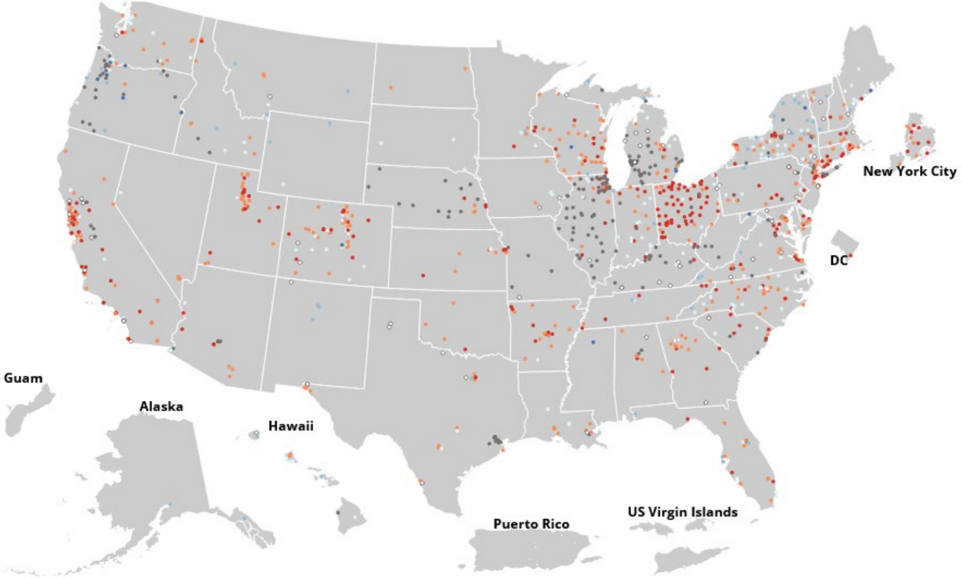
Framework for Evaluating Future Targets
(beyond ongoing COVID-19 surveillance)



NATIONAL ACADEMIES *Sciences Engineering Medicine*

Temporal and Spatial Resolution

- Current system based on willingness to participate
- Current distribution not fully representative, equitable, optimally actionable; may not be sustainable
- NWSS should be intentionally designed spatially & temporally based on rigorous analysis of data for priority pathogens

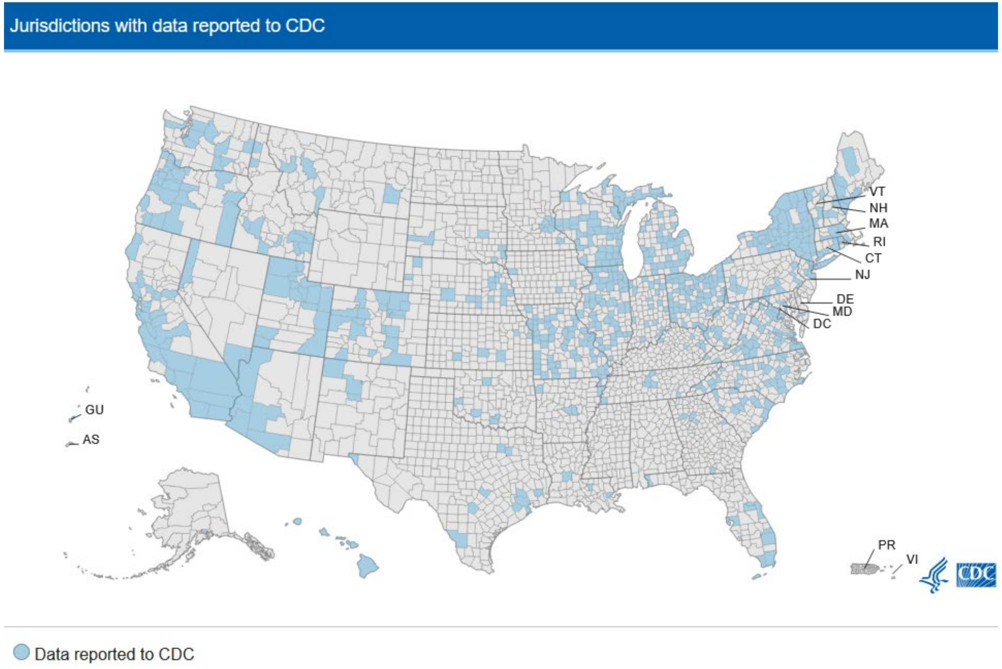


Source: CDC

Improving the Distribution of NWSS Benefits

Based on intentional design CDC should:

1. Create a comprehensive outreach program to states/localities not currently participating
2. Reduce financial and capacity barriers
3. Assess capacity to extrapolate data to areas without wastewater surveillance



Source: CDC

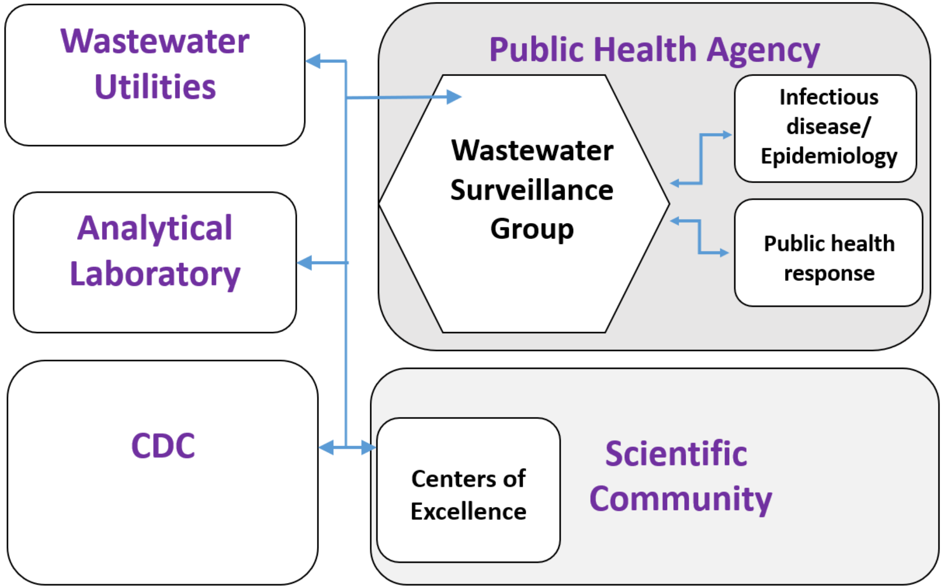
Sentinel sites

- Intentionally selected sites would provide important, distinct benefits in a national surveillance network
- Allow early detection of emerging pathogens at points of entry
- Could include:
    - Major international airports
    - Zoos and wildlife parks
    - International athletic events

Strategies for Achieving the Vision

Strategies for Achieving the Vision

- CDC should develop an open and transparent process for prioritizing targets
- Close coordination among public health agencies, analytical labs, and utilities is essential
- Scientific community essential to drive innovation
- Effectiveness of NWSS will depend on predictable, sustained federal investments



Addressing Privacy Concerns

CDC should:

- Convene an ethics advisory committee, modeled after data use committees
- Clearly communicate how data are used with public
- Maintain strong firewall that precludes use by law enforcement
- Revisit data sharing policies as technology evolves

Summary

- Wastewater surveillance has proven to be a valuable component of the COVID-19 pandemic response with increasing importance to understand trends and variants
- Looking forward, a national wastewater surveillance system should be equitable, sustainable, integrated, actionable, and flexible.
- CDC should develop a transparent process for prioritizing new targets and work to address privacy concerns
- Predictable and sustained federal funding and coordination/collaboration among many partners will be critical to the effectiveness

NATIONAL ACADEMIES *Sciences Engineering Medicine*

Next Steps

- Full report at http://www.nap.edu/
- Webinar posted online in ~1 week
- Phase 2 to start in early 2023, due mid-2024