

# Environmental Scan: Respiratory Virus Surveillance Systems

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## Key Highlights

- During the 2022–23 respiratory virus season, Ontario experienced a wave of three respiratory viruses (i.e., SARS-CoV-2, influenza, and respiratory syncytial virus [RSV]). Influenza and RSV occurred weeks ahead of their typical seasons and at higher-than-expected levels of transmission. This contributed to a burden on health system capacity, with paediatric respiratory emergency room visits tripling over the seasonal average. These experiences highlight the crucial role of effective and timely disease surveillance systems for identifying emerging disease patterns and informing public health responses.
- This scan provides a snapshot of Ontario’s respiratory virus surveillance system compared to 13 other jurisdictions. Select public health surveillance guidance documents were also reviewed and emphasized the importance of timeliness and early detection, recommending that syndromic surveillance (e.g., reporting any influenza-like illness in primary care) should serve as a main surveillance approach for respiratory viruses, with laboratory-based surveillance playing a supportive role.
- Strengths identified in Ontario include the recent integration of wastewater monitoring, monitoring of healthcare capacity for SARS-CoV-2 and influenza, and well-established laboratory testing throughout the Ontario system.
- Compared to other jurisdictions, potential areas for improvement for Ontario surveillance include: increasing syndromic surveillance, particularly in primary care; increasing monitoring of severity indicators for viruses other than SARS-CoV-2; establishing routine monitoring of vaccine coverage for pathogens other than SARS-CoV-2; and establishing documentation of processes to ramp up and ramp down surveillance monitoring activities.
- Incorporating areas identified for improvement into Ontario’s respiratory virus surveillance may contribute to strengthening Ontario’s surveillance of respiratory viruses. Furthermore, despite not being a focus of this scan, an absence of equity-related initiatives (e.g., incorporating sociodemographic data into routine surveillance) suggests a need for further work on how surveillance can contribute to improving or exacerbating inequities in health outcomes as it pertains to respiratory viruses.

## Background

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Each year in Ontario, there are predictable outbreaks involving established seasonal respiratory viruses such as influenza and RSV. The onset of the winter respiratory virus season is associated with significant health and social impacts such as excess deaths, hospitalizations and work and school absenteeism.<sup>1-4</sup> The addition of endemic COVID-19 infections may result in further changes to the transmission dynamics of respiratory viruses, as well as the relative and overall burden across populations and on systems designed to prevent, mitigate and respond to these infections in the years ahead.

During the 2022–23 respiratory virus season, Ontario experienced a substantial wave of the three aforementioned respiratory viruses (i.e., SARS-CoV-2, influenza, and RSV), with influenza and RSV occurring weeks ahead of their typical seasons and at higher-than-expected levels of transmission.<sup>5</sup> This contributed to a significant burden on health system capacity, with paediatric respiratory emergency room visits tripling over the seasonal average.<sup>6</sup>

Effective and timely disease surveillance systems are crucial for identifying emerging disease patterns and informing public health responses. Optimal disease detection and monitoring systems are built on the premise that it is possible to mitigate the adverse consequences of seasonal viruses.<sup>7</sup> In the case of respiratory virus surveillance, effective integrated respiratory surveillance systems should provide data sufficient for near real-time monitoring of the spread of respiratory viruses, in order to inform prevention and control measures that can mitigate the intensity of their impact.<sup>8</sup> In addition to common respiratory viruses, this ability to detect and monitor viral pathogens must include the capacity to rapidly adapt in response to emerging variants of SARS-CoV-2, zoonotic and novel strains of influenza A and B, Middle East respiratory syndrome coronavirus (MERS-CoV) and other emerging viruses of concern.

Given the recent unexpected surge in respiratory virus activity in Ontario, and the addition of endemic COVID-19, it is particularly salient to ensure that Ontario's respiratory virus surveillance systems are as efficient and functional as possible and to confirm they can sufficiently detect the rise of these viruses, monitor their evolution and mitigate their consequences.<sup>8</sup>

## Purpose

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This environmental scan provides an overview of respiratory virus surveillance approaches used in select jurisdictions, and compares these to Ontario. Although surveillance systems will vary based on the needs of specific jurisdictions, this scan aims to be useful to decision-makers by identifying both gaps and practices to consider that may strengthen Ontario's respiratory virus surveillance system.

## Scan Development and Scope

We completed a number of activities during the initial stages of developing the scan. As a first step, we reviewed surveillance system frameworks and guiding documents from major public health organizations, including the World Health Organization (WHO), United States Centers for Disease Control and Prevention (CDC), and the European CDC (ECDC). The public health guidance and frameworks documents helped to identify major concepts and describe organizational guidance. To augment the grey literature searches, we contacted several experts in the field to seek their input

around scope, key issues and to learn their understanding about the current landscape of respiratory virus surveillance in their respective locales, including Ontario.

Upon examination of the guidance documents, we agreed that the WHO Mosaic framework provides a useful framing for this report. The WHO Mosaic Framework is the most comprehensive, with three broad domains of guidance allowing for grouping of information and comparison across jurisdictions (Mosaic Framework described below).

The remainder of the scan focused on searching publically accessible websites to identify what select jurisdictions are doing in terms of respiratory virus surveillance. We selected these jurisdictions based on consultation with subject matter experts and a number of factors including proximity and comparability. Although this environmental scan was not exhaustive, it aimed to include examples from Canadian provinces, the United States, Europe, South Africa and Australia, to compare to practices in Ontario. Common respiratory viruses of interest included SARS-CoV-2, influenza and RSV.

**The guiding questions for the scan included:**

1. What approaches were used for the detection and assessment of common respiratory viruses (SARS-CoV-2, influenza and RSV) among humans in select jurisdictions?
2. How do select jurisdictions conduct ongoing monitoring of common respiratory viruses?
3. How were surveillance data used to inform human health interventions?
4. How do the select jurisdictions compare with Ontario in terms of the above three questions?

Evaluation of novel respiratory virus indicators and surveillance system effectiveness (e.g., evaluations of surveillance approaches and initiatives) were out of scope. We extracted limited data about dimensions of inequality (e.g., geography, ethnicity, gender), but a purposeful review of equity considerations was not within scope.

## WHO Mosaic Respiratory Surveillance Framework

The WHO released the “Mosaic Respiratory Surveillance Framework” (the ‘Mosaic Framework’) in 2023, to assist with filling gaps in surveillance systems.<sup>8</sup> The WHO Mosaic Framework establishes three domains of a surveillance system: detection and assessment, monitoring of epidemiological characteristics, and informing use of human health interventions.

The Mosaic Framework provides guidance on core, enhanced, and innovative surveillance approaches for respiratory viruses. (See Appendix A for figure describing the framework). The framework asserts that respiratory virus surveillance has complex needs not met by a single system, instead requiring multiple systems that can provide information on the risk, transmission, severity, and impact of respiratory viruses. The Mosaic Framework prepares jurisdictions to take stock of their respiratory virus surveillance systems currently in place and to recognize gaps requiring further prioritization, evaluation, and implementation of improvements.<sup>8</sup>

## Methods

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The methods comprised searching grey literature for organizational guidance and frameworks as well as separate searches for jurisdictional information on surveillance strategies and approaches for SARS-CoV-2/COVID-19, influenza, and RSV. Public health organizations were selected based on expert input and included the ECDC, CDC, and Public Health Agency of Canada (PHAC).

We included 13 jurisdictions to compare to results from Ontario: Alberta, British Columbia (BC), Manitoba, Nova Scotia, Quebec, Michigan, New York, England, France, Germany, Netherlands, Australia,

and South Africa. These jurisdictions were selected based on proximity and/or similarity to Ontario and input from subject matter experts.

To collect the findings, a data extraction form was developed based on the three domains of the Mosaic Framework. Extraction included activities related to detection and assessment (e.g. lab and syndromic-based surveillance activities), monitoring of epidemiological characteristics (e.g., indicators of severity and healthcare capacity), and informing use of human health interventions (e.g. vaccine coverage and modelling). Three researchers carried out searches of Ontario, the 13 comparison jurisdictions, and selected public health organizations between April 3<sup>rd</sup> and May 31<sup>st</sup>, 2023. Searches included scanning of government and public health websites, as well as Google searches for items related to respiratory surveillance. During August 2023, we checked the findings reported from the jurisdictions' public websites to ensure accuracy.

## Results

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As noted earlier, we identified the WHO Mosaic Framework during scoping and there was agreement among the working group that it provided a useful framing for the overall scan report. We have grouped the public health guidance information and the jurisdictional scan findings according to the three surveillance domains of the WHO Mosaic Framework. A description of each domain is provided in the relevant section. See Appendix B for a summary table of surveillance approaches by jurisdictions.

### Mosaic Domain 1: Detection and Assessment

Domain 1 focuses on the detection and assessment of emerging or re-emerging respiratory viruses. The core recommended approaches focus on laboratory-based approaches that include laboratory networks, notifiable disease systems, and outbreak surveillance in healthcare settings and the community. Enhanced approaches include syndromic indicators, while innovative approaches include wastewater surveillance and the use and reporting of rapid antigen tests.

### Public Health Organization Guidance

Of the three public health organizations searched (i.e., ECDC, CDC, and PHAC), two organizations recommended implementing both laboratory-based surveillance and syndromic-based surveillance systems (i.e., ECDC and PHAC).<sup>9-12</sup> The ECDC recommends representative sentinel syndromic surveillance in primary and acute care settings as the main method for respiratory infections to estimate incidence in the population, with the objective of identifying upsurges and outbreaks with laboratory-based surveillance to support. Similarly, PHAC recommends surveillance include the combination of epidemiological and laboratory-based systems. Both the ECDC and PHAC recommend integrating respiratory virus syndromic surveillance systems by utilizing more sensitive case definitions to capture a wider range of symptoms (i.e., ARI versus ILI). The CDC did not have formally documented recommendations for respiratory virus surveillance.

## Jurisdictions

### Laboratory-Based Surveillance Data

**Testing Eligibility.** When testing eligibility criteria is reported by jurisdictions, most indicate testing is only performed on, or recommended for, specific symptomatic and/or high-risk individuals in acute care settings. Relevant presenting symptoms and high-risk populations vary between the three respiratory viruses and across jurisdictions.<sup>13-19</sup> South Africa is the only jurisdiction where influenza and RSV testing is available for the general population of symptomatic individuals and Alberta performs influenza and COVID-19 testing on symptomatic individuals in outpatient/community care settings.<sup>18,19</sup>

In Ontario, a multiplex respiratory virus polymerase chain reaction (PCR) test, used to detect a panel of respiratory viruses, is performed in symptomatic children (acute respiratory illness [ARI] symptoms in <18 year olds) seen in the emergency department, all hospitalized patients, the first four symptomatic patients in an outbreak and symptomatic patients in institutional settings (non-outbreak).<sup>20</sup> Specimens that are subsequently positive for influenza and SARS-CoV-2, and all results from outbreaks, are reported to the MOH. RSV tests are performed as part of outbreak investigations and on symptomatic individuals in the following groups: inpatients and emergency department visits requiring admission (if the patient is <18 years old).<sup>20</sup>

**Laboratory Surveillance.** All included jurisdictions report laboratory-confirmed influenza, SARS-CoV-2, and RSV case data, except France who does not report on RSV.<sup>15,21-51</sup> Five jurisdictions (i.e., Australia, England, France, Germany and Quebec) report confirmed influenza cases from sentinel laboratory surveillance, while only England reports confirmed SARS-CoV-2 cases from sentinel laboratory surveillance. In four out of these 13 jurisdictions (i.e., Australia, England, Michigan and New York), confirmed case data for RSV comes from sentinel laboratory surveillance.

In Ontario, laboratory-confirmed cases are reported for influenza, COVID-19, and RSV.<sup>5</sup>

**Wastewater Surveillance.** All jurisdictions, except France, report wastewater data for SARS-CoV-2 surveillance.<sup>37,41,52-61</sup> None of the included jurisdictions currently use wastewater surveillance for influenza or RSV.

In Ontario, approximately 75% of the population is represented through its SARS-CoV-2 wastewater surveillance program.<sup>62,63</sup> However, this excludes rural communities not connected to centralized wastewater treatment systems. In addition, eight out of 33 public health units surveyed in Ontario monitor wastewater in institutions such as universities, correctional facilities, LTCFs, or shelters.<sup>64</sup> Ontario does not currently monitor influenza or RSV in wastewater.

#### Syndromic-Based Surveillance Data

**Clinical Syndromic Surveillance.** Of the 13 jurisdictions, only Michigan reports searching for coronavirus-like illness symptoms in emergency department data.<sup>65</sup> Five jurisdictions (i.e., England, Manitoba, New York, Nova Scotia, and Quebec) monitor ILI activity in emergency departments.<sup>22,26,37,45,46</sup> In addition, all jurisdictions, except Nova Scotia, Manitoba, and Alberta, monitor respiratory illness activity in primary care.<sup>22,24,26,29,31,35,46,48,66,67</sup> In Australia, England, France, Quebec and the Netherlands, a sentinel system of general practitioners report respiratory illness activity.

While Ontario, along with other Canadian provinces, participates in a national primary care respiratory virus surveillance network (i.e., the Sentinel Practitioner Surveillance Network), they do not have provincial-level primary care surveillance.<sup>68</sup> Currently, the Ontario Acute Care Enhanced Surveillance (ACES) system monitors emergency department and hospital admissions records from participating hospitals, identifying potential respiratory disease trends and outbreaks in real-time.<sup>69</sup>

**Other Syndromic Surveillance.** Four jurisdictions (i.e., Alberta, England, France and Quebec) report monitoring telehealth calls for ILI.<sup>22,46,67,70</sup> Four jurisdictions (i.e., Australia, France, England and Germany) use voluntary online surveys for community level respiratory illness surveillance.<sup>22,24,48,67</sup> England reports Google search queries for COVID-19 symptoms and a web-based model that assesses internet-based search queries for respiratory illness.<sup>22</sup> Of the 13 comparison jurisdictions, one (i.e., Manitoba) monitors units of antiviral drugs dispensed from pharmacies.<sup>37</sup> Two jurisdictions (i.e., Quebec and Nova Scotia) report data on absenteeism.<sup>71,72</sup>

Ontario does not currently collect or report on TeleHealth data, drug-based data, absenteeism, or internet-based surveillance data, including search engine trends, social media trends, or online surveys.

**Other Surveillance.** An additional form of community-based surveillance recommended as an innovative approach by the Mosaic Framework is the use and reporting of rapid antigen tests. Only the Netherlands reports self-reported positive SARS-CoV-2 rapid antigen test results.<sup>52</sup>

Ontario does not currently report on the results of rapid antigen tests.

## Mosaic Domain 2: Monitoring Epidemiological Characteristics of Respiratory Viruses

Domain 2 focuses on monitoring epidemiological characteristics of respiratory viruses. Monitoring activities are often guided by a documented process to ramp up surveillance activity once the virus is detected in the population. Core recommended approaches by the Mosaic Framework include targeted special population surveillance in high-risk settings or vulnerable populations, and healthcare capacity monitoring. Enhanced approaches of note include monitoring severity indicators such as hospitalization and mortality.

### Public Health Organization Guidance

All three organizations searched (i.e., ECDC, CDC, and PHAC) recommend having a documented process for ramping up surveillance activities in response to an epidemic or pandemic.<sup>10,11,73</sup> Two (i.e., ECDC and PHAC) also recommend monitoring severity indicators (e.g., hospitalizations and mortality) and performing targeted surveillance of vulnerable populations and in high-risk settings.<sup>10-12</sup> PHAC specifically mentions performing surveillance in remote and isolated communities and indigenous communities. No organization mentioned monitoring healthcare capacity indicators.<sup>11,12</sup>

### Jurisdictions

#### Surveillance Ramp-Up Process

Alberta is the only included jurisdiction that has documented processes to ramp up surveillance in their influenza pandemic plan.<sup>74</sup> Their ramp up processes include but are not limited to: 1) expansion and collapse processes for surveillance efforts; 2) maintaining routine surveillance activities; 3) expanding indicator monitoring; and 4) more timely reporting. No jurisdictions had a documented ramp-up process for COVID-19 or RSV.

While Ontario does have a plan for an influenza pandemic, any ramp up activities for surveillance are at the discretion of the Ministry of Health and are not explicitly documented.<sup>75</sup>

#### Severity Indicator Monitoring

Indicators of severe outcomes include hospitalizations and mortality. Nine jurisdictions (i.e., Australia, BC, France, Germany, Manitoba, Michigan, New York, Nova Scotia, and Quebec) report influenza and COVID-19-related mortality data while three jurisdictions (i.e., Alberta, England, and the Netherlands) report only COVID-19-related deaths. Nine jurisdictions report influenza and COVID-19-related hospitalizations (i.e., Australia, England, France, Germany, Manitoba, Michigan, New York, Nova Scotia, and Quebec),<sup>15,22,24-26,28,35,37,45,46,48,49,67,76,77</sup> while three (i.e., BC, Alberta and the Netherlands) only report hospitalizations for COVID-19. No jurisdictions report mortality data for RSV.<sup>41,66,77</sup> Only New York and Michigan monitor RSV-associated hospitalizations, using population-based surveillance of laboratory-confirmed RSV-associated hospitalizations.<sup>78</sup>

Ontario reports hospitalizations and mortality data for COVID-19 but not for influenza or RSV.<sup>5</sup>

### Healthcare Capacity Monitoring

Five out of 13 jurisdictions report healthcare capacity data (i.e., Alberta, England, Michigan, the Netherlands, New York).<sup>76,79-82</sup> However, only three jurisdictions (i.e., England, Michigan, and the Netherlands) reported healthcare capacity data specific to COVID-19, while Alberta and New York do not provide information about the disease being treated or specific treatments in these reports, which may limit the utility for respiratory virus-specific capacity monitoring. No jurisdictions routinely report on influenza- or RSV-specific healthcare capacity.

Ontario publicly reports data on healthcare capacity specific to COVID-19, including hospital beds and ICU beds occupied by COVID-19 patients.<sup>5</sup> According to subject matter experts consulted by the authors, Ontario began monitoring influenza healthcare capacity in the 2022-23 influenza season. However, this information is not currently publicly reported.

### High-Risk Settings and Vulnerable Populations

Five jurisdictions (i.e., BC, England, Michigan, New York, and Nova Scotia) report on certain high-risk settings and/or vulnerable populations in their routine influenza, COVID-19, and RSV surveillance. Five additional jurisdictions (i.e., Alberta, Australia, Manitoba, Netherlands, and Quebec) report on high-risk settings and/or vulnerable populations in their routine influenza and COVID-19 surveillance only.

In terms of potential vulnerability to disease, many jurisdictions report surveillance data by age or age group for influenza and/or COVID-19.<sup>15,22,25,26,28,33-35,37,41,42,45,47,49,66,83</sup> Three jurisdictions (i.e., BC, Nova Scotia and England) also report surveillance data for RSV by age or age group.<sup>22,45,50</sup> Additionally, four jurisdictions (i.e., Alberta, Quebec, New York, and England) also report surveillance data by sex for influenza and/or COVID-19.<sup>15,22,26,41</sup> Beyond this, New York and Manitoba also stratify hospitalized influenza patients by underlying medical conditions, and New York, Michigan and England by race/ethnicity for COVID-19 patients.<sup>22,26,28,34,37</sup> Australia reports on influenza and COVID-19 surveillance data for Indigenous populations and people living with disabilities.<sup>49,83</sup>

For high-risk settings, four jurisdictions (i.e., Alberta, Michigan, the Netherlands, and Quebec) report influenza outbreaks in congregate living settings, particularly long-term/residential care homes.<sup>29,35,42,46,84</sup> For COVID-19 outbreaks, six jurisdictions (i.e., Alberta, Quebec, Manitoba, Michigan, the Netherlands, and Australia) report data on outbreaks in long-term care.<sup>22,37,41,49,84-86</sup> Michigan also reports influenza and COVID-19 outbreak data for additional congregate living settings including: schools and childcare programs; jails, prisons, and detention centers; healthcare settings; and shelters and settings providing services for people experiencing homelessness, while England also reports acute respiratory (ARI) events for educational settings and prisons as well as long-term care facilities and hospital settings.<sup>22</sup> No jurisdictions reported on RSV in high risk settings.

Similarly, Ontario reports surveillance data by age/age group for influenza, COVID-19, and RSV, and by sex/gender for influenza and COVID-19.<sup>5</sup> In addition, institutional outbreaks of influenza, COVID-19, and RSV are reported for long-term care, and congregate living facilities including group homes, correctional facilities, and shelters.<sup>5</sup>

## Mosaic Domain 3: Informing Use of Human Health Interventions

Finally, Domain 3 focuses on informing the use of human health interventions. While there are a multitude of ways surveillance data can be used to inform interventions, we focus on two that are particularly relevant for the respiratory viruses of note: vaccination coverage in the population and

modelling. We chose to focus on these two in particular given that vaccination is the primary mechanism for the prevention of infection and severe outcomes for influenza and COVID-19, and modelling can help inform healthcare capacity needs and outcomes.

## Public Health Organization Guidance

Vaccination coverage was not mentioned by any of the public health organizations searched, despite being a priority objective of Domain 3 in the Mosaic Framework. However, one organization (i.e., PHAC) recommended that studies and field investigations, including mathematical modelling, be incorporated to answer specific questions including the anticipated impact, intervention effectiveness, and whether further waves of respiratory illness will occur.<sup>11,12</sup>

## Jurisdictions

### Vaccine Coverage

Six out of 13 jurisdictions report data on influenza vaccination coverage (i.e., Alberta, BC, France, Manitoba, Michigan, and Nova Scotia), although BC only reports coverage for healthcare facility staff and residents.<sup>37,42,87-90</sup> All of the included jurisdictions, except Nova Scotia, BC, England and France, report vaccine coverage for COVID-19, although Australia only reports coverage for aged care residents.<sup>37,41,91-97</sup> There was no RSV vaccine at the time data extraction was completed for this scan, but the United States Food & Drug Administration (FDA) did subsequently approve the first RSV vaccine on May 3, 2023.<sup>98</sup>

Ontario only reports influenza vaccine coverage estimates for long-term care facility and hospital staff annually, but not for the general population.<sup>99</sup> However, Ontario does report COVID-19 vaccine coverage estimates for the population.<sup>100</sup>

### Modelling

None of the included jurisdictions publicly reported on recent influenza nor RSV modelling. Modelling for COVID-19 was reported in eight jurisdictions at the beginning of the COVID-19 pandemic (i.e., Alberta, BC, England, France, Germany, Nova Scotia, Quebec and South Africa).<sup>101-108</sup> However, only six jurisdictions (i.e., BC, England, France, Germany, and Quebec) continue to publicly report on COVID-19 modelling.

While Ontario did report modelling for the effective reproduction number for COVID-19 at the beginning of the pandemic, this is no longer being reported as of January 2022.<sup>109</sup>

## Discussion

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Public health guidance from major organizations highlights the importance of a respiratory virus surveillance system to be timely, comprehensive, accurate, and have a coordinated approach to data collection and reporting. Upon examining the guidance documents, we used the WHO Mosaic Framework as a framing for this report; it allows jurisdictions to "take stock" of their current systems and identify potential gaps. The framework comprises three broad domains allowing for grouping of information and comparison across jurisdictions.

We identified both areas of strength and areas for improvement comparing Ontario's respiratory virus surveillance system to 13 other jurisdictions. See Appendix B for a summary table of surveillance approaches by jurisdictions. Key areas of strength include the recent integration of wastewater monitoring for SARS-CoV-2 and monitoring of healthcare capacity for COVID-19. There also appears to be a significant amount of laboratory testing throughout the Ontario system.



However, Ontario appears to conduct less syndromic surveillance compared to other jurisdictions, less monitoring of severity indicators for viruses other than COVID-19, and does not routinely monitor vaccine coverage for pathogens other than SARS-CoV-2 outside of high-risk settings. Based on our findings and discussions with experts, there appears to be limitations in surveillance in rural areas, specifically limited wastewater testing due to lack of integration with central wastewater networks. Ontario also appears to have limited surveillance among equity-seeking groups, some of whom may be at elevated risk of severe outcomes. These equity-related surveillance issues include, but are not limited to, geographic and sociodemographic inequities in access to testing and healthcare resources, limited use of wastewater surveillance in rural communities, and limited collection of important equity-related measures to monitor and evaluate social and health-related outcomes. Further discussion below is organised according to the three domains of the Mosaic Framework.

## Detection and Assessment of Respiratory Viruses (Domain 1)

Ontario has established laboratory-based surveillance of SARS-CoV-2, influenza and RSV, and has established a wastewater surveillance system for SARS-CoV-2 across much of the province. These activities are in line with the majority of the included comparison jurisdictions. However, a review of testing eligibility reveals a potential bias toward severe cases, as testing generally only occurs in high-risk individuals and emergency or outbreak settings. Therefore, many cases of respiratory viruses are likely missed in the community. Testing limitations may exist due to constraints in testing capacities, as such expanded testing may warrant consideration to strengthen Ontario's surveillance system. Ontario may further benefit from considering strategies to reduce rural health disparities by extending wastewater surveillance to rural communities not connected to centralized wastewater treatment systems.<sup>110</sup> Ontario does not currently collect telehealth data or data on school absenteeism. However, several other jurisdictions collect these data as an early detection method; Ontario may benefit from incorporating these data sources in the provincial surveillance system. No internet-based approaches, such as search engine trends or online surveys, were identified in Ontario respiratory surveillance, though online surveys may be a cost-effective way to collect information and can be conducted at the population-level.<sup>111</sup>

There is also an emphasis on the use of syndromic surveillance strategies that incorporate more sensitive case definitions (i.e., acute respiratory illness instead of influenza-like illness) as a primary surveillance mechanism supported by laboratory-based approaches. While Ontario employs limited use of syndromic-based surveillance through the Acute Care Enhanced Surveillance (ACES) in emergency departments and hospitals, a timely and comprehensive provincial-level primary care surveillance system is not widely utilized. The lack of such a provincial-level system in Ontario differs from current recommendations by leading public health organizations and the surveillance approaches used by several similar jurisdictions.

## Monitoring of Epidemiological Characteristics (Domain 2)

Ontario has implemented healthcare capacity monitoring for influenza and COVID-19, which was rare among other included jurisdictions despite being a core recommended approach by the Mosaic Framework. However, Ontario only monitors severity indicators for COVID-19, while the majority of jurisdictions also report severity indicators for influenza. Furthermore, Ontario does not have a publicly available process for ramping up surveillance activities in response to an epidemic or pandemic for any of the three viruses, limiting transparency and capacity for contribution to these protocols from a wider audience. Finally, while in line with the majority of included jurisdictions, Ontario's targeted surveillance includes age, sex, and institutional settings, but does not extend to include other demographics representative of populations or communities, such as race, ethnicity, or Indigenous identity. This may limit the ability to understand the populations at greatest risk for contracting respiratory viruses and/or developing severe respiratory illnesses.

## Informing Human Health Interventions (Domain 3)

Ontario reports vaccine coverage for COVID-19, in line with the other included jurisdictions. However, Ontario does not report on general population vaccine coverage for influenza. Should Health Canada follow the FDA and approve the first RSV vaccine for use in Canada, Ontario should consider reporting on RSV vaccine coverage much like with COVID-19. While some modelling was conducted for COVID-19 in Ontario during the pandemic, this has not been reported since January 2022. No jurisdictions, including Ontario, reported modelling for influenza or RSV.

### Health Equity in Respiratory Virus Surveillance

Health equity is achieved when all individuals in a population have a fair opportunity to reach their fullest health potential by minimizing avoidable differences that are unfair and unjust.<sup>112</sup> Health inequity is often a function of differing social and environmental factors including, but not limited to, income, social status, race, gender, education, and the physical environment. While not explicitly searched for, there was a limited focus on health equity among guidance documents from leading public health organizations. For example, the term “equity” appeared only once in the WHO Mosaic Framework, although the WHO has a separate guidance document that mentions health equity in public health surveillance.<sup>113</sup> Prior evidence from Ontario early in the COVID-19 pandemic demonstrated that integration of equity into public health approaches by incorporating sociodemographic data may have helped reduce disparities in COVID-19 case-rate ratios.<sup>114</sup> Therefore, understanding the sources of inequity in respiratory viral illness in Ontario will assist with improving respiratory virus surveillance (and vice versa) and should be a priority for future work to support health equity.

### Limitations

The findings are limited by several factors including possible selection bias and timing issues. We did contact experts in the field during scoping but it is possible some jurisdictions comparable to Ontario were missed. The organisational and jurisdictional data we examined relied mainly on grey literature searching through Google to gather information on respiratory virus surveillance activities. These searches may have missed relevant information, particularly if the practice is being conducted in a jurisdiction but not publicly reported. In addition, while we used Google Translate with non-English website information where possible, we may have missed details from non-English speaking jurisdictions.

Another limitation is the snapshot nature of the scan relative to respiratory virus season. This scan represents a cross-sectional summary of surveillance activities as of May 2023 (fact checked in August 2023). It does not capture any evolving practices that may change on an annual basis when Ontario and other jurisdictions participate in planning and preparation for seasonal surges in respiratory viral illness. We could minimise this in the future by conducting and incorporating findings from structured expert interviews.

This scan is limited to surveillance of established respiratory viruses and does not examine surveillance approaches for novel pathogens.

Finally, we acknowledge the scope of this scan did not focus on examining health equity-related surveillance activities, which limits our ability to make definitive conclusions about the presence or absence of it. Still, our initial discussions with experts and review of guidance documents from leading public health organizations highlighted a gap with respect to health equity. Health equity is an important consideration in the design of surveillance systems, which bears further study and exploration in future work.

## Conclusion

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This environmental scan of Ontario and 13 comparator jurisdictions revealed both strengths and potential areas of improvement within Ontario's respiratory virus surveillance. From this scan, syndromic surveillance, examination of other early indicators, monitoring health consequences and severity, and limited monitoring of vaccine coverage appear to be areas less well developed in Ontario compared to others. There also appeared to be evidence of gaps in monitoring in rural areas, and in demographic groups beyond sex/gender or age groups, limiting the ability to determine which groups may be at higher risk of disease.

Despite these gaps, Ontario's strengths are evident in the well-established laboratory-based surveillance system, wastewater surveillance for SARS-CoV-2, and healthcare capacity monitoring for COVID-19 and influenza. Although not the focus of or explicitly searched for in this scan, there was a notable absence of equity-related guidelines and initiatives in respiratory virus surveillance in public health guidance and across jurisdictions. Considering these gaps may aid in strengthening Ontario's respiratory virus surveillance, with the potential to improve preparedness and responsiveness to surges in cases in the future.

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# Appendix A: WHO Mosaic Framework

Figure 1. Summary of priority surveillance objectives for each domain of the WHO Mosaic Framework

 <p>Detection and Assessment</p>	<p><b>Domain I:</b> Detection and assessment of an emerging or re-emerging respiratory virus</p>	<p><b>Surveillance objectives</b></p> <ol style="list-style-type: none"> <li>1 Rapidly detect emerging or re-emerging respiratory virus outbreaks and other events</li> <li>2 Assess transmissibility, risk factors for transmission, and extent of infection from an emerging or re-emerging respiratory virus</li> <li>3 Describe clinical presentation and risk factors for severe outcomes associated with an emerging or re-emerging respiratory virus</li> </ol>
 <p>Monitoring epidemiological characteristics</p>	<p><b>Domain II:</b> Monitor epidemiological characteristics of respiratory viruses in interpandemic periods</p>	<ol style="list-style-type: none"> <li>1 Monitor epidemiologic and clinical characteristics of illness over time</li> <li>2 Monitor virologic and genetic characteristics of circulating viruses</li> <li>3 Monitor situation in high-risk settings and vulnerable populations</li> <li>4 Monitor impact on and coping abilities of health care systems</li> </ol>
 <p>Informing use of interventions</p>	<p><b>Domain III:</b> Informing use of human health interventions</p>	<ol style="list-style-type: none"> <li>1 Monitor the impact of non-medical interventions in the population</li> <li>2 Provide candidate vaccine viruses for vaccine composition, production, and risk assessment</li> <li>3 Monitor vaccine coverage, effectiveness, impact, and cost-effectiveness</li> <li>4 Monitor the effectiveness of antivirals and other therapeutics</li> <li>5 Monitor the effectiveness of diagnostic tests</li> <li>6 Monitor the effectiveness of clinical care pathways, including Infection, Prevention and Control (IPC)</li> <li>7 Monitor adverse events to vaccines and therapeutics</li> </ol>

Source: World Health Organization (WHO). “Crafting the mosaic”: a framework for resilient surveillance for respiratory viruses of epidemic and pandemic potential. Geneva: WHO; 2023. Figure 2, summary of priority surveillance objectives for each domain; p. 4. Available from: <https://iris.who.int/bitstream/handle/10665/366689/9789240070288-eng.pdf?sequence=1> Licence: CC BY-NC-SA 3.0 IGO.

# Appendix B: Summary Table of Jurisdiction Results

**Table 1: Summary of Surveillance Approaches by Jurisdiction**

Surveillance Approach	ON	BC	AB	MN	QC	NS	NY	MI	EN	FR	NETH	GER	SA	AUS
Laboratory-based	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>ab</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>	✓ <sup>abc</sup>
Wastewater	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>		✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>
Clinical Syndromic - Emergency	✓			✓	✓	✓	✓	✓	✓					
Clinical Syndromic – Primary Care		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓
Additional Syndromic*			✓	✓	✓	✓			✓	✓	✓	✓		✓
Ramp-up Process			✓ <sup>b</sup>											
Severity	✓ <sup>a</sup>	✓ <sup>ab</sup>	✓ <sup>a</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>a</sup>	✓ <sup>ab</sup>		✓ <sup>ab</sup>
Healthcare Capacity**	✓ <sup>ab</sup>							✓ <sup>a</sup>	✓ <sup>a</sup>		✓ <sup>a</sup>			
High-risk settings	✓ <sup>abc</sup>		✓ <sup>ab</sup>	✓ <sup>a</sup>	✓ <sup>ab</sup>			✓ <sup>ab</sup>	✓		✓ <sup>ab</sup>			✓ <sup>a</sup>
Vulnerable Populations***				✓ <sup>b</sup>			✓ <sup>ab</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>					✓ <sup>ab</sup>
Vaccine Coverage	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>ab</sup>	✓ <sup>a</sup>	✓ <sup>b</sup>	✓ <sup>a</sup>	✓ <sup>ab</sup>		✓ <sup>b</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>	✓ <sup>a</sup>
Modelling		✓ <sup>a</sup>			✓ <sup>a</sup>				✓ <sup>a</sup>	✓ <sup>a</sup>		✓ <sup>a</sup>		

✓ approach is present in the jurisdiction

<sup>a</sup>COVID-19/SARS-CoV-2

<sup>b</sup>Influenza

<sup>c</sup>RSV

\* Any additional syndromic surveillance beyond emergency and primary care clinical surveillance

\*\* Only included if healthcare capacity is specific to one of the viruses of interest

\*\*\* Only included if data includes demographics beyond sex/gender and/or age

ON = Ontario; BC = British Columbia; AB = Alberta; MN = Manitoba; QC = Quebec; NS = Nova Scotia; NY = New York; MI = Michigan; EN = England; FR = France; NETH = The Netherlands; GER = Germany; SA = South Africa; AUS = Australia

# About the Ontario Public Health Emergencies Science Advisory Committee

The Ontario Public Health Emergencies Science Advisory Committee (OPHESAC) is a group of independent, multi-disciplinary experts whose role is to enhance provincial capacity to respond to a spectrum of public health emergencies with the best available evidence. OPHESAC provides independent scientific advice to Public Health Ontario to inform the management of public health emergencies, including COVID-19. For more information about OPHESAC and its members, visit the [OPHESAC webpage](#) or contact [communications@oahpp.ca](mailto:communications@oahpp.ca).

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