EXECUTIVE SUMMARY

Wastewater Surveillance for SARS-CoV-2 RNA in Canada

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Wastewater surveillance for SARS-CoV-2 RNA, which was rapidly implemented in 2020, is a recent and noteworthy adaptation of public health surveillance of wastewater for infectious and other harmful agents – a technique practiced for decades (Chapter 1). Wastewater surveillance for SARS-CoV-2 RNA uses the same polymerase chain reaction (PCR) technology as clinical tests for the presence of the virus. Shortly after identification of the causative agent, individuals with COVID-19 were found to shed SARS-CoV-2 in their faeces. As the World Health Organization (WHO) was declaring a global pandemic in March 2020, researchers in several locations around the world rapidly confirmed that RNA fragments specific to SARS-CoV-2 could be detected in community wastewater.

Canadian initiatives, largely volunteer efforts by academic researchers at a number of locations, began testing the efficacy of this technique as early as March 2020, reporting proof-of-concept by April 2020. The monitoring locations most active had effective collaboration among public health agencies, local wastewater treatment plant (WWTP) operators, and proficient, mostly academic, research laboratories (case studies in Appendix 1).

National collaboration among parties interested in wastewater surveillance was facilitated by a wastewater coalition launched by the Canadian Water Network (CWN) in April 2020. Programs across the country rapidly began working collaboratively, as exemplified by implementing one of the world's first interlaboratory trials (September 2020, involving 8 laboratories) to evaluate the ability to accurately and reproducibly detect and quantify SARS-CoV-2 in wastewater. This study was organized by CWN in collaboration with the National Microbiology Laboratory (NML) of the Public Health Agency of Canada (PHAC).

Many public health officials were initially skeptical about whether or not actionable information could be provided by wastewater surveillance for SARS-CoV-2. However, previous experience has shown that public health surveillance for a pandemic has no single, perfect, all-purpose tool to characterize all the important features of what is happening in a timely manner (Chapter 2).

Various applications of wastewater surveillance for SARS-CoV-2 have emerged internationally as summarized in Chapter 3, along with rapid advances in methods detailed in Chapter 4. Although initial emphasis was on monitoring at WWTPs serving large communities, researchers have also successfully monitored sewers directly serving priority locations (e.g., long-term care facilities, hospitals, university residences, industrial and correctional facilities). Because of the smaller, potentially identifiable population monitored, CWN convened a national panel to review and develop ground-breaking, focused ethical guidance for wastewater surveillance.

Wastewater surveillance has been an important source of objective evidence, independent of clinical testing programs, that also captures signals from asymptomatic individuals. Since late

2021, as Omicron infections overwhelmed clinical testing capacity in many Canadian locations, wastewater surveillance has become a primary source of insight into the status of community infection. As with previous waves of infection, the new Omicron sub-variants have also showcased how allele-specific PCR assays applied to wastewater enable ongoing surveillance, in near real-time, of virus variants at the community level.

Ultimately, public health organizations including PHAC, the WHO, the European Commission and the U.S. Centers for Disease Control and Prevention have recognized wastewater surveillance for SARS-CoV-2 to be an important source of evidence for informing COVID-19 response and management. Public health considerations with wastewater surveillance, including ethics and communication, are discussed in Chapter 5.

Experience has shown that different methods provide different insights, each with its own strengths and limitations. Public health science needs to triangulate among different forms of evidence to maximize understanding of what is happening and what may be expected. Because of the rapid onset and increasing transmissibility of COVID-19, accurate and near real-time population surveillance data are key requirements for decision makers. Well-conceived, resourced and implemented wastewater-based platforms can provide a cost-effective, independent source of useful surveillance to support other lines of evidence. The authors applied their diverse range of perspectives and expertise to evaluate the strengths and limitations of wastewater surveillance for SARS-CoV-2 RNA in Chapter 6. Emerging opportunities and research needs are elaborated in Chapter 7.

A challenge going forward will be to sustain established wastewater monitoring platforms for future surveillance of other disease targets and health states, including effectively managing COVID-19 as an endemic disease and the early identification and characterization of future pandemics. Indeed, Canada can benefit from taking lessons learned from the COVID-19 pandemic to develop forward-looking interpretive frameworks and capacity to implement, adapt and expand such public health surveillance capabilities for biomarkers in wastewater that are relevant to public health.

Conclusions and recommendations of this pan-Canadian expert panel are detailed in Chapter 8. Actions must be taken to address identified challenges of ensuring that achievements of wastewater surveillance for SARS-CoV-2 in Canada are fully exploited to the benefit of public health knowledge, including planning for future pandemics. We provide the following recommendations to help guide such plans:

Recommendation 1. Capture useful lessons from wastewater surveillance for SARS-CoV-2.

Recommendation 2. Create structures and capacity to sustain capability and develop rapid response to future public health threats

Recommendation 3. Develop frameworks for surveillance program design

Recommendation 4. Develop frameworks for interpretation of surveillance program results

Recommendation 5. Maintain and promote academic partnerships and communication networks that will help identify new opportunities and threats.

Recommendation 6. Build upon existing infrastructure and programs