Canadian Coalition on Wastewater-related COVID-19 Research

Ethics and communications guidance for wastewater surveillance to inform public health decision-making about COVID-19

Governing disclaimer

Research conducted by Canadian institutions must ensure that research conducted under their auspices complies with the ethics policies of the Tri-Council (2018). Consequently, nothing in the following guidance should be interpreted as taking precedence over any ethics policy requirements of the Tri-Council. This guidance is intended to provide authoritative ethical perspectives that are specific to the conduct of wastewater surveillance. Additional relevant ethics guidance has been provided by the Public Health Agency of Canada (PHAC, 2017; 2020).

Key takeaways

- Investigation of wastewater for the detection of signals of SARS-CoV-2 is fundamentally an application of public health surveillance and must be governed by appropriate ethical guidance.
- The purpose of public health surveillance is to inform public health decision-making for the protection of public health, a goal that requires public trust to be effective.
- Effective use of wastewater surveillance to inform public health decision-making about COVID-19 requires collaboration between investigators and public health decision-makers. Not all investigators have previously worked with public health agencies. Accordingly, they may not be familiar with the ethical obligations necessary when such evidence is communicated to the public and/or being relied upon to make public health decisions.
- Because data from wastewater monitoring for COVID-19 has the potential to identify groups of individuals, it is sensitive, human health-related information that requires guidance about ethics and appropriate communication.
- Public health surveillance involves balancing individual rights and freedoms with population interests, resulting in difficult choices in the face of competing interests.
- Ethics guidance articulates the issues to be considered and weighed when making decisions about planning, implementing and using data from wastewater surveillance, and when communicating findings related to public health.

- Ethics guidelines issued by the World Health Organization (WHO) (2017) specifically for public health surveillance include considerations of common good, equity, respect for persons and good governance (including accountability, transparency and community engagement).
- Canada has an obligation to develop appropriate public health surveillance systems and to ensure that the data collected are timely and of sufficient quality to achieve public health goals. Given the public health implications of wastewater-based surveillance for SARS-CoV-2, rigorous and thorough validation of methods are an essential obligation of every Canadian investigative team.
- Investigators have an imperative to work with public health authorities to account for community values and concerns and to minimize or mitigate risks of harm. They must take care to avoid imposing additional burdens on vulnerable or disadvantaged communities which are already more susceptible to COVID-19 impacts. With smaller population sizes, there is an increased likelihood that surveillance results can identify specific groups of individuals as sources of COVID-19 infection.
- There is potential for ill-considered public release of data to stigmatize communities whose wastewater has been surveyed, seriously undermine public confidence, or reduce the effectiveness of public health measures during a global pandemic. As a generic default, data should be treated with the same level of security as individual health information data while recognizing that wastewater samples represent groups of individuals. Wastewater can essentially be considered to contain anonymized human biological materials.
- Data from wastewater surveillance for SARS-CoV-2 must be effectively communicated to the communities from which the data has been collected. Public health officials may be unfamiliar with the limitations of wastewater detection. Investigators have a duty to fully inform and educate public health officials about the full implications of those limitations.
- For wastewater surveillance to provide early warning of localized COVID-19 outbreaks, fully validated results must be communicated to public health authorities as soon as possible. The tension between the time needed to validate vs. communicate results must be understood and managed by investigators and public health authorities.

Introduction

Public health programs and policies seek to achieve **the most good for the most people**. Success in achieving this aspirational goal requires a **high level of public trust** in the motives and actions of public health programs and policies.

Public health surveillance involves gathering relevant data (evidence) to inform public health programs and policies, improving the ability to achieve the most good for the most people. Securing and maintaining the public's trust requires that public health actions observe the highest ethical standards. Important in this consideration of both public trust and potential good is that in a global pandemic, public health surveillance activities have the potential to impact individual rights and create or exacerbate stigma when groups of individuals or communities are identified.

Attaining trust in affected communities requires community confidence in the quality and validity of the scientific evidence underpinning public health policies and decisions. This notion is well established in the closely related field of human clinical research that underlies medical interventions (Emmanuel et al., 2000), meaning that achieving ethical requirements demands the most rigorous, highest quality scientific evidence. Current public discourse and debate regarding confidence in the approval of new vaccine(s) for COVID-19 being scrupulously evidence-based and free from political interference provides an illustration of such concerns.

A novel, rapidly emerging form of public health surveillance for COVID-19 is the monitoring of SARS-CoV-2 in wastewater (sewage). Inevitably, any such novel scientific development will go through a process of evolution and development during which the meaning of results will be uncertain. In these evolving circumstances, basing public health decisions on such evidence requires extreme caution and a commitment to minimizing uncertainty by demanding the best possible data validation procedures.

For those unfamiliar with public health ethics, the nature of the governing issues must be recognized. In some cases, competing ethical issues will inevitably arise, particularly framed by ensuring what is best for the majority of a population while balancing individual rights and freedoms. "*Public health surveillance may limit not only privacy but also other civil liberties. For example, surveillance may trigger mandatory quarantine, isolation or seizure of property during an epidemic.*" (Fairchild et al., 2007)

The difficult choices involved with making decisions in the face of competing interests are necessarily context-specific and no guidelines can provide absolute rules to determine decisions in advance. Ethics guidance can only articulate the issues that must be considered and weighed in arriving at specific, principled decisions. This document will introduce the main applicable ethical issues and provide relevant guidance in relation to measuring and reporting signals of SARS-CoV-2 in community wastewater.

The need for ethics guidance for research on SARS-CoV-2 in wastewater

Monitoring municipal wastewater for signals of SARS-CoV-2 is an international rapidly developing approach for providing evidence about the possible presence of COVID-19 infections in the population served by the sewer network being sampled (LaRosa et al. 2020; Medema et al. 2020; Orive et al. 2020; Peccia et al. 2020; Rendazzo et al. 2020; Wurtzer et al. 2020). The WHO (2020) has summarized the state of play for sampling for detecting signals of SARS-CoV-2 in community wastewater as of August 2020. The scientific foundations and techniques for this approach are rapidly evolving, such that there is still much uncertainty concerning the interpretation and meaning of specific results. However, the compelling needs for understanding — in real time — the distribution (both geographic and level of prevalence) of COVID-19 infection in our communities requires an evaluation of as many valid tools as possible that have the potential to usefully inform public health decisions, even as the science is evolving. This rapid and important evolution of application of wastewater techniques for COVID-19 management must be approached from the outset with a clear consideration of the ethics and the implications of applying such techniques.

In April 2020, Canadian Water Network (CWN) created the Canadian Coalition on Wastewater-based COVID-19 Research to promote a coordinated Canadian response to the international developments in this field. The coalition was established on implicit and explicit ethical foundations. Coalition participants have been required to agree to four high-level guiding principles that are founded on an ethical approach. CWN's principles for guiding a valid proof-of-concept pilot study network for wastewater-based viral epidemiology to inform public health decision-making include an explicit reference to ethics:

> ***Principle 8: Consider ultimate use and ethics of data use in public health decision-making***
>
> The ultimate objective of informing public health decision-making demands that decision makers are actively engaged in study planning and implementation. Full consideration must be given from the outset to how the wastewater monitoring data is likely to be disseminated and used. This will inevitably invoke ethical considerations in data collection, availability and use. Ethical concerns will likely become greater when the number of contributing individuals in a community or institution is smaller.

The majority of investigators exploring or participating in wastewater-based surveillance come from science disciplines that are rarely engaged in collecting human health-related information and are typically unfamiliar with the associated legal and ethical requirements for confidential management of such data. Investigator unfamiliarity with the handling of health-related data, combined with the novel and very rapidly developing nature of wastewater surveillance for SARS-CoV-2, creates a need for clear ethical guidance specific to wastewater surveillance.

An inevitable reality of how research is conducted is that research investigators must rely on obtaining funding in order to carry out their research. Securing research funding, in turn, depends on publishing research findings. These imperatives also exist for health sciences researchers. As noted in the opening disclaimer, all academic institutional researchers must operate within a very explicit, well-established ethical framework for any research involving humans, including human biological materials (Tri-Council, 2018). Investigators who are not normally constrained by conducting research within such an ethical framework face a potential conflict of interest between the need to promote their research and how the public release of their findings may adversely affect communities and groups of individuals.

This document adopts authoritative guidance developed by the WHO for ensuring ethical approaches to public health surveillance by viewing this guidance specifically through the lens of issues arising with wastewater surveillance for SARS-CoV-2. The following guidance is provided to assist investigators generating wastewater-based SARS-CoV-2 surveillance data and supports the rapid evolution of our understanding and application of the technique in an ethical manner. This guidance is subject to amendment and adjustment as more is learned.

WHO guidelines on ethical issues in public health surveillance

This document has benefited substantially from the extremely relevant WHO guidelines (2017) on ethical issues in public health surveillance that were informed by a systematic review commissioned for the WHO's guideline development process (Klingler et al., 2017). Items extracted from the WHO's summary of the dimensions of public health surveillance (Table 1, WHO, 2017) confirm the relevance of applying the WHO guidelines to the current task:

> **Scope:** Communicable diseases
>
> **Objectives:** Early detecting and warning of epidemics, trend and spatial analyses, risk detection
>
> **Data collection tools:** Secondary data sources (wastewater monitoring, population-based/sentinel sites)
>
> **Types of analysis**[1]**:** Assessment of trends, assessment of spatial patterns
>
> **Uses:** Structural intervention, testing of hypotheses (epidemic detection)

[1] WHO (2017) also lists "*Estimation of incidence or prevalence*" under types of analysis. In theory, wastewater surveillance may be able to develop estimates of incidence or prevalence, but the state of the art in this emerging methodology is not yet capable of providing reliable estimates of these measures because such estimates will rely upon much more knowledge than currently available about the comparative rates of faecal shedding of SARS-CoV-2, rates of dilution and/or degradation of SARS-CoV-2 in sewer networks, and interlab quantitation of the signals for SARS-CoV-2 in the wastewater matrix at different sampling locations.

The WHO Guidelines Development Group identified the following four high level ethical considerations that form the backbone of the WHO (2017) guidelines on public health surveillance:

1. **Common good**: Surveillance is acknowledged to be a common good (Kaul & Faust, 2001) and its benefits are fundamentally shared and cannot be subdivided into individual private benefits (Beauchamp et al., 1990; Segelid et al., 2011).

2. **Equity**: This consideration involves ensuring the just distribution of socioeconomic benefits and burdens across a group or population, often in accordance with need and merit. Equity is a central concern for public health ethics, recognizing that social inequality has adverse effects on health (WHO 2008).

3. **Respect for persons**: Sometimes referred to as "dignity," this is the recognition of the inherent worth of all persons by virtue of being a person. This consideration recognizes that the rights, liberties and other interests of individuals are important in addition to overall population well-being. Individuals should be involved in decisions that affect them whenever possible.

4. **Good governance**: Not specifically an ethical principle, good governance is a sound political aspiration that is subject to several ethical considerations. This includes accountability, transparency and community engagement.

Respecting the above considerations, the WHO (2017) proposed 17 guidelines that establish the "*duty to conduct surveillance, share data and engage communities transparently, while recognizing the limits of that mandate*." The current guidance document finds that 14 of those guidelines are directly applicable to the generation of wastewater-based data for public health surveillance.

Ethics guidelines for wastewater-based SARS-CoV-2 data for public health surveillance

Two of the guidelines included in the WHO (2017) ethics guidelines that are recommended for wastewater-based SARS-CoV-2 surveillance are already captured by CWN's COVID-19 Wastewater Coalition Guiding Principles for a Valid Proof of Concept Pilot Study.

WHO's (2017) first guideline addresses adequate planning, preparation and purpose, stating:

Guideline 1. Countries have an obligation to develop appropriate, feasible, sustainable public health surveillance systems. Surveillance systems should have a clear purpose and a plan for data collection, analysis, use and dissemination based on relevant public health priorities.

WHO's (2017) Guideline 4 addresses the need to ensure the collection of valid data, stating:

Guideline 4. Countries have an obligation to ensure that the data collected are of sufficient quality, including being timely, reliable and valid, to achieve public health goals.

All investigators must recognize these overriding requirements for study planning and quality performance need to apply to their own work as well as being foundational ethical requirements.

In addition to the adoption of these two foundational ethics guidelines, the following discussion recommends adoption of 12 other WHO (2017) guidelines that are directly relevant to the implementation of wastewater-based surveillance for SARS-CoV-2.

Guideline 3. Surveillance data should be collected only for a legitimate public health purpose.

There is little question that public health surveillance aimed at achieving reliable and effective early detection of COVID-19 outbreaks is a legitimate public health purpose in dealing with the current pandemic. International perspectives (Bivins et al., 2020; Daughton, 2020; Hart & Holden, 2020; Mao et al., 2020) about early detection of signals of SARS-CoV-2 in wastewater provide considerable promise that this approach can support a legitimate public health purpose. However, much remains to be demonstrated before concluding that current Canadian investigations can provide reliable and effective early detection of COVID-19 outbreaks. A clear ethical obligation from this guideline is that rigorous and thorough validation of the methods used in this approach by each and every Canadian investigative team is essential; shortcuts on method validation cannot be justified in the name of urgency. The details of what level of validation is necessary will depend on the defined purposes of the study. Some identified means for serving this guideline include prioritizing early detection of events, achieving efficiency through reduction of false positives, and harmonization of methods to improve sharing arrangements (Klingler et al., 2017).

Guideline 7. The values and concerns of communities should be taken into account in planning, implementing and using data from surveillance.

Investigators capable of delivering valid surveillance of wastewater for signals of SARS-CoV-2 are not normally equipped to assess and consider the values and concerns of communities about their activities. This guideline reinforces the imperative for such investigators to work closely with and be accountable to the responsible public health authorities and those who can best ensure their work engages with and is cognizant of community concerns and values. If investigators do recognize any such concerns and values to be addressed, including any perception of results unnecessarily being kept confidential, they should raise those concerns with public health authorities.

Guideline 8. Those responsible for surveillance should identify, evaluate, minimize and disclose risks for harm before surveillance is conducted. Monitoring for harm should be continuous, and, when any identified, appropriate action should be taken to mitigate it.

As with Guideline 7, investigators capable of delivering valid surveillance of wastewater for signals of SARS-CoV-2 are not typically equipped with the skills and tools to enable them to identify, evaluate, minimize or disclose risks for harm from their surveillance activities. Consequently, this guideline also reinforces the imperative to work closely with and be accountable to the responsible public health authorities in identifying, evaluating, minimizing and disclosing risks.

Guideline 9. Surveillance of individuals or groups who are particularly susceptible to disease, harm or injustice is critical and demands careful scrutiny to avoid the imposition of unnecessary additional burdens.

Emerging evidence is consistently showing that already marginalized or disadvantaged communities are more susceptible to COVID-19 infection and experience more serious outcomes including death. This evidence is most likely tied to the knowledge that COVID-19 risks are higher for individuals with pre-existing health conditions that are also more prevalent in disadvantaged communities. Likewise, there are constraints on many individuals from such communities being able to limit their personal exposure to SARS-CoV-2 because of their housing circumstances or the nature of their employment. These realities make it more likely that wastewater surveillance will detect signals of SARS-CoV-2 in wastewater that has substantial contributions from disadvantaged communities. As noted in Guidelines 7 and 8, close linkage to responsible public health authorities is imperative.

Guideline 10. Governments and <u>others</u> who hold surveillance data must ensure that identifiable data are appropriately secured.

Investigators capable of competently pursuing surveillance of wastewater for signals of SARS-CoV-2 are generally unfamiliar with the management of health information data and the high level of sensitivity that such data carries. Most, if not all, investigators pursuing this type of surveillance recognize that the purpose must be to assist public health decision-makers in managing the pandemic. Release of surveillance data to media coverage without the knowledge and approval of those public health decision-makers will at a minimum risk creating an unwanted distraction from the challenging tasks of managing the pandemic. At worst, failing to maintain privacy might:

a) stigmatize and discriminate those communities whose wastewater has been surveyed,

b) breach trust between these marginalized communities and public health, and/or

c) seriously undermine public confidence and jeopardize the effectiveness of measures that public health decision-makers are seeking to achieve to manage the pandemic.

In the face of such unfamiliarity, the safest default position should be to treat such data with the same level of security that groups of individual health information data must be treated. Those requirements are regulated by privacy and specific health information security legislation in most provinces and territories. This obligation also reinforces the imperative of Guidelines 7, 8 and 9 requiring close linkage to responsible public health authorities.

Guideline 11. Under certain circumstances, the collection of names or identifiable data is justified.

Surveillance of wastewater for signals of SARS-CoV-2 should not require the collection of individual names. However, as the size of the population contributing to a sewer network being sampled decreases, the likelihood increases that surveillance results can be linked to small groups of individuals, creating a risk of their identity being disclosed. This concern applies to surveillance of small communities, individual institutions, or sampling within a sewer network draining a small but geographically identifiable portion of that network. For example, sampling of a septic tank would be very identifiable as to source.

Guideline 12. Individuals have an obligation to contribute to surveillance when reliable, valid, complete data sets are required and relevant protection is in place. Under these circumstances, informed consent is not ethically required.

Informed consent is a foundational element of public health and medical ethics. As outlined in this guideline, the tension between individual rights to privacy and the common good can be resolved in favour of the latter when risks to the common good are compelling. Although most circumstances of wastewater surveillance will not involve identification of individuals or even groups of individuals, usual requirements for obtaining informed consent can be overridden when the practicality of obtaining individual informed consent is not realistic for surveillance that does meet the common good threshold (Klingler et al., 2017).

Guideline 13. Results of surveillance must be effectively communicated to relevant target audiences.

The preamble to the WHO (2017) guidelines emphasizes an imperative to engage communities transparently. There is no question that data from wastewater surveillance for SARS-CoV-2 must ultimately be communicated to the communities from which the data has been collected. However, a key phrase in this guideline is "*effectively communicated*." These data cannot be effectively communicated until their meaning is fully understood by those communicating the data.

Notably, the kind of surveillance being implemented does not directly measure the presence of infective or even intact SARS-CoV-2; the common monitoring methods measure genetic signals, as RNA fragments, for the virus derived from its specific genetic code. The chance of false positives inherent to these monitoring methods is not high when competent, verifiable quality assurance/quality control (QA/QC) measures are followed. However, given the pervasive occurrence of SARS-CoV-2, there is certainly a substantial risk of cross-contamination of samples during collection or processing unless rigorous QA/QC measures are followed and demonstrated. Because of the challenges of detecting small signals of SARS-CoV-2 in complex and variable matrices like community wastewater samples, the chance of false negatives is inherently higher than false positives. This means that caution must be used when interpreting the reassurance provided by negative (non-detect) results in community wastewater samples as well as detection of an unexpected positive (detect) result.

Such caution equally applies to the absence of positive clinical tests, given the lack of universal and repetitive testing and the dynamics of SARS-CoV-2 occurrence in pre- and asymptomatic as well as convalescent individuals. However, because public health officials are less likely to be familiar with the limitations of wastewater detection, investigators have a duty to fully inform and educate public health officials about the full implications of those limitations for wastewater surveillance.

Guideline 14. With appropriate safeguards and justification, those responsible for public health surveillance have an obligation to share data with other national and international public health agencies.

Because the pandemic is a global phenomenon and all nations are scrambling to understand as much as possible about the novel virus causing the COVID-19 pandemic, national and international sharing of knowledge is critical. In the case of wastewater surveillance for signals of SARS-CoV-2, European investigators initially led by an experienced team in the Netherlands have generated much of the international knowledge about this approach. The Netherlands, the European Union, France, Germany, Finland and England have implemented national wastewater surveillance programs. There are also numerous other programs underway, including in Australia, South Africa and across the United States. Canadian investigators are learning from and sharing with these international investigators who are extensively sharing information on their methodology and results. The obligation to reciprocate is compelling, subject to satisfaction of the constraints of all the other guidelines and interagency agreements. The details of how this

would be done will be very context specific, but satisfying this guideline should not explicitly violate other guidelines.

Guideline 15. During a public health emergency, it is imperative that all parties involved in surveillance share data in a timely fashion.

One of the strongest — if not the most compelling — reasons for pursuing wastewater surveillance for signals of SARS-CoV-2 is the potential to provide early warning of localized COVID-19 outbreaks in communities, institutions or parts of a community. That rationale cannot be effective unless fully validated results are rapidly communicated to public health authorities. This reality creates an inevitable tension between the time needed to validate surveillance results and the need to communicate with public health decision-makers as rapidly as possible. Investigators working in medical and public health diagnostic testing are familiar with this explicit tension, but many investigators capable of pursuing wastewater surveillance have not previously dealt with the need to interact with public health authorities. A fundamental understanding must be reached between investigators and public health decision-makers about how that tension will be managed to ensure that the latter receive fully validated results as soon as possible.

Guideline 16. With appropriate justification and safeguards, public health agencies may use or share surveillance data for research purposes.

Because so much is not known about COVID-19 and its cause, SARS-CoV-2, investigators are working to generate better understanding on all fronts. Wastewater surveillance for signals of SARS-CoV-2 has enormous potential to contribute to those knowledge needs. However, the full extent of knowledge that can be contributed in the long run is secondary to the immediate needs for early detection of COVID-19 outbreaks. Such secondary priorities include determining how well quantitative measures of SARS-CoV-2 signals in wastewater can be correlated to estimate the prevalence of COVID-19 in the population source of the wastewater versus the priority ability to detect trends (up or down) in prevalence.

Guideline 17. Personally-identifiable surveillance data should not be shared with agencies that are likely to use them to take action against individuals or for uses unrelated to public health.

There is likely no ethically justifiable reason for investigators to ever share personally identifiable surveillance data with anyone other than the public health decision-makers to whom they need to be accountable for data handling.

Guidance on communicating to public health agencies and communities

Effective communications are an integral element of the foregoing ethics guidelines. To communicate effectively, it is important to identify the key players involved and their responsibilities.

Key players and their responsibilities

In Canadian provinces and territories, the Chief Medical Officer of Health (CMOH) is the top civil servant responsible for provincial and territorial public health programs. There is considerable variability among provinces and territories about the legislated authority, roles and responsibilities of the CMOH (Fafard et al., 2018) as well as the operational structure for delivering public health programs. Despite this variability, the positioning of the CMOH role presents an inherent conflict between the individual's professional ethical responsibility to the public as a medical doctor, and their role of advising and reporting to the Minister of Health and the Premier. Only in British Columbia and Ontario (as well as federally within the Public Health Agency of Canada) does the CMOH have explicit legislative authority to communicate with the public, independent of the Minister. However, even in those cases, the CMOH might risk being removed from office if communications were made entirely independent of the Minister. In the majority of provinces and territories, where the CMOH does not have explicit authority to speak independently of government, there is certainly public pressure for politicians to follow considered advice from the CMOH. **For the purposes of this ethics guidance, the CMOH will be judged to normally be the person who must receive wastewater-based surveillance data and determine how such data must be managed for public and media release.**

Prior to communicating wastewater-based surveillance data, it is a primary responsibility of the investigators who are generating this data to establish its validity. It is essential to ensuring trust by all parties that generated data provide an accurate representation of the surveillance results. This can be achieved through the investigators' ongoing practice of laboratory quality management (Standard Operating Procedures written and followed with training on same, ongoing proficiency testing, as well as ongoing QA/QC), within the limitations of what even totally unassailable results can provide.

No matter how competent investigators are with generating data, those who are working outside of the provincial public health laboratory system are likely unfamiliar with the standard security requirements for public health data. **A second responsibility of all investigators is to ensure that they have consulted in the beginning with the CMOH (or designate) about the nature and meaning of wastewater surveillance data *before* any data are communicated to the CMOH.** That consultation should establish the detailed mechanisms of communication channels,

including specifying a designate for the CMOH because the latter is likely to be too busy to participate directly in all future communications.

Once data are generated and validated, those data must be reported to the CMOH, or specified designate, in a sufficiently timely and practical[2] manner to make the data capable of providing the early warning that is a key justification for the wastewater-based surveillance program. This reporting should follow a mutually agreed upon, written standard operating procedure for transmission of both positive and negative results.

Finally, the investigators must ensure the security of those data, both within their settings and with the transmission of results to public health authorities, to prevent them from being released to the public or the media before the CMOH (or designate) is able to manage such data release. The timing of the data release must also include an opportunity for the CMOH to fully brief, as necessary, the affected government leaders, provincial/territorial public health workers and regional Medical Officers of Health (MOH).

For wider data sharing, channels of communication should include the Council of Chief Medical Officers of Health (CCMOH) that includes Medical Health Officers MOH in their province or territory, any central provincial/territorial public health agency such as the Chief Public Health Officer of Canada and the Canadian Public Health Laboratory Network (CPHLN) as the CCMOH deems necessary. The CCMOH and the CPHLN provide networks that are appropriate for sharing data from and experience with wastewater-based surveillance for signals of SARS-CoV-2 as agreed on.

What and how to communicate

Advance coordination between the investigators and the CMOH or their designate must establish agreement on what data and associated explanations will be communicated by investigators to the CMOH's office. There needs to be thorough understanding established before data are generated, among all parties, about the meaning and the limitations of data that can be generated by wastewater-based surveillance. Advance coordination and planning can also ensure that the data are actually useful for public health decision-making. With adequate to excellent advance understanding established, the CMOH (or designate) can be best equipped to determine the mechanisms and nature of public data release. The CMOH will have extensive experience in communicating public health messages. Provided there is full understanding of what wastewater-based surveillance for signals of SARS-CoV-2 can and cannot reveal, the

[2] Large volumes of data require secure and reliable electronic modes of transmission. Paper results and/faxes would be second best. Positives, if new or unusual, may require a telephone call to the CMOH or designate.

surveillance data is best communicated in the same manner that the responsible CMOH is using for public release of COVID-19 data. A practice of posting data as online dashboards for public access is emerging in some international jurisdictions. Such practices should be pursued with great caution. What such data does and does not mean needs to be thoroughly understood before it is posted online.

When to communicate

The timeliness of reporting wastewater-based surveillance to the responsible public health authorities is fundamental to its utility as a means of providing early warning of COVID-19 infection in the community population being monitored. The urgency of subsequent public communication of such data is much more context-specific. The relative timeliness of providing positive or negative results must be discussed and agreed on with public health authorities prior to start of testing, and the generators of data must follow a written protocol for providing such test results. The timeliness of satisfying the public's need to know must be determined in the context of what measures are needed to best manage the pandemic. That timing is a valid determination for the responsible public health authorities. Investigators who generate those data are typically neither experienced nor adequately informed to make a judgment about the timing of public release within all the foregoing ethical guidance.

Media relations

Public trust is an essential element for ensuring the effectiveness of public health authorities because most measures that they can recommend for managing a pandemic require cooperation from the public. Media reporting of matters related to the COVID-19 pandemic will influence how the public perceives the competence and trustworthiness of public health authorities. Media relations are an ongoing, continuous challenge for public health authorities who must develop strategies for dealing effectively with the media on a wide range of public health issues. This stands in contrast to many of the investigators generating the data who, regardless of their experience working with the media, are unlikely to have the equivalent depth and range of experience in dealing with the media about public health issues.

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References cited

Beauchamp, D. E. (1990). *The health of the republic: Epidemics, medicine, and moralism as challenges to democracy*. Temple University Press.

Bivins, A., North, D., Ahmad, A., Ahmed, W., Alm. E., Been, F., Bhattacharya, P., Bijlsma, L., Boehm, A. B., Brown, J., Buttiglieri, G., Calabro, V., Carducci, A., Castiglioni, S., Gurol, Z. C., Chakraborty, S., Costa, F., Curcio, S., de los Reyes F. L., Vela, J. D., et al. (2020). Wastewater-Based Epidemiology: Global collaborative to maximize contributions in the fight against COVID-19. *Environmental Science & Technology*, *54*. dx.doi.org/10.1021/acs.est.0c02388

Daughton, C. (2020). The international imperative to rapidly and inexpensively monitor community-wide Covid-19 infection status and trends. *Science of the Total Environment*, *726*. Doi: 10.1016/j.scitotenv.2020.138149

Emmanuel, E. J., Wendler, D., & Grady, C. (2000). What makes clinical research ethical? *Journal of the American Medical Association*, *283*. doi: 10.1001/jama.283.20.2701

Fafard, P., McNena, B., Suszek, A., & Hoffman, S. J. (2018). Contested roles of Canada's Chief Medical Officers of Health. *Canadian Journal of Public Health*, *109*, 585-589. Doi: 10.17269/s41997-018-0080-3

Fairchild, A. L., Bayer, R., Colgrove, J. K., & Wolfe, D. (2007). *Searching eyes: Privacy, the State, and disease surveillance in America*. University of California Press.

Hart, O. E. & Holden, R. U. (2020). Computational analysis of SARS-CoV-2/COVID-19 surveillance by wastewater-based epidemiology locally and globally: Feasibility, economy, opportunities and challenges. *Science of the Total Environment, 730*. Doi: 10.1016/j.scitotenv.2020.138875

Kaul, I. & Faust, M. (2001). Global public goods and health: Taking the agenda forward. *Bulletin of the World Health Organization*, *79*, 869-874. https://apps.who.int/iris/handle/10665/268416

Klingler, C., Silva, D. S., Schuermann, C., Reis, A. A., Saxena, A., & Strech, D. (2017). Ethical issues in public health surveillance: A systematic review. *BMC Public Health*, *17*, 295. https://doi.org/10.1186/s12889-017-4200-4

La Rosa, G., Iaconelli, M., Mancini, P., Ferraro, G. F., Veneri, C., Bonadonna, L., Lucentini, L., & Suffredini, E. (2020). First detection of SARS-CoV-2 in untreated wastewaters in Italy. *Science of the Total Environment*, *736*. https://doi.org/10.1016/j.scitotenv.2020.139652

Mao, K., Zhang, K., Du, W., Ali, W., Feng, X., & Zhang, H. (2020). The potential of wastewater-based epidemiology as surveillance and early warning of infectious disease outbreaks. *Current Opinion in Environmental Science & Health*. Doi: 10.1016/j.coesh.2020.04.006

Medema, G., Heijnen, L., Elsinga, G., Italiaander, R., & Brouwer, A. (2020). Presence of SARS-Coronavirus-2 RNA in sewage and correlation with reported COVID-19 prevalence in the early stage of the epidemic in the Netherlands. *Environmental Science & Technology Letters*. Doi: 10.1021/acs.estlett.0c00357

Orive, G., Lertxundi, U., & Barcelo, D. (2020). Early SARS-CoV-2 outbreak detection by sewage-based epidemiology. *Science of the Total Environment*, *732*. https://doi.org/10.1016/j.scitotenv.2020.139298

Peccia, J., Zulli, A., Brackney, D. E., Grubaugh, N. D., Kaplan, E. H., Casanovas-Massana, A., Ko, A. I., Malik, A. A., Wang, D., Wang, M., Warren, J. L., Weinberger, D. M., & Omer, S. B. (2020). SARS-CoV-2 RNA concentrations in primary municipal sewage sludge as a leading indicator of COVID-19 outbreak dynamics. *medRxiv.* doi.org/10.1101/2020.05.19.20105999

Public Health Agency of Canada (2017). *Framework for ethical deliberation and decision-making in public health: A tool for public health practitioners, policy makers and decision-makers*. Public Health Agency of Canada. https://www.canada.ca/content/dam/phac-aspc/documents/corporate/transparency/corporate-management-reporting/internal-audits/audit-reports/framework-ethical-deliberation-decision-making/pub-eng.pdf

Public Health Agency of Canada (2020). *Public health ethics framework: A guide for use in response to the COVID-19 pandemic in Canada*. Public Health Agency of Canada. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/canadas-reponse/ethics-framework-guide-use-response-covid-19-pandemic.html

Randazzo, W., Truchado, P., Cuevas-Ferrando, E., Simón, P., Allende, A., & Sánchez, G. (2020). SARS-CoV-2 RNA in wastewater anticipated COVID-19 occurrence in a low prevalence area, *Water Research*, *181.* doi.org/10.1016/j.watres.2020.115942

Selgelid, M. J. (2011). *Infectious disease ethics: Limiting liberty in contexts of contagion*. Springer, New York.

Tri-Council: Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & Social Sciences and Humanities Research Council. (2018). *Tri-Council policy statement: Ethical conduct for research involving humans.* https://ethics.gc.ca/eng/documents/tcps2-2018-en-interactive-final.pdf

World Health Organization. (2020). *Status of environmental surveillance for SARS CoV-2 virus*. Scientific Brief. 5 August 2020.

World Health Organization. (2017). *WHO guidelines on ethical issues in public health surveillance*. World Health Organization. https://www.who.int/ethics/publications/public-health-surveillance/en/

World Health Organization. (2008). *Closing the gap in a generation: Health equity through action on social determinants of health*. World Health Organization. https://www.who.int/social_determinants/thecommission/finalreport/en/

Wurtzer, S., Marechal, V., Mouchel, J.-M., Moulin, L. (2020). Time course quantitative detection of SARS-CoV-2 in Parisian wastewaters correlates with COVID-19 confirmed cases. *medRxiv*. doi.org/10.1101/2020.04.12.20062679.