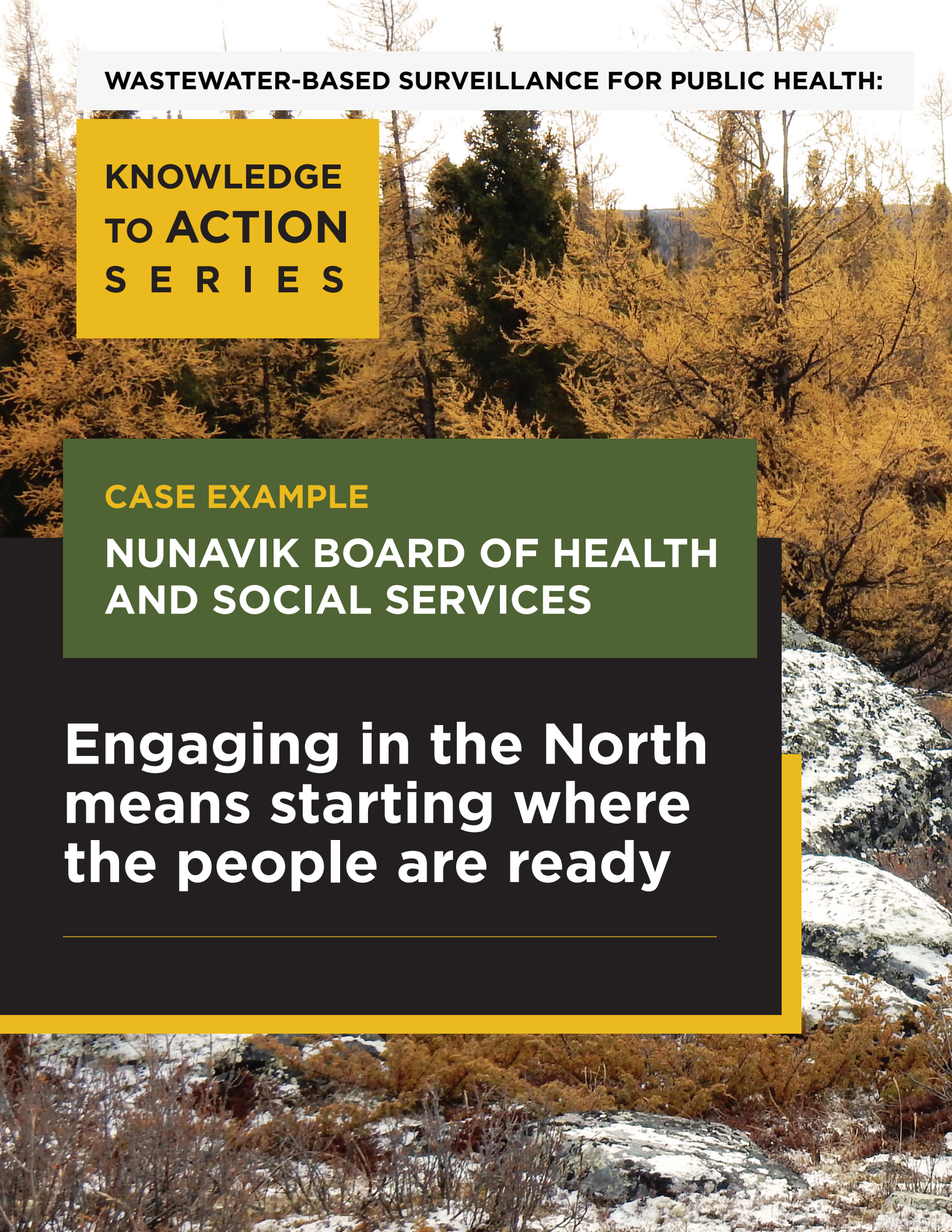
WASTEWATER-BASED SURVEILLANCE FOR PUBLIC HEALTH:

KNOWLEDGE TO ACTION SERIES



CASE EXAMPLE

NUNAVIK BOARD OF HEALTH AND SOCIAL SERVICES

Engaging in the North means starting where the people are ready

KEY TAKEAWAYS

1 Value of early detection: Limitations in the collection of other surveillance data in remote communities make early detection of pathogens through wastewater surveillance all the more valuable. This allows communities to respond in a timely way to contain contagions and reduce their dependence on external public health assistance once a disease has spread more broadly.

2 Infrastructure and testing: The capacity to collect sewage in a non-piped system, appropriately sample, and analyze the samples in a timely manner is an ongoing challenge in rural and remote communities. The solutions will be different in every community and need to be developed to fit the local context, with the appropriate investment in infrastructure and people to ensure sustainability over time.

3 Partnerships: Partnerships are essential for wastewater-based surveillance (WBS) systems, but they look different and take longer to develop in rural and remote communities. Indigenous government organizations, public health and academia all have roles to play in the development and implementation of a WBS system that is effective and sustainable and that meets local needs.

4 Community-based data: WBS information that represents the entire community is invaluable for understanding the local context and developing appropriate responses to outbreaks and other urgent health issues. Individual privacy is more protected compared to case-based data. However, as with all public health surveillance, it is important to consider the risk of stigmatizing populations if they are specifically identifiable. Community members must be part of planning and approval processes as co-owners of the data. Collaboration with Indigenous communities must follow Inuit Qaujimajatuqangit principles, the First Nations Principles of OCAP®, and other appropriate ethical protocols.

NUNAVIK BOARD OF HEALTH AND SOCIAL SERVICES

In Inuktitut, Nunavik means
"the great land."

The Nunavik region in northern Quebec covers approximately one-third of the landmass of the province and has a population of over 14,000 permanent residents. The region includes 14 communities scattered along the coast, from Hudson Bay in the west to Ungava Bay in the east. The largest community is Kuujjuaq, with a population of 2,600 people sitting at the tree line on Ungava Bay (see Figure 1 for a map of the region).

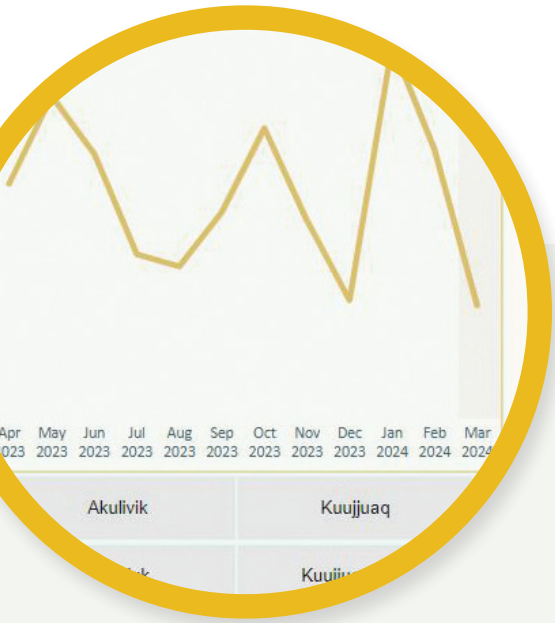
Health and social care programs and services in the region are provided by the Nunavik Board of Health and Social Services (NRBHSS), the Inuulitsivik Health Centre (IHC) and the Ungava Tulattavik Health Centre (UTHC). The NRBHSS Department of Public Health is responsible for the management of the regional public health program, which includes surveillance, environmental health, prevention and promotion, as well as the prevention and control of infectious diseases and emergency response.

Surveillance of respiratory infections

The public health department, with its surveillance mandate, collects information on mandatory declaration of diseases and other outbreak-prone infections. The plan to integrate respiratory infection surveillance data into a single dashboard was initiated in 2022 during the restructuring of the COVID-19 response teamwork. This brought together lab-based data for certain diseases, as well as clinical and administrative data for certain syndromes, with the intention of eventually integrating environmental surveillance data as well.

The **Nunavik Respiratory Infections Dashboard** provides up-to-date data on respiratory infections in the region (see: https://nrbhss.ca/en/coronavirus).

Trends are reported monthly as a consolidated data point representing all respiratory infections. The numbers of cases are not provided, but the distribution of cases is reported by village. This is visualized as bubbles, where the size corresponds to the number of cases identified, and the colour represents the level of risk for individuals to be exposed. Green represents low risk, yellow represents medium risk, and orange represents a high risk of viral circulation in the community. Key messages about recommended health behaviours for individuals to protect themselves are communicated for each level of risk.



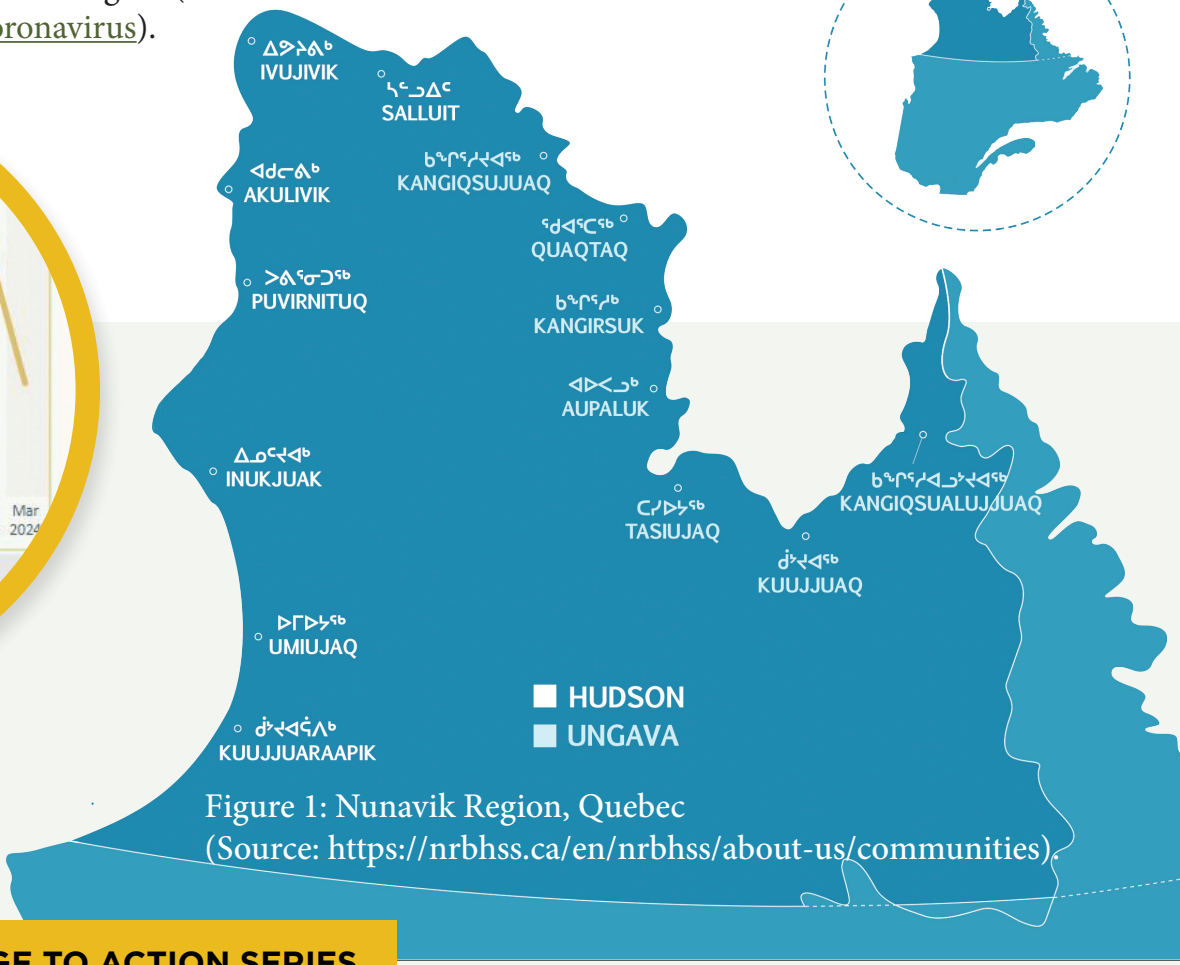


Figure 1: Nunavik Region, Quebec (Source: https://nrbhss.ca/en/nrbhss/about-us/communities).

WASTEWATER-BASED SURVEILLANCE (WBS) PILOT PROJECT

A pilot project to monitor sewage (i.e., wastewater-based surveillance) for respiratory viruses has been under way since November 2022 as a joint effort between NRBHSS and its partners at the University of Ottawa and the municipality of Kuujjuaq (NRBHSS, pg. 24). Exploratory projects have also been conducted in other municipalities. The plan is to eventually add WBS data to the Respiratory Infections Dashboard.

The remote nature of Nunavik, with many small communities and the lack of a piped sewage system (see Part 1 – Overview for an example of an urban sewage system), is part of the challenge of undertaking a surveillance project like this. Infectious disease specialists and epidemiologists are excited about the potential benefits of adding WBS to their toolbox and have wanted to move a project like this forward in the region for many years.

See Part 1 – Overview for an example of an urban sewage system.

Yassen Tcholakov, the clinical lead in infectious diseases (based in Montreal), describes how they have been moving forward one step at a time.

"We've talked about wastewater surveillance for a few years now, especially when it started becoming more popular during COVID-19. Then we had an outbreak of Hepatitis A in the region in 2021-2022 and explored the possibility of obtaining wastewater samples to see which communities were actually affected. While we weren't able to do this in a meaningful timeframe, the project remained in our minds and we picked it up after intensive COVID-19 operations wound down."

The public health team then had an opportunity to collaborate with colleagues Dr. Robert Delatolla and Dr. Stéphanie Guilherme from the University of Ottawa, who have expertise in WBS and relationships with local municipalities. This led to the pilot in Kuujjuaq as well as the exploratory projects in the other communities.

Data and sampling

Septic systems with tanks that need to be pumped out are common in rural communities. This is true for Kuujjuaq where trucks go around to individual homes to collect sewage and pump it into a municipal sewage lagoon. Where the trucks offload is the collection point for WBS samples.

Yassen points out the challenges of collecting wastewater in a setting like this. "Every sample is collected by an actual human being … we're basically relying on someone collecting. This is much more challenging than [working with] systems which can be mostly automated, and it also limits the nature of the samples that can be collected. These kinds of small [and rural] community challenges have a significant impact [which is] no one's fault … it's a kind of systems issue."

The pilot project is at the point where they have data over time, but it still needs to be triangulated with other surveillance data to evaluate its detection threshold and its accuracy. There is a lot more to learn before they can be certain it is useful and combine it with other data for use on the Respiratory Infections Dashboard in the region.

Community members must also be part of planning and approval processes as co-owners of the data, and collaboration with Indigenous communities must follow Inuit Qaujimajatuqangit principles, the First Nations Principles of OCAP®, and other appropriate ethical protocols.

For more information see: WBS Resources & Tools #1 - Data Governance and Ethics.

Funding and leadership

The partnership with Robert Delatolla's research lab at the University of Ottawa has been critical for getting the project to this point. The university is able to leverage research funding to provide technical knowledge and to test the samples.

The small amounts of funding the public health team has been able to secure have been used to support local workers collecting sewage samples and to fund students assisting the project team.

Ultimately, it is the collaboration of the municipality and the commitment of the public health team, in partnership with the university researchers, that keeps the project moving forward. They have made WBS a priority and they continue to do the work off the side of their desks. When asked about whether additional funding would be valuable, the team acknowledges that more resources are helpful but there are many issues that will not go away by throwing money at the problem. Both long-term collaboration and adaptation of solutions to the local context are necessary to resolve key challenges that are largely field operational issues.

Senior public health leadership is needed. As Fiston Muneza, a public health epidemiologist based in Ottawa notes, "the will is there and whenever there is a need [the leadership] responds [to support us]."

Yassen emphasizes the importance of the work during this pilot phase being driven by those who are most interested and committed to learning and exploring.

"We've created the impetus within ourselves … and we've chosen communities who are interested in working with us at this point. We are so [early in the process that] we don't want to force or try to convince someone … when we are not yet sure what the true benefit [will be]."

Opportunities and challenges

Both Yassen and Fiston are inspired by the potential benefits of WBS for rural and remote communities like Nunavik, even as they continue to learn. Limitations in other surveillance data in small communities may make WBS even more important to implement. Yassen points out, "this is an example of something [that may be missing] in the current discourse. In large urban centres, wastewater surveillance is sometimes easier to deploy but there's probably more benefit to be gained from [small centres]".

Some of the benefits of wastewater testing in smaller and more rural communities are that:

- Wastewater can provide another data point, in addition to data from clinical and environmental testing, which may also be the best data point for certain pathogens.
- Certain public health interventions can be deployed (e.g., visits to all households) where they would be impossible in larger communities.
- Testing for emergent zoonotic diseases can be done closer to the interface between people undertaking traditional practices and wildlife, which can provide a critical piece to global health surveillance and security.

However, setting up a system in a remote community so that it can be activated when there is an urgent need is challenging. A large urban centre can install an automated pump for a one-time cost and then activate it when needed (hopefully!). In a small community, once manual wastewater sampling is stopped, it takes a lot of training and time to get it started again.

This has implications for emergent priorities. Yassen notes, "Let's say we get a measles outbreak, we could use this to target certain interventions more rapidly in communities affected.

There's all kinds of use cases in theory for it, especially in places that are small communities that are remote and separate from each other … [compared to large cities] where, given the size of the population, you can obtain valuable information from standard signals."

In small communities where there is limited clinical testing, being able to detect and assess the absence or presence of a pathogen at very early stages of contagion could allow the communities to contain the pathogen themselves and reduce their dependence on outside public health assistance to respond to a larger outbreak. This would also be part of overcoming systemic inequities in social determinants of health that remote and largely Indigenous communities in Canada experience.

Community partnership

The villages participating in the expansion of the project are involved because of their interest and enthusiasm. However, possibly more importantly, they are involved because of their already strong relationship with the University of Ottawa research program.

While the provincial government in Quebec has a strong public health surveillance program (Institut national de santé publique du Québec - INSPQ), it was the long-term relationship between communities in Nunavik and the University of Ottawa researchers around drinking water that opened many doors for development of the WBS pilot project.

"[University of Ottawa] researchers are regularly up north … meeting the people and know them personally … It was very clear that they had partnerships that we could capitalize on and then together build more," notes Yassen.

Communication

While the project is still in the pilot phase, early results have been communicated internally to build public health capacity as well as externally to share basic information back to the communities where samples have been collected. However, the essential external communication at this point has been about building and maintaining relationships to support learning and engagement. Ultimately the goal is to communicate WBS data via the Respiratory Infections Dashboard so that it can be used by everyone in the region.

Promising practices and vision for the future

The public health team is proud of its ability to develop and implement the WBS pilot project in a very short amount of time and with very few resources. "I think it was the partnerships … with the community … and with the labs who have experience with this type of analysis," says Fiston, describing what made this possible.

The experience of coming together during the COVID-19 pandemic also had a significant impact on the ability of partners to work on the WBS pilot project.

"We had various ways of engaging with community partners, including things that we've reused afterwards for other purposes. That will eventually be beneficial for wastewater surveillance, I think … [for example] we had very regular forums with the mayors of every community. We've reused those connections recently [to work on things] like immunization and preparation for measles," notes Yassen.

There has also been a general population increase in knowledge around infection, disease and epidemiology which is likely beneficial for public health surveillance work.

For the future, Yassen envisions a WBS system that is useful for a variety of pathogens and functioning throughout Nunavik to support public health with risk planning. "Then we would be able to rapidly pivot if we needed something specific in the local context."

Fiston adds, "my vision is getting a system running within [at least] one community [but also an approach] that is portable and can be shifted from one community to another."

References

Nunavik Regional Board of Health and Social Services (2023). *Annual Report 2022-2023*. Available from: https://nrbhss.ca/sites/default/files/NRBHSS_AR_2022-23_EN_web.pdf

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 2. Case Examples.
Nunavik Board of Health and Social Services.
Engaging in the North means starting where the people are ready.

We would like to thank Yassen Tcholakov, Clinical Lead in Infectious Diseases, NRBHSS and Fiston Muneza, Public Health Officer – Epidemiologist, PHAC, for sharing their knowledge and experience for this story. They have reviewed the story for accuracy. The perspectives and opinions do not necessarily reflect those of their employer (NRBHSS: Nunavik Regional Board of Health and Social Services), or of CWN and NCCID.

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