

# WASTEWATER-BASED SURVEILLANCE FOR PUBLIC HEALTH

KNOWLEDGE  
TO ACTION  
S E R I E S



# WELCOME TO THE WASTEWATER-BASED SURVEILLANCE FOR PUBLIC HEALTH Knowledge-to-Action Series

The purpose of the Wastewater-Based Surveillance (WBS) for Public Health Knowledge-to-Action Series is to capture what is being learned by public health practitioners and their partners about interpreting and communicating wastewater-based surveillance (WBS) information. The resources in this series are intended to guide and support the use of WBS to protect and improve the health and wellbeing of people in health regions and communities across Canada.

This series evolved out of a partnership between the Canadian Water Network (CWN) and the National Collaborating Centre for Infectious Diseases (NCCID), which launched in 2022 with funding from the Public Health Agency of Canada (PHAC) and Indigenous Services Canada (ISC). This peer-learning project brought together over 30 Public Health practitioners, researchers and advisors from across Canada to explore promising practices for interpreting and communicating WBS data to protect and promote the health of Canadians.

For more information please visit [WBS Program – Canadian Water Network \(cwn-rce.ca\)](https://cwn-rce.ca)



## How to use this information

This series is intended for public health personnel working across all levels (front line, research and decision-making), disciplines (epidemiology/informatics, environmental health, infectious disease prevention/management, and health promotion) and jurisdictions (local, regional, national). Some of the resources may be appropriate for sharing with community partners to strengthen learning and collaboration for building a strong monitoring and assessment system in support of community health.

These resources will develop as new information is added to this rapidly evolving area. Users are encouraged to provide feedback and recommend additional tools and topics for the series.



# What is public health wastewater-based surveillance?

## Public Health Surveillance

Public health surveillance is both “the ongoing, systematic collection, analysis and interpretation of health-related data essential to planning, implementation, and evaluation of public health practice” (CDC, 2017), and the “prompt dissemination of results to those who need to know, particularly those who are in a position to take action.” (WHO, n/d)

Within various surveillance systems, public health professionals collaborate with partners across different settings and organizations to:

1. Systematically collect, manage, analyze and interpret data.
2. Communicate the resulting information to guide decisions and inform public health action, including for various audiences.

**Surveillance program = processes + components + administration**

**Surveillance system = processes + components**

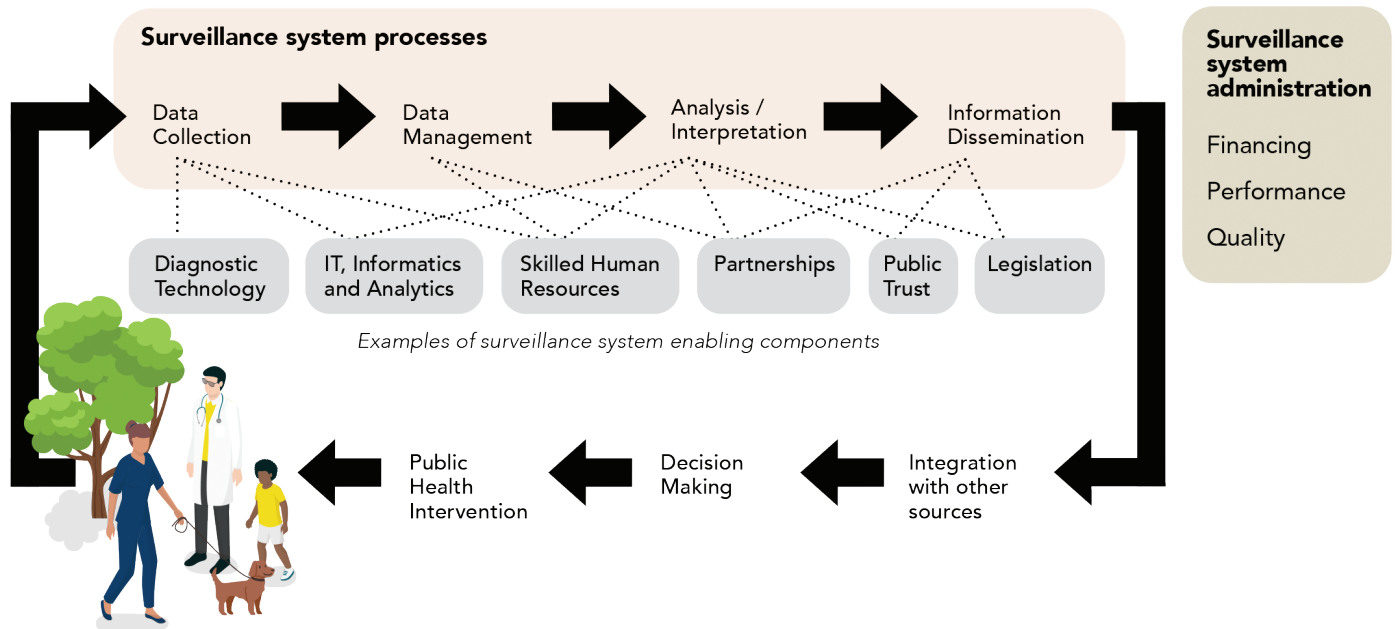


Figure 1: Surveillance processes, systems and programs (PHAC, 2023, pg. 4)

## Wastewater-based Surveillance

Wastewater-based surveillance is part of the public health surveillance system (see Figure 2). It has been used since the 1950s when it was applied to polio virus surveillance. It evolved quickly in the last few years with the rapid development of related technology for the identification and tracking of the SARS-CoV-2 virus. In Canada, wastewater surveillance is currently used for the detection of SARS-CoV-2, influenza, mpox and respiratory syncytial virus (RSV). Wastewater

surveillance can also be used for monitoring opioids and anti-microbial resistance (CADTH, 2022; NCCID, 2023; PHAC, n/d).

Wastewater is a useful matrix to study as it provides a pooled sample from a group of people in a specific geographic allocation at a point in time. It is non-invasive, anonymous and has the potential to be applied at a range of scales, from single facilities to large towns and cities. Viruses such as SARS-

CoV-2 do not replicate outside of a host. Therefore, the quantity detected in wastewater indicates the total amount being shed by the community at a point in time (O’Keeffe, 2021).

There are several benefits for using WBS:

- Early identification of a problem: Using WBS can help anticipate disease incidence in communities and enable a targeted public health response before cases are reported through clinical testing.
- Small community/facility protection: Early data can prevent outbreaks in specific resident populations who may be vulnerable, or where testing levels are low.
- Evaluation of interventions: WBS can be used as a tool for observing and assessing the impact of public health measures during an outbreak or health emergency, or to detect new variants/issues.

At the same time, there are many challenges still to be overcome, including:

- Analytical issues related to methods, quality controls and sample storage, the impact of seasonal or weekly

changes in water flow, and how to normalize data.

- Understanding variability between people and the community size/ context.
- Who has responsibility for managing the WBS program, human resource capacity, health and safety concerns, integration into existing surveillance systems, and costs/benefits of scaling up.
- Determining how to communicate with decision-makers to transition from a research-based approach to a service-based approach

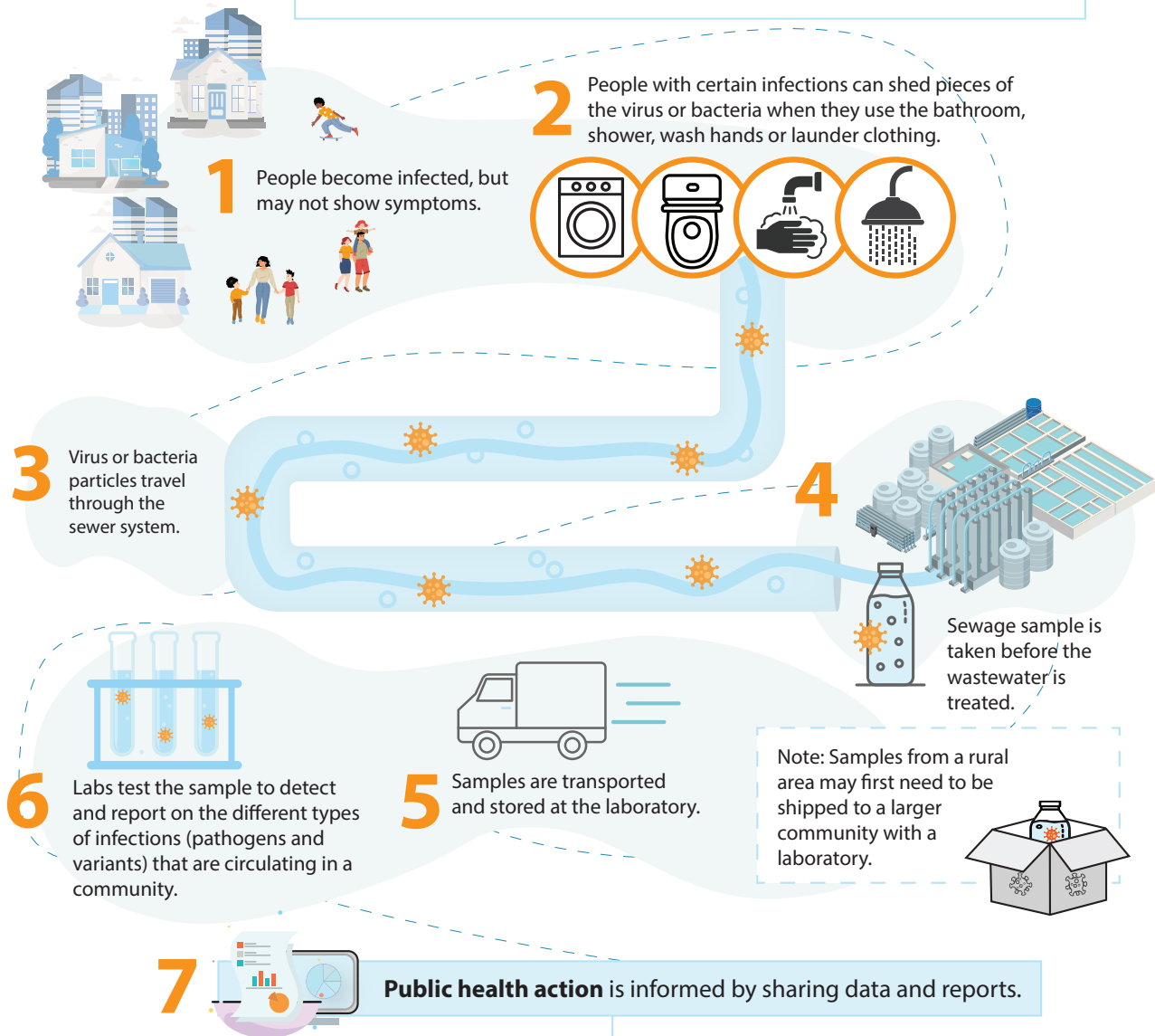
Future uses of wastewater surveillance may include expanded monitoring of antibiotic use and resistance, detection of cancers in the population, or assessment of the prevalence of other infections within communities (CADTH, 2022).

WBS cannot replace the gold standard of clinical diagnostic testing for surveillance purposes, but it is an important tool as a leading indicator or early warning, depending on the disease/health issue of interest and when clinical data is unavailable.



## Public Health Wastewater-Based Monitoring

Wastewater-based monitoring is an early detection tool that can help communities, public health and researchers prepare for and take action to address increases of infectious disease, and monitor other health indicators in a population.



**Interpret Results:** alongside other public health and clinical data, to better understand disease trends and make decisions.

**Who:** Public health officials along with environment and wastewater collaborators.

**Share Information:** in an open and transparent way to engage the public in prevention and control measures, including options for prevention, testing and vaccination.

**Who:** Public, policy makers, media

**Advance Science:** to better understand the virus, bacteria, or disease/illness.

**Who:** Researchers, students, and informed public

## WHAT DO WE MEAN BY KNOWLEDGE TO ACTION?

This series aims to share public health experiences and information to support the interpretation and communication of wastewater-based surveillance (WBS) information. This will strengthen public health action at a population level and potentially influence health behaviours at the individual level. Trust is central to this public health role.


The context for public health surveillance has changed dramatically in the last 20 years, and especially since the COVID-19 pandemic. The pace of innovation continues to increase as technology evolves. But perhaps, more importantly, public awareness has changed as well. The public expects transparency and access to information. There is also an increased demand for data from scientists, clinicians, policymakers and media. In addition, there has been increased recognition of the importance of health equity and the value of data that is specific to different groups (e.g., disaggregated data) (Hoffman, 2023).

“  
*Our entire approach to public health is based on people having a basic level of trust in public institutions. Without it, our health communications are destined to fail.*  
”

(Communicate Health, 2023, pg. 2)



*Surveillance communication* has shifted from a technocratic approach with minimal and basic information for the public to a more democratic approach that uses storytelling, social media and interactive tools. Government policies have shifted to an ‘open government’ approach with a streamlined web presence and improved accessibility and interoperability. An equity focus is now integral and requires consideration of the impact of social determinants of health and attention to structural inequities such as colonization. This has impacted the surveillance communication skillset and competencies (e.g., storytelling, health literacy, etc.) and technical knowledge (e.g., how to support Indigenous data sovereignty) to engage the full spectrum of stakeholders (Hoffman, 2023).



See **Part 2 – Ottawa Public Health** for more about the increase in public demand for open data.

Two key concepts are essential for effective surveillance communication: health literacy and science communication.

## Health Literacy

Health literacy informs effective surveillance communication and is essential for bridging the ‘knowledge to action’ divide. Health literacy includes two dimensions (CDC, n/d):

- **Personal health literacy:** The degree to which individuals can find, understand and use information and services to inform health-related decisions and actions for themselves and others.
- **Organizational health literacy:** The degree to which organizations equitably enable individuals to find, understand and use information and services to inform health-related decisions and actions for themselves and others.

The design of surveillance communication tools needs to consider the needs and abilities of the target audiences, including healthcare stakeholders outside of public health and community partners.

## Science Communication

Science communication, which includes risk communications, needs elements of both communication and engagement to be effective.

- **Communication** is a process of developing shared meaning that forms our experiences and relationships with each other and the material world in which we live.
- **Engagement** is multidirectional interaction among stakeholders that leads to different kinds of change, including (but not limited to) furthering relationships among stakeholders, building connections between seemingly unrelated viewpoints, promoting shared learning and understanding, discussing the benefits and risks of science and technology, and co-creating research and generating new scientific knowledge relevant to communities (Aurbach et al, 2019).

The need for two-way communication and engagement in the context of WBS and SARS-CoV-2 was reinforced in the Royal Society of Canada Policy Briefing (Hrudey et. al., 2022). The report noted that communicating WBS data is also a potential strategy to enhance risk communication by keeping the presence of COVID-19 in the public eye and may encourage people to seek clinical testing and reduce complacency about control interventions (Hrudey et. al., 2022).

See **Part 3 – Data Governance and Ethics**



for exploring issues related to data control and data sovereignty for Indigenous peoples as part of engagement.

## Evidence informed action for practice and decision making

Ultimately, knowledge needs to inform action to protect the public and improve health. The Royal Society of Canada Policy Briefing notes that “translating knowledge into action is best facilitated by having the decision-makers involved in the early stages of surveillance development” (Hrudey et al., 2022, pg. 82).

Establishing an effective and timely WBS system requires an integrated approach to knowledge translation (see **Figure 3**).

*“The extensive research conducted on WBS to date has developed sampling methodologies, analysis approaches and modeling using wastewater data. The next step is to translate these findings into action to inform decision systems, engage communities and increase resilience to future pandemics”*

(Korfmacher & Harris-Lovett, 2022, pg. 2).

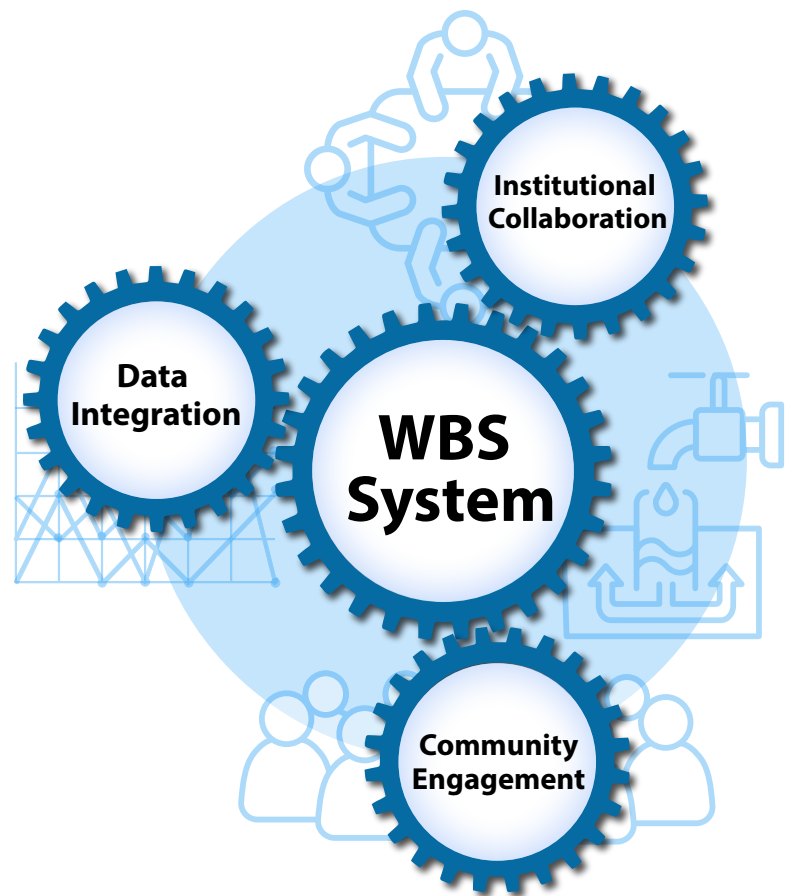


Figure 3: Elements of an effective WBS system (Korfmacher & Harris Lovett, 2022).



## For more information

### Canadian resources

- Canadian Water Network (CWN) – Public Health Peer Learning [Program](#).
- National Collaborating Centre for Infectious Disease (NCCID) – Covid-19 Monitoring [Program](#).
- National Collaborating Centre for Environmental Health (NCCEH) - Looking for COVID-19 clues in our sewers ([Resource](#), 2021) .
- CANCovid (2023). How Language Shapes Change: Perspectives on the Most and Least Effective Communication Strategies and Tactics During the COVID-19 Pandemic ([Resource](#)).
- Canada’s Drug and Health Technology Agency (CADTH) (2023). Wastewater Surveillance for Communicable Disease ([Project](#)).

### American resources

- Centers for Disease Control and Prevention (2022). National Wastewater Surveillance System (NWSS - [Program](#)).
- Mathematica (2023). Translating Wastewater Data into Public Health Action ([Project](#) and Resources).

## References

- Aurbach, E.L., Prater, K.E., Cloyd, E.T. & Lindenfeld, L. (2019). *Foundational Skills for Science Communication: A Preliminary Framework* [White Paper]. Retrieved from the University of Michigan: <https://deepblue.lib.umich.edu/handle/2027.42/150489>
- Canada's Drug and Health Technology Agency (CADTH) (2023). *Wastewater Surveillance for Communicable Disease*. Available from: <https://www.cadth.ca/wastewater-surveillance-communicable-disease>
- Centers for Disease Control and Prevention (CDC) (2014). Introduction to Public Health. In: Public Health 101 Series. Atlanta, GA: *U.S. Department of Health and Human Services, CDC*; 2014. Available at: <https://www.cdc.gov/training/publichealth101/surveillance.html>.
- Centers for Disease Control and Prevention (CDC). *How Wastewater Monitoring Works*. November, 2023. Available from: <https://www.cdc.gov/nwss/how-wws-works.html>
- Centers for Disease Control and Prevention (CDC) (n/d). *Health Literacy*. Available from: <https://www.cdc.gov/healthliteracy/index.html>
- Communicate Health (2023). *A Framework for Equity-Centered Health Communication*. Available from: <https://communicatehealth.com/wp-content/uploads/CH-ECHC-Framework.pdf>
- Hoffman, SJ (2023). Public Health Surveillance in Canada: Future Directions. *Public Health Agency of Canada*, January 25, 2023. Available from: <https://www.fields.utoronto.ca/talk-media/1/67/37/slides.pdf>
- Hrudey, S. E., et al. (2022). Wastewater Surveillance for SARS-CoV-2 RNA in Canada. *Royal Society of Canada Policy Briefing*. 2022. Available from: <https://rsc-src.ca/en/covid-19-policy-briefing/wastewater-surveillance-for-sars-cov-2-rna-in-canada>
- Korfmacher, KS and Harris-Lovett, S (2022). Invited Perspective: Implementation of Wastewater-Based Surveillance Requires Collaboration, Integration, and Community Engagement. *Environmental Health Perspectives*, 130(5): May 2022. <https://ehp.niehs.nih.gov/doi/10.1289/EHP11191>
- Manuel, D, Amadei, CA, Campbell, JR, Brault, J-M, Zierler, A, and Veillard, J (2022). Strengthening Public Health Surveillance Through Wastewater Testing: An Essential Investment for the COVID-19 Pandemic and Future Health Threats. *International Bank for Reconstruction and Development / The World Bank*, Washington. Available from: <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/761521642623044776/strengthening-public-health-surveillance-through-wastewater-testing-an-essential-investment-for-the-covid-19-pandemic-and-future-health-threats>
- National Collaborating Centre for Infectious Disease (NCCID) (2023). *PHAC Wastewater Monitoring Program for COVID-19*, November 29, 2023. Available from: <https://nccid.ca/wastewater-surveillance-for-covid-19/>
- O'Keeffe J. (2021). Looking for COVID clues in our sewers [blog]. Vancouver, BC: *National Collaborating Centre for Environmental Health*. Available from: <https://ncceh.ca/resources/evidence-briefs/looking-covid-19-clues-our-sewers>
- Public Health Agency of Canada (n/d). Emergency preparedness and response – Wastewater monitoring. Government of Canada: <https://www.canada.ca/en/public-health/services/emergency-preparedness-response/wastewater-monitoring.html>
- Public Health Agency of Canada (2023). *A vision for public health surveillance in Canada by 2030: technical discussion guide*. Available from: <https://www.canada.ca/en/public-health/programs/consultation-vision-public-health-assessment-canada-future/document-technical.html>
- World Health Organization (n/d). Public health surveillance. *WHO Eastern Mediterranean Region*. Available from: <https://www.emro.who.int/health-topics/public-health-surveillance/index.html>

## OTHER TOPICS IN THIS SERIES

### PART 1: OVERVIEW

### PART 2: CASE EXAMPLES

The case examples in this Knowledge-to-Action Series are stories told from the perspective of the Public Health practitioners most closely involved in the development and implementation of the WBS program in their region. They are intended to provide a deeper understanding of the organizational and community context, and key learnings related to interpretation and communication of information related to wastewater-based surveillance.

- BC Centre for Disease Control.
- Ottawa Public Health.
- Nunavik Board of Health and Social Services.

### PART 3: WBS RESOURCES AND TOOLS

The resources and tools in this Knowledge-to-Action Series are intended to provide a summary of key information and communication topics for public health practitioners related to WBS. Each document includes core concepts with references and links to additional materials. There is also a set of reflection questions at the end for individuals and teams to consider when applying the concepts to the development and implementation of WBS programs.

- Data Governance and Ethics.
- Dashboards for Communication and Decision Making.



## **Wastewater-Based Surveillance for Public Health: The Knowledge-to-Action Series.**

### **Part 1 - Overview**

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