EVIDENCE SYNTHESIS BRIEFING NOTE

TOPIC: NON-CANADIAN APPROACHES TO COVID-19 TESTING

Information finalized as of August 25, 2020.[a]

This Briefing Note was completed by the Research, Analysis, and Evaluation Branch (Ministry of Health) based on information provided by members of the COVID-19 Evidence Synthesis Network. Please refer to the Methods section for further information.

Purpose: This note provides a summary of evidence on approaches to COVID-19 testing identified in non-Canadian jurisdictions, with a focus on approaches to using three types of diagnostic tests: molecular, antigen, and serologic. This note also includes information about the populations targeted for testing and the location of testing, as well as planned or proposed approaches to environmental surveillance testing.

Key Findings:

- There are three main types of tests used in COVID-19 testing strategies identified across non-Canadian jurisdictions as well as emerging innovative surveillance testing strategies:
  - Molecular: RT-PCR or rapid-PCR are the most commonly used tests and are typically used for those exhibiting symptoms of COVID-19 or are at particular risk due to either their living arrangements (e.g., congregate housing) or employment. For example, Australia, China, Hong Kong, Germany, Israel, Japan, New Zealand, and Singapore use strategic enhanced testing (using RT-PCR) for high-risk individuals (e.g., front-line health care workers, migrant workers, marketplace workers, tourism industry workers) or widespread testing in localized areas of concerns (e.g., schools, airports, or towns).
    - Rapid point-of-care tests can be used to inform triage of RT-PCR use, allowing earlier detection of those testing positive. However, current evidence of test performance (i.e., using average observed sensitivities and specificities) suggests that rapid tests can only perform this type of triage role in higher-prevalence settings (i.e., 20% or higher) due to the relative risk of false positive results in lower-prevalence settings.
    - Some regions (e.g., Germany) adopted rapid response testing early in their COVID-19 management strategy and continue to do so, but have altered the criteria of who is eligible or must be tested as part of their ongoing surveillance.
  - Antigen: Two jurisdictions offer antigen testing: 1) France fully covers antigen testing through health insurance and a prescription is not required; and 2) The District of Columbia in the US offers this type of testing in select physician offices.
  - Serologic: Serologic tests are identified in many jurisdictions including all US states (except Alaska) to monitor the immune status of individuals. Italy and Switzerland are following a sub-cohort of their population longitudinally to assess antibody development, how long the immunity lasts, and whether it protects against re-infection. Potential uses of this type of testing include rapid return-to-work screening. In Australia, persons who have symptoms for more than one week are eligible for a serologic testing, with a follow up PCR test for positive COVID-19 results.
  - Innovative Surveillance Testing Strategies: Some jurisdictions are exploring different surveillance strategies such as wastewater monitoring (e.g., Australia, Italy, Netherlands, New Zealand) and are using different testing methods that are less intrusive (i.e., saliva and self-administered short nasal swabs) (i.e., New York).

[a] This briefing note includes current available evidence as of the noted date. It is not intended to be an exhaustive analysis, and other relevant findings may have been reported since completion.

Supporting Evidence

Table 1 below summarizes evidence on approaches to COVID-19 testing in non-Canadian jurisdictions. The identified approaches are from 12 countries (i.e., Australia, China, France, Germany, Iceland, Israel, Italy, Netherlands, New Zealand, South Korea, Switzerland, and the United Kingdom [UK]) and eight states in the United States (US) (i.e., Alaska, California [CA], District of Columbia [DC], Louisiana, Massachusetts [MA], Michigan, New York, and Rhode Island [RI]), with a focus on their approaches to using three types of diagnostic tests: molecular, antigen, and serologic. Some planned or proposed approaches to environmental surveillance testing are also included.

Additional details are provided on each of these topics in the Appendix as follows: Table 2 summarizes the testing approaches in eight countries and five US states. Table 3 summarizes novel strategies or technologies for surveillance in 10 countries (i.e., Australia, China, Italy, Israel, Netherlands, New Zealand, South Korea, Switzerland, the UK, and the US). Table 4 summarizes guidance from international health agencies. Table 5 summarizes research and innovative technologies identified in France, Germany, Israel, and the US.

Table 1: Summary of Scientific Evidence and Jurisdictional Experiences on COVID-19 Testing in Non-Canadian Jurisdictions

Type of Test Description	Testing Strategy	Jurisdictions that Use the Test	For Whom the Tests are being Done and Who are they Targeting	Where the Tests Being Done (Home/Self Administered, Community Workplace, and Hospital Clinic)	How the Tests are Done (Pool or Individual)
Molecular Tests (e.g., RT-PCR, NAAT, and LAMP)					
• Molecular tests detect the virus' genetic material (e.g., reverse transcriptase-polymerase chain reaction [RT-PCR], nucleic acid amplification test [NAAT], and loop-mediated isothermal amplification [LAMP]), the sample for which can be taken by nasal or throat swab and in some cases with saliva. ○ PCR and Rapid PCR testing are widely used as are	• RT-PCR or rapid-PCR tests are the most commonly used and are typically conducted for those exhibiting symptoms of COVID-19 or those at particular risk due to either their living arrangements (e.g., congregate housing) or employment.[2] • Australia, China, Hong Kong, Israel, Japan, New Zealand, Singapore, and Germany are employing strategic enhanced testing (using RT-PCR) for high-risk individuals	• Australia • China • France • Germany • Iceland • Israel • New Zealand • UK • US states: ○ Alaska ○ RI ○ New York ○ DC ○ Louisiana ○ CA ○ MA ○ Michigan[b]	• Most jurisdictions offer molecular tests to those who: ○ Have symptoms ○ Have travelled or plan to travel ○ Have been in contact with someone who has COVID-19 ○ Reside or work in health care or congregate settings • Israel is beginning to use pooled tests for low prevalence areas supported by artificial intelligence to identify pools with higher likelihood of having cases.	• Testing is being carried out in a range of settings: ○ Community including airports and ports ○ Walk up and drive-through ○ Hospital/clinic ○ Health care or congregate settings ○ Mobile testing sites • Four jurisdictions (i.e., China, Germany, UK, US [Alaska]) offer home-based testing. • New York State's Wadsworth Lab has developed a new,	• In most jurisdictions testing is done for individuals. • Pooled testing is used in Israel and Wuhan, China.

[b] In Michigan, limited numbers of rapid point-of-care tests (i.e., Abbott ID NOW tests) are available in four hospital systems; they are currently being used for hospitalized patients, those in the emergency department or acute situations (Government of Michigan, 2020).

point-of-care rapid PCR tests[1]	(e.g., front-line essential workers in health care and other industries, migrant workers, marketplace workers, tourism industry workers) or wide-spread testing in localized areas of concerns (e.g., schools, airports, or towns).[3] • Some regions (e.g., Germany) adopted rapid response testing early on in their COVID-19 management strategy and continue to do so but have altered the criteria for who is eligible or must be tested as part of their ongoing surveillance.[4] • Rapid point-of-care tests have the potential to be used to inform triage of RT-PCR use, allowing earlier detection of those testing positive, but			less intrusive test for COVID-19. The test is done through a saliva sample and a self-administered short nasal swab in the presence of a health care professional.	

	with current evidence of test performance (using average observed sensitivities and specificities), rapid tests could only perform this type of triage role in higher-prevalence settings (i.e., 20% or higher) because of the relative risk of false positive results in lower-prevalence settings.[5]				
Antigen Tests					
• Antigen tests detect specific proteins on the surface of the virus, the sample for which can be taken using nasal or throat swab and where a molecular test may also be needed if the antigen test is negative in a symptomatic individual.	• No information identified.	• France • US (i.e., DC)	• France offers antigen tests (nasal or salivary) to any symptomatic or asymptomatic individuals, their contact persons, symptomatic individuals admitted to a health care facility, and asymptomatic prior to scheduled hospitalization.	• In France, antigen tests are fully covered by health insurance and do not require a prescription. • In DC, antigen testing is offered in select physician offices.	• No information identified.
Serology Tests					
• Serology tests detect antibodies that the	• Many jurisdictions including all US	• Australia • China	• Serology tests target:	• No information identified.	• No information identified.

immune system has developed in response to the virus, the sample for which can be taken by finger stick or blood draw (and where two may be needed).[6]	states except Alaska use serologic tests to monitor the immune status of individuals. • New Zealand plans to introduce serosurveillance to understand the immune status of the tested population. • Italy and Switzerland are following a sub-cohort of the population longitudinally to assess antibody development, how long the immunity lasts, and whether it protects against re-infection. • Potential use includes rapid return-to-work screening. • The Centers for Disease Control and Prevention (CDC) has a COVID-19 Serology Surveillance Strategy (updated June 25, 2020).	• France • Germany • Italy • Switzerland • UK • US states (except Alaska)	○ Populations for surveillance such as students or staff and/or residents in health care or congregate settings; and ○ Individuals such as staff in health care or congregate settings. • In Australia, persons who have had symptoms for more than one week are eligible for a serologic test (with a follow up PCR test for positive results). • In France, serology testing is done for symptomatic hospitalized patients and non-symptomatic health care professionals. • In Iceland, individuals having blood taken for other purposes are eligible for serologic tests.		

Innovative Surveillance Tests					
• "Wastewater," also referred to as "sewage," includes water from household/building use (i.e., toilets, showers, sinks) that can contain human fecal waste, as well as water from non-household sources (i.e., rainwater and industrial use). It can be tested for RNA from SARS-CoV-2, the virus that causes COVID-19.[c]	• Some jurisdictions are exploring widespread surveillance strategies such as wastewater monitoring. However, many jurisdictions did not delineate between active outbreak/ongoing testing and surveillance.[7] • Wastewater sampling could be used to monitor high-risk facilities, such as hospitals and aged care facilities, to identify early transmission in such settings where case numbers are low.	• Jurisdictions planning or proposed use of wastewater surveillance: ○ Australia ○ Italy ○ Netherlands ○ New Zealand	• Proposed wastewater sampling includes the following settings: ○ High-risk populations (e.g., hospitals, aged care facilities). ○ Urban centres countrywide with the possibility of reporting on specific areas such as neighbourhoods and airports, ○ Regional populations defined by local water treatment plans.	• Health care facilities • Community settings	• Not applicable.

[c] What is wastewater surveillance for COVID-19? (CDC, 2020).

Methods

The COVID-19 Evidence Synthesis Network is comprised of groups specializing in evidence synthesis and knowledge translation. The group has committed to provide their expertise to provide high-quality, relevant, and timely synthesized research evidence about COVID-19 to inform decision makers as the pandemic continues. The following members of the Network provided evidence synthesis products that were used to develop this Evidence Synthesis Briefing Note:

- Dinnes_J, Deeks_JJ, Adriano_A, Berhane_S, Davenport_C, Dittrich_S, Emperador_D, Takwoingi_Y, Cunningham_J, Beese_S, Dretzke_J, Ferrante di Ruffano_L, Harris_IM, Price_MJ, Taylor-Phillips_S, Hooft_L, Leeflang_MMG, Spijker_R, Van den Bruel_A. Rapid, point-of-care antigen and molecular-based tests for diagnosis of SARS-CoV-2 infection. *Cochrane Database of Systematic Reviews* 2020, Issue 8. Art. No.: CD013705. DOI: 10.1002/14651858.CD013705.
- Ontario Health (Quality). Surveillance strategies and technologies used to monitor and manage COVID-19 spread: A jurisdictional scan, August 25, 2020.
- Waddell K, Wilson MG, Bhuiya A, Ahmad A, Gauvin FP, Wang Q, Lavis JN. COVID-19 rapid query response #3: What testing approaches are being used in other countries? Hamilton: McMaster Health Forum, 25 August 2020.

For more information or to request a copy of any of the cited reports, please contact the Research, Analysis and Evaluation Branch (Ministry of Health).

APPENDIX

Table 2: Non-Canadian Jurisdictions' Testing Approaches[8]

This jurisdictional scan examined COVID-19 testing approaches across eight countries (i.e., Australia, China, France, Germany, Iceland, Israel, New Zealand and the UK) and five US states that currently have the highest rates of testing per capita (i.e., Alaska, District of Columbia, Louisiana, New York, and Rhode Island), with a focus on their approaches to using molecular, antigen and serology tests.

PCR or rapid-PCR are the most commonly used tests and are typically conducted for those exhibiting symptoms of COVID-19 or those at particular risk due to either their living arrangements (e.g., congregate housing) or employment. In addition, serologic tests are being used in nine of the jurisdictions examined (i.e., Australia, France, Germany, Iceland, United Kingdom and all US states except Alaska) to monitor the immune status of individuals. Only two countries (i.e., Israel and China), have implemented pooled testing, however, the Centers for Disease Control and Prevention recently released guidelines on conducting pooled tests and indicated that it should be undertaken as an approach by a US state.

Country	What Type of Test are Being Used? (Molecular Tests [E.G., RT-PCR, NAAT and LAMP]; Antigen Tests; and Serology Tests)	For Whom are the Tests Being Done Or Who are they Targeting?	Where are the Tests Being Done? (Home/Self-Administered; Community; Workplace; and Hospital/Clinic)	How are the Tests Done? (Individual or Pooled)
Australia	• Molecular tests (PCR) • Serologic test (lateral flow IgG/IgM, enzyme immunoassays for understanding immune status).	• Anyone with fever, respiratory symptoms, or other symptoms of COVID-19. • Persons who have had symptoms for more than one week in select states are eligible for a serologic test (with a follow up PCR test for positive results).* • Serologic tests may be used in the future to understand the immune status of the tested population and potentially used to implement in rapid return-to-work screening.	• Community • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified.
China	• There are two main types of currently approved reagent test kits: nucleic acid reagent test kit, and an antibody test kit. • On 18 August 2020, China's National Health Commission, and the National Administration of	• People who are required to take nucleic acid tests include: ○ Close contacts of confirmed cases ○ Inbound travellers ○ Outpatients with fever	• Tests are provided in hospitals and clinics including medical institutions, disease-control institutions, customs agencies, qualified medical institutions, and private testing agencies.	• Testing is largely conducted for individuals, but Wuhan, China conducted city-wide nucleic acid tests on all residents by combining five test samples to accelerate mass testing.

	Traditional Chinese Medicine, released the Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (Trial Version 8) and recommendations about laboratory testing • The recommendations about molecular and antigen tests include: ○ Novel coronavirus nucleic acid can be detected in nasopharyngeal swabs, sputum, lower respiratory tract secretions, blood, feces and other specimens using RT-PCR and/or NGS (next-generation sequencing) methods. ○ It is more accurate if specimens are obtained from lower respiratory tract (sputum or air tract extraction). ○ The specimens should be submitted for testing as soon as possible after collection. • The recommendations about serological testing include ○ The positive rate of novel coronavirus specific IGM and IGG is low one week after onset. ○ Serological testing will not be used alone for diagnosis.	○ New inpatients and their caregivers ○ Staff working at medical institutions ○ Port quarantine and border inspection staff ○ Staff working at prisons and detention houses ○ Workers in nursing homes • Other people can take voluntary tests.	• Home-based testing is arranged for those who have trouble visiting the testing sites.	• China's Joint Prevention and Control Mechanism of the State Council issued technical guideline on 10-in-1 test for COVID-19 nucleic acid testing.
France	• Molecular tests (the detection of the SARS-CoV-2 genome by amplification gene on saliva sample). • Antigen tests (virological tests (RT-PCR) are fully covered by health insurance and do not require a physician's prescription). • Serology tests that detect antibodies (ELISA or a unitary and	• Molecular tests are provided to patients infected or suspected of being infected with COVID-19 and during the outpatient diagnosis of symptomatic patients with mild symptoms of COVID-19. • Antigen tests with a nasal or salivary sample can be done for any symptomatic or asymptomatic individuals, their contact persons,	• Tests are provided in: ○ Hospitals and clinics ○ Community (dedicated temporary screening centres)	• Testing is done for individuals and no examples of pooled testing were identified.

	rapid immunochromatographic technique).	symptomatic individuals admitted to a healthcare facility, and asymptomatic individuals with a scheduled hospitalization (e.g., surgery patients). • Antigen tests can also be performed for targeted groups as part of specific screening campaigns (e.g., frail individuals, residents of long-term care facilities and staff). • The detection of serum anti-COVID-19 antibodies by an automated method or by TDR is carried out for symptomatic hospitalized patients and non-symptomatic health care professionals.		
Germany	• Molecular testing using PCR based on swabs taken from the back of the throat is used for diagnosis. • Serological tests can be used to detect antibodies for COVID-19 if a person has previously been infected, with serological tests implemented through a two-step process using ELISA.	• Testing is recommended for individuals with COVID-19 symptoms, individuals who have been in contact with confirmed COVID-19 cases, individuals residing in care facilities, patients in healthcare facilities, frontline staff, those working in community facilities, and those traveling from abroad. • All individuals residing in a particular area may also be tested.	• Tests may be administered at home using a mobile test. • Samples may also be taken by a trained professional but it is unclear where these are administered.	• It is unclear whether testing is done individually or through pooling.
Iceland	• Molecular PCR tests • Serologic tests for antibodies	• Targeted testing for persons at high risk of infection (e.g., symptomatic or recent travellers). • All persons who would like a test in addition to 6,782 randomly chosen Icelanders. • All visitors (born before 2005) arriving to Iceland.** • Individuals undergoing blood draws for other purposes are eligible for serologic tests.	• Community (airport and ports) • Community • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified.

Israel	• Standard and pooled testing are conducted using a clinically approved PCR-based diagnostic assay.	• Anyone who meets one of these conditions is tested: ○ Household members (even if asymptomatic) of a confirmed case. ○ Individuals without symptoms who have been in close contact with a confirmed case in schools (in the same class, in the same vehicle and in some cases the entire school). ○ People without symptoms who have been in close contact with a confirmed case in institutional housing settings such as long-term care institutions, sheltered housing, nursing wards and welfare institutions. ○ Anyone with a referral from a physician, at the discretion of the attending physician. ○ All special populations in accordance with the instructions of the ministry of health in special cases. ○ Any person with symptoms who was in close contact with a verified patient (symptoms are fever, cough, loss of taste and 'close contact' means less than two meters apart, for at least 15 minutes). ○ Anyone with symptoms who visited a hospital. • Pooled testing has been identified as allowing schools, college campuses, businesses, and airlines to clear whole groups of people far faster than has been possible until now.	• Testing is available through labs authorized by the Ministry of Health, health care providers and hospitals that have adapted their own labs to be able to perform tests, drive-through test stations which are provided in each of the four metropolitan areas and at the airport for passengers returning from abroad. • The recent evaluation of a pooled testing approach notes that group testing is not effective when the carrier rate is greater than eight percent, but when lower than this it can be used for efficiently conducting screening for the general population and specific groups (e.g., health care workers, staff in long-term care homes, schools and college campuses and businesses) to identify hotspots for COVID-19 cases.	• Individual tests are suggested to be conducted and then verified five days later. • Pooled tests were recently approved for use in Israel where up to 48 samples can be tested at once with each sample being assigned into multiple pools a strategy designed for maximizing carrier detection - an evaluation of the strategy using 383 samples in 48 pools found an eight-fold increase in case testing efficiency, as well as an eight-fold reduction in costs. • The pooled tests are noted as being best for low prevalence areas, requiring further tests if a pool tests positive for COVID-19, and having implementation supported by artificial intelligence to identify pools that have a higher likelihood of being positive.

New Zealand	• The viral (PCR) test is the main publicly available test, and antibody tests are not yet widely available for use in New Zealand.	• Those with any of the COVID-19 symptoms are suggested to be tested.	• The testing procedure indicates that those who think they may need a test should: ○ Call their doctor or the Healthline (which also has interpreters available) if they have any symptoms or are feeling unwell. ○ Use the list of locations for COVID-19 tests to seek a test from: 1) their family doctor; 2) a designated general practice clinic for COVID-19 testing (enrollment is not required); 3) an urgent-care clinic (some are open 24 hours a day and seven days a week); or 4) a community testing stations that provide testing.	• Testing is done for individuals and no examples of pooled testing were identified.
United Kingdom	• According the National Health Service (NHS), molecular tests which diagnose COVID-19 using RT-PCR for oral swabs are the ideal method of testing. • For the initial diagnostic testing, two swabs are required: one from the upper respiratory tract and another from the lower respiratory tract (if possible). • A serological antibody test may also be taken to determine if an individual has previously had COVID-19.	• With respect to the molecular swab test, individuals with active COVID-19 symptoms are encouraged to be tested. ○ Care home residents or staff members are also encouraged to take a test, even if they do not have COVID-19 symptoms. ○ Essential employees may be referred by their employers to get tested using a referral portal. • With respect to the serological. antibody test, all NHS and care staff, as well as some hospital and care home residents are able to test for COVID-19 antibodies free of cost.	• There are two ways in which an individual may take a swab for the molecular swab test: self-administered or assisted. ○ For self-administered tests, home testing kits can be directly delivered to an individual's home, and step-by-step guides on how to conduct the test are available online. ○ For assisted testing, mobile testing units are able to test essential workers, with NHS facilities and satellite centres also available for assisted testing. • With respect to antibody testing, at-home tests are not recommended ○ NHS staff can have the test conducted at select hospitals and health centres.	• Tests are processed individually.

			○ As the test is not free for everyone, tests can be also be paid for and completed at private clinics.	
United States				
Alaska	• Molecular-based test type including RT-PCR, TMA, and isothermal nucleic acid amplification.	• Testing is available for individuals who are: ○ Experiencing COVID-19 symptoms. ○ Planning for future travel or return from travel. ○ Who will need admission to a health care facility or before a surgery. ○ Who will be in close contact with someone with COVID-19. ○ Who may have been exposed in an outbreak or are in congregate settings (i.e., correctional facilities, nursing homes, long-term care facilities).	• Home/self-administered by four FDA-approved commercial home kits including Pixel system from LabCorp, Everlywell COVID-19 Test Home Collection Kit, Vault Health, and Picture Genetics. • Community testing including airports • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified. • The CDC has released guidance for pooled lab testing which could be applied if individual states begin to use this approach.
District of Columbia	• PCR and Rapid PCR testing are widely used as are point-of-care rapid PCR tests. • There is some use of antigen testing (Quidel Sofia Rapid test) in select physician offices, but rates of false negatives remain high. • Serologic antibody tests are not widely in use but may be considered for future use for population disease surveillance.	• Any resident of DC that is six years or older and experiencing symptoms of COVID-19 (regardless of severity) is eligible for a test. • Routine testing is conducted for high-risk individuals, including health care workers, residents and staff in nursing homes and those in congregate settings such as those in assisted living, adult family homes, low-income housing/high risk housing, correctional settings, homeless shelters, farm-worker housing, and worksites such as meat-packing plants with one or more active cases such as nursing homes, assisted living, and adult family homes.	• Community (e.g., drive thru and walk-up sites, congregate-living facilities) • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified. • The CDC has released guidance for pooled lab testing which could be applied if individual states begin to use this approach.

Louisiana	• Viral RT-PCR test is the most widely used test. • Serologic testing to monitor seroprevalence .	• Testing for those with symptoms of COVID-19 or those thought to be have been exposed. • Routine testing vulnerable populations including those living in congregate settings, communities with insufficient access to testing and populations that require specialized approaches. • Routine serologic testing across each of the nine health regions, including: at least 500 students and staff at two school-based health clinics; 250 residents and staff at least two nursing home; and at least 100 residents and staff at two congregate settings.	• Home for older adults • Community including schools and mobile testing sites • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified. • The CDC has released guidance for pooled lab testing which could be applied if individual states begin to use this approach.
New York	• New York uses PCR diagnostic testing. • Microsphere immunoassay (MIA) are used to detect IgG antibodies, which are collected using a dried-blood spot card.	• Testing is available to all New York residents.	• Community testing is being prioritized for vulnerable symptomatic individuals, health care workers, nursing home employees, and first responders. • Hospital/clinic	• Testing is done for individuals and no examples of pooled testing were identified. • The CDC has released guidance for pooled lab testing which could be applied if individual states begin to use this approach.

Rhode Island	• PCR-based diagnostic testing
	• Serology antibody test
		• Testing is available to members of the general public:
		  ○ Who are experiencing COVID-19 symptoms or may be asymptomatic (especially high-contact workers, who attended a large gathering such as a protest of demonstration, hotspots).
		  ○ Who are between the ages of 18 to 39.
		  ○ Who plan to travel to another state requiring a COVID-19 test.
		  ○ Who are recent out-of-state travelers arriving from states
			• Community including walk-up and drive-thru, public safety agencies, correctional facilities, and nursing homes.
			• Hospital/clinic
				• Testing is done for individuals and no examples of pooled testing were identified.
				• The CDC has released guidance for pooled lab testing which could be applied if individual states begin to use this approach.

		with a COVID-19 positivity rate greater than five percent. • Asymptomatic testing is available for high-contact workers such as barbers, child care workers, clergy, cosmetologists, first responders, gym and exercise trainers, health care professionals, personal care services, public transit drivers, or restaurant workers. • Individuals may be eligible for serology test if they are: a first responder, Rhode Island National Guard member, correctional facility worker, or a hospital or nursing home staff member.		

* Directions from the public health laboratory network note that they continue to have concerns about the use of serologic tests particularly for diagnostic purposes, though several have been approved for use

**Visitors can either choose to register and take a test or to undergo a two-week quarantine

Table 3: Surveillance Strategies and Technologies Used to Monitor and Manage COVID-19 Spread [9]

This table summarizes the surveillance strategies from several national and regional government agencies where innovative technologies or techniques have been applied. Some jurisdictions are exploring widespread surveillance strategies such as wastewater monitoring (e.g., Australia, New Zealand, Italy). However, many jurisdictions did not delineate between active outbreak/ongoing testing and surveillance. Some regions (e.g., Germany) adopted rapid response testing early on in their COVID-19 management strategy and continue to do so but have altered the criteria for who is eligible or must be tested as part of their ongoing surveillance.

Jurisdiction[d] (reference)	Surveillance Strategy				Use
	Technology	Method/ Description	Setting	Population	
Australia Pandemic Health Intelligence Plan	• Serosurveillance and wastewater sampling (using RT-PCR)	• Serosurveillance measures long lasting levels of antibodies in individuals, which can improve understanding of the cumulative extent of transmission at a population level. Wastewater sampling could also be used to monitor high-risk facilities, such as hospitals and aged care facilities, in order to identify early transmission in such settings where case numbers are low.	• Healthcare settings and community	• Serosurveillance and wastewater in high-risk populations (hospitals and aged care facilities).	• Planned but not started
China Notification for Facilitating SARS-CoV-2 Nucleic Acid Tests	• Random sampling (using RT-PCR)	• Random sampling individuals to test and conduct epidemiological survey.	• Community	• General population	• Unclear, only vaguely described
Italy Higher Institute of Health (ISS)	• Wastewater monitoring (using RT-PCR)	• Testing in wastewater for surveillance of SARS-CoV-2 presence and dissemination.	• Community setting	• Urban centres countrywide with the possibility of reporting on specific areas such as neighbourhoods and airports depending on the epidemiological scenarios.	• Phase one (estimated start: July 2020)—pilot in priority areas, e.g., tourist areas • Phase two (estimated start: October 2020)—

[d] Some surveillance plans (i.e., Australia, China, and Israel) have both innovative strategies planned as well as implementing strategic enhanced surveillance similar to other jurisdictions.

Jurisdiction[d] (reference)	Surveillance Strategy				Use
	Technology	Method/ Description	Setting	Population	
					urban centres at the national level
Italy Ministry of Health National Institute of Statistics (ISTAT)	• Serosurveillance (cross-sectional with longitudinal f-up in sub-cohort). • Antibody test + RT-PCR in case of positive serological test.	• Measures seroprevalence and antibody response development. • Allows a better understanding of the epidemiological characteristics in the different regions and may aid the identification target groups for vaccination when available. • The study results may also provide information on the persistence of the antibody response and its neutralizing capacity.	• Community setting	• Sample (150,000) representative of the national population. • Stratified by six age groups, gender, economic activity sector, and region of residence.	• Started on May 25, 2020.
Israel Media article	• Pooled testing (using RT-PCR)	• Single staged pooled testing using an algorithm described in the P-BEST academic paper.	• To be determined – expected to be widespread as can identify asymptomatic individuals.	• To be determined – expected to be widespread as can identify asymptomatic individuals.	• Received approval from the ministry.
Netherlands[e] RIVM: sewage examined for novel coronavirus	• Wastewater monitoring for novel. coronavirus (using RT-PCR)	• Weekly samples from up to 80 sites sewage treatment plants.	• Community	• Regional populations defined by local water treatment plans.	• Proposed for long-term monitoring. Currently as ongoing research study since April 2020.
New Zealand COVID-19 Surveillance Plan	• Serosurveillance and wastewater sampling (using RT-PCR)	• Considering seroprevalence surveys to identify where and whether herd immunity exists and testing in wastewater to potentially identify otherwise undetected infection in communities and prompt further investigation.	• Community	• Targeted communities.	• Proposed

[e] The Netherlands National Institute for Public Health and the Environment (RIVM) recommends against buying a rapid diagnostic test as they are unreliable for individual patient or home use (rivm.nl, 2020).

Jurisdiction[d] (reference)	Surveillance Strategy				Use
	Technology	Method/ Description	Setting	Population	
South Korea [How we fought COVID-19: A Perspective from Science & ICT]	• Rapid coronavirus test • 1 brand: Seegene	• Using artificial intelligence, a rapid diagnosis can be made in 30 minutes and diagnose multiple infection and measure its severity using quantitative information about the infection.	• Hospitals and labs	• Available testing for all.	• Early adoption and ongoing widespread access to testing.
Switzerland [Federal Office of Public Health (FOPH)]	• Serosurveillance (cross-sectional and longitudinal [20% of original cohort]) (using RT-PCR)	• Will help determine the spread of SARS-CoV-2, whether the protective measures have been effective in different groups, how long immunity lasts, and whether it protects against re-infection • May also contribute to planning of vaccination programs when available.	• Community	• > 25,000 people • National (including different regions and population subgroups).	• April–October 2020
United Kingdom [Government of UK Press Release, August 3, 2020]	• Rapid coronavirus tests • 2 brands: DnaNudge, LamPORE	• Nasal swab, with results in less than 90 minutes. • DnaNudge: point-of-care machine can process 15 tests per day. • LamPORE: with desktop GridION machine can process 15,000 tests and with mini-ion machine in a pop-up lab up to 2,000 tests per day.	• NHS hospitals, care homes and labs. Could also be rolled out in non-clinical settings as they do not require trained health professionals.	• Current access in cancer wards, A&E and maternity wards.	• Limited. • 8 DnaNudge machines are in London hospitals, and planned across the NHS for September. • LamPORE tests were expected 1 week after press release published.
US [National Institutes of Health]	• Three point-of-care tests and four high throughput laboratory tests.[f]	• The government initiative named "Rapid acceleration diagnostics (RADx)" aims to deploy more tests across the country by September. Each of the seven tests recommended have slightly different methodologies.	• Various, health care settings and community.	• Targeting symptomatic individuals.	• Expectations of tens of millions of tests per week by September 2020.

[f] Approved through US Food and Drug Administration emergency use authorization.

Table 4: Guidance from Health Agencies on COVID-19 Testing and Surveillance Strategies[10]

The following guidance was identified from government and inter-governmental health agencies.

Organization	Key Findings
European Centre for Disease Prevention and Control	Strategies for the surveillance of COVID-19, April 9, 2020 • A list of objectives and details of routine surveillance systems for the European Union/European Economic Area (EU/EEA) and additional objectives for the national level for members. Themes include monitoring the impact on the health care system, resource mobilization, mitigation measures and for national members to contain nosocomial outbreaks and outbreaks in long-term care and other closed communities. Laboratory support for COVID-19 in the EU/EEA, June 15, 2020 • In the event of severe shortages recommendations include pooling low risk samples and using a single swab for both oropharyngeal and nasopharyngeal in one patient.
Organization for Economic Co-Operation and Development (OECD)	Policy responses to coronavirus: Testing for COVID-19, a way to lift confinement restrictions, updated May 4, 2020. • Advancements in point of care and rapid tests could help ensure widespread deployment of testing, tracking and tracing contacts for infection, once validity is established. • Serological tests of antibodies could be informative in managing the epidemic across the population, but clinical performance needs to be confirmed before deployment.
World Health Organization (WHO)	Public health surveillance for COVID-19: interim guidance, August 7, 2020 • National surveillance objectives should include the ability to detect and contain clusters and outbreaks. Robust comprehensive surveillance should be maintained even where transmission has been suppressed or controlled. • Environmental surveillance and wastewater surveillance are not robust enough to be recommended for routine use at this time. Other surveillance systems can be combined at different sites, using different techniques including contract tracing and cluster investigation.
US Centers for Disease Control and Prevention (CDC)	There are multiple surveillance documents that aid the US in population-based surveillance: • COVID-NET is a population-based surveillance system that collects data on laboratory confirmed COVID-19 hospitalizations from 250 hospitals in 14 states. • The CDC is collaborating with state governments to implement serology surveillance strategies to better understand how infections have occurred at different points in time, in different locations and within different populations in the US. • The National Wastewater Surveillance System (NWSS) is meant to complement existing COVID-19 surveillance to provide an efficient pooled community sample, data for communities where timely COVID-19 clinical testing is underutilized or unavailable and data at the sub-county level.

Table 5: Research and Innovative Technologies in Non-Canadian Jurisdictions[11]

There are several ongoing research studies on novel ways to test for COVID-19, as well as proposals by academic scientists of surveillance strategies.

International Scan	• **France**: ○ Development of rapid test for the detection of SARS-CoV2 virus that can be used outside laboratories ○ Developing a low-cost lab-on-a-chip for diagnosing SARS-CoV-2 ○ The LuLISA research project (Luciferase-Linked ImmunoSorbent Assay) aims to develop high throughput serological tests from epidemiological studies at local, regional or national levels. ○ France's Scientific Council and Haute Autorite de Sante (HAS) acknowledge that the SARS-CoV-2 saliva test offers a potential alternative to sample collection compared to nasopharyngeal specimen with the standard RT-PCR that is less invasive to obtain, may be more acceptable by patients, and may be used as a rapid test—however they state that it requires validation. A study was started in the French Guyana to evaluate the saliva test. When available, HAS will review the study results to determine its widespread use. • **Germany** is training 'sniffer dogs' to detect the virus. For more information (in German), read here. • **Israel**: ○ The Middle East's largest hospital, Sheba Medical Center in Israel, launched a breakthrough rapid COVID-19 detection test pilot program that enhances virus detection spectral technology and adapts it into rapid coronavirus testing. The innovative process uses an artificial intelligence algorithm to separate the profile of a person infected with a specific virus, from someone else who has a different virus or that of another healthy person. ○ A non-expensive Israeli gargle test that gives COVID results in one second, at 95% accuracy is in trial. Read more here. • **US**: Quick and affordable saliva-based COVID-19 test (SalivaDirect) developed by Yale scientists received FDA Emergency Use Authorization.

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