One Health Against Pathogens

2025 Policy Challenge:

A Participant's Guide

Topic: Wastewater Monitoring in Canada

Policy Questions

Question 1

What should be the goals of municipal level wastewater monitoring?

Context

Wastewater monitoring is essentially collecting and quantifying pathogen load in raw sewage samples – usually using relative nucleic acid sequences as a proxy for total pathogen load. This technique can be used to provide a broad overview of the total disease burden of an entire community (i.e. city, village, or borough) or an institution (i.e. hospital, airport, or dormitory) (Diamond et al., 2022). Some pathogens – which are stable in wastewater and reliably shed in fecal material, are excellent candidates for this technique (Diamond et al., 2022). However, significant zoonotic shedding of the same pathogen may make negatively affect the usefulness of the data (Honein et al., 2024). In the past, wastewater surveillance played an important role in the eradication of polio, and it currently plays an important role in understand which SARS-CoV-2 variants are circulating in a community (Diamond et al., 2022). Data has been used to direct public health resources and is routinely shared with the public to help inform decision making at the level of the individual. Though, the latter varies by location (Benedetti et al., 2024). There is not a consistently available source of information in most jurisdictions. What is the future of wastewater monitoring in Canada?

Objectives

In developing this policy students should gain an understanding of the potential uses of wastewater monitoring at the municipal level and decide which are scientifically sound and could justify the cost.

1- Develop a list of which pathogens are suitable for being monitored via wastewater
2- Describe who should fund monitoring activities and how
3- Identify if/ how the results should be reported to the public
4- Determine if there should be required responses by public health if levels of a certain pathogen become very high and what the response might be

Question 2

What should be the goals of wastewater monitoring of incoming aircraft at Canadian ports of entry?

Context

Wastewater monitoring of aircraft is the practice of analyzing wastewater from incoming flights to detect infectious diseases. This can provide early warning signals about potential outbreaks that could be linked to international travel (Li et al., 2023; Tay et al., 2024). Several countries have determined that testing flights from high-traffic and strategic travel nodes could provide early indication of infectious disease transmission trends and provide an early alert system for public health officials (Ahmed et al., 2022). However, the usefulness and accuracy of this technique is highly dependent on the length of the flight (short-, medium-, or long-haul) as well as what proportion of the passengers use the toilet while onboard the aircraft (Jones et al., 2023). In a world that is largely interconnected by flight, what are the potential uses of wastewater monitoring infectious diseases on incoming flights?

Objectives

In developing this policy students should gain an understanding of what the accuracy of wastewater monitoring from flights would be for different pathogens and learn about the feasibility and challenges of using the available information to improve Canadian public health outcomes and surveillance.

1- Develop a list of which pathogens are suitable for being monitored via wastewater on flights
2- Develop a list of Canadian airports that could serve as useful hubs for aircraft wastewater monitoring
3- Describe what the reporting requirements and public health response should be for different pathogens of interest (does the containment level (CL) of the pathogen effect how it should be monitored or reported?)
4- Balance potential public health benefits with personal privacy for travellers

Question 3

When wastewater monitoring leads to the possible identification of an infected individual person, what should be done with the data?

Context

Cryptic lineages are genetic variants of a virus (usually SARS-CoV-2) that are not widely circulating in the population and are unlikely to be detected through routine surveillance. However, cryptic lineages can be found in wastewater. Cryptic lineages have greater genetic diversity than is observed in circulating variants and may be evolved from variants which have not circulated widely for years. These variants are believed to have come from immunocompromised patients or animals (Schmidt et al., 2025). In 2022, researchers identified a SARS-CoV-2 cryptic lineage that was likely being excreted by a single, persistently infected, person at a thousand times higher concentration than normal. They were able to detect this single lineage in several watersheds and determined that the infected person likely travelled regularly between two cities for work – and that this person was likely very ill but attempts to find the infected person failed. The same group traced another cryptic lineage to a single office building, but was still unable to identify the infected person (Shafer et al., 2024). Cryptic linages may also offer insights on the direction in which viral evolution is headed and inform vaccine developers or public health responses well in advance (Paaby & Rockman, 2014). Persistently infected individuals may not know they are infected, and they may be experiencing symptoms which could potentially be treated – but privacy outweigh answering these hypotheticals? In addition, research aimed at understanding persistent infection could provide much needed clues about how viruses will evolve in the future – but how can research benefits be balanced with personal privacy of those infected (if they were identified outside of the hospital setting, and may not benefit directly from the research)?

Objectives

In developing this policy students should gain an understanding of the remaining unknowns surrounding cryptic lineages and think about the ethics of using wastewater monitoring data to identify infected individuals – for treatment or research.

1- Develop a list of key unanswered research questions in the field of cryptic lineages
2- Identify the current ethical uses of cryptic lineage data sets
3- Describe the ethical requirements and reviews that should be completed before attempting to identify or contact a person harboring a cryptic lineage
4- Determine if systemic bias or historical racism should be considered when developing a set of guidelines for individual level data in wastewater monitoring

Question 4

What should the process be for determining what methods are acceptable for wastewater monitoring?

Context

Wastewater monitoring is likely an important epidemiological and public health tool that has much potential to revolutionize the way we manage population health. However, there are a variety of technical protocols available for collecting, processing, and analyzing wastewater samples and data. Several experts agree that there should be a global wastewater consortium that aligns methodologies and determines best practices to facilitate the generation of datasets that could be comparable across regions (Murakami et al., 2023). But others disagree and argue this will limit innovation. As an example of how this may work, in Canada many analytical methods for food safety analysis are governed by the Compendium of Analytical Methods (Government of Canada, 2017).

Objectives

In developing this policy students should gain an understanding of the importance of protocol standardization, the major bodies that govern standard protocols, and determine how to balance consistency while allowing innovation.

1- Establish a list of organizations which could provide leadership in standardizing protocols for wastewater monitoring
2- Determine how data could be shared and with who
3- Develop a pipeline for proposing, validating, approving, and publishing/ sharing a new standard protocol for wastewater monitoring
4- Decide if technicians should undergo regular testing on approved protocols, and what the testing procedure would entail

Excluded Elements

Students participating in this policy challenge are not expected to conduct a review of the legality of any of the policies they propose. Students are also not expected (or allowed) to conduct any type of public survey to generate data or information about the policy they propose — or how the public may react.

References

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