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Health Reform Monitor

Testing surge capacity—A Canadian COVID-19 experience, Ontario’s surge capacity for the first wave

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 ABSTRACT

As of September 1st 2020, over 42 000 COVID-19 cases and 2 800 COVID-19-related deaths have been confirmed in Ontario, Canada. Testing enables quick identification of cases, which results in effective contact tracing, containment of the virus, spread. With a surge of testing capacity in the public health laboratory system at the start, health officials implemented changes in testing and laboratory infrastructure to significantly expand testing capacity to include 1) the centralization of resources; and 2) the integration of private and independent labs into the COVID-19 testing program. With these changes, testing capacity has grown from approximately 4 000/day in March to 32 000/day by the end of August, 2020. Eligibility criteria for testing has expanded to increase sensitivity and include testing of asymptomatic individuals. Along with previous outbreaks, the COVID-19 pandemic has highlighted the need for integration of testing surge capacity in public health systems before outbreaks occur. This paper details the development and implementation of a COVID-19 testing program in Ontario from January 2020 to September 2020 during the first-wave of the pandemic. The goal of this analysis is to explore the historical precedence, present influences, and future implications of the program.

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1 Introduction

Widespread testing is a cornerstone of an effective response to the COVID-19 pandemic. Countries such as South Korea are considered model nations for their management of the COVID-19 outbreak due to their rapid adoption of testing strategies to control virus propagation [1]. A higher testing capacity lets more individuals access testing, facilitates case identification, and decreases the turnaround time (TAT) for results. This enables public health officials to isolate positive cases, monitor the spread of disease, and control outbreaks. Management of virus transmission relies on a combination of testing along with contact tracing [2]. A robust testing program also reduces PPE over-usage by identifying confirmed positive cases from patients with COVID-like symptoms.

Public health is managed by different levels of governance and organizations across Ontario. Public Health Ontario (PHO) is the official body that regulates outbreaks and contact tracing in the province. It was established in response to SARS and began operations in 2008. It provides technical guidance to public health staff across Ontario, gives scientific input in policy development to the Ministry of Health and Long-Term Care (MOHLTC), and operates eleven public health laboratories [3].

The provincial MOHLTC is responsible for setting and distributing guidance, policies and criteria, informed by the scientific expertise of PHO, to local public health units and assessment centres on topics like testing, screening and outbreak response. Local public health units and PHO work within policies set by the MOHLTC [3]. For example, the ministry’s guideline for Streptococcus pneumoniae requires clinicians to contact the PHO laboratory prior to submitting a sample for approval from a clinical microbiologist.

This paper details the development and implementation of a COVID-19 testing program in Ontario from January 2020 to September 2020 during the first-wave of the pandemic. The goal of this analysis is to explore the issues, historical precedence, present influences, and future implications of the program. Sources of evidence will include published research evidence, government reports, policy documents and news media. Findings will be used to create a timeline of events to evaluate Ontario’s COVID-19 testing response. We will focus on two elements of the program:

1 Centralization of equipment and resources; and
2 Integration of private and independent laboratories into the program.

2. Issues with surging testing capacity

As of September 1st, 2020 there have been over 42,000 cases of COVID-19 and over 2,800 COVID-19-related deaths in Ontario. The pandemic severely disrupted life in the province, with a lockdown that closed businesses, public spaces and services, banned large gatherings, and enforced social distancing [4]. As Ontario moved toward reopening the economy, a comprehensive testing program was identified as essential for informing contact tracing. The optimal level of testing for a province like Ontario can be derived similarly to New Zealand’s 152,562 tests per million population during the first-wave of COVID-19 [5]. In comparison, Taiwan’s testing rate up to the first-wave was performed at 7,520 tests per million population; however, other studies suggested that this low rate is possible due to Taiwan’s previously outlined flexible pandemic response compounded with the country’s well-established culture of face mask use, and proactive government support of production and distribution to the public ([5,6]). In contrast, Ontario had a testing rate of 111,207 tests per million population—37.2% less tests than New Zealand [7]. Additionally, Canada does not have the capacity nor infrastructure to conduct large-scale testing like other countries (e.g., New Zealand) [8].

2.1. Centralization of testing

At the beginning of the pandemic, the testing program was solely the responsibility of PHO, with the administration adjusting practices on the ground to rapidly deploy this program. By centralizing testing, the intention was to create a surveillance network that would inform coordinated responses against outbreaks. A decentralized system might have been perceived by decision-makers as creating challenges around tracking cases given the lack of integration of information systems across hospitals, private laboratories, and PHO in Ontario [9–12]. However, the World Health Organization and other studies have demonstrated success in healthcare delivery decentralization that can overcome delays due to distance and inadequate communication ([9,10]). The lack of integration of Ontario’s information systems led to failures of communication that were documented in the media where hospitals failed to consolidate cases during a critical period [13]. With only public labs run by PHO permitted to conduct tests, Ontario struggled to keep up with demand with wait times for results growing to a week or more. The existing structure of PHO lab testing is not designed to be scalable to the magnitude of the initial COVID-19 outbreak, leading to a bottleneck in the early stages of the pandemic when mass testing was necessary. In addition, Ontario was lagging in its testing capacity in comparison to other Canadian provinces that were not as centralized as Ontario ([14,15]). For example, during the mid-April peak of the first-wave of the pandemic, Ontario rate of testing at 445 tests/100,000 individuals compared to British Columbia’s, Alberta’s and Saskatchewan’s 926 tests, 1,371 tests and 1,025 tests/100,000 individuals, respectively ([14,15]).

The following are possible reasons that Ontario chose a highly centralized system for testing. First, with a centralized point of contact for supply chain, surveillance, testing, and responsiveness to regional requirements based on clear flow of communication, the government of Ontario has the flexibility to distribute and reallocate supplies, manpower, and resources based on local needs. This can be especially beneficial to vulnerable populations, such as rural and Indigenous communities and long-term care home residents whose public health units may not be as well-funded and who may suffer disproportionately more infections ([16,17]). Second, the ability to provide this chain of command aids the government of Ontario to establish 2 objectives—1) population-based surveillance and 2) diagnostic testing of patients presenting with COVID-19 symptoms [18]. A clear chain of command is key to population-based surveillance. Lastly, it allows for quick isolation of patients who are identified as positive cases.

2.2. Integrating hospital-based and private laboratories into the testing program

As outlined in Learning from SARS: Renewal of public health in Canada, better integration of hospital-based and private laboratories to the public health network is pivotal for monitoring of infectious spread [19]. Due to notifiable disease legislation, public health systems have access to data from private and hospital-based laboratories. Despite this, at the start of the pandemic, laboratories had limited involvement in the public monitoring system because a formal integrated system had yet to be established between public and independent labs. Communication and coordination relied on informal e-mails between scientists. The involvement of private and hospital-based laboratories was further limited by the bureaucratic and slow nature of these procedures. “There is no single oversight [...] We try to work together as best as we can but a lot of it is informal.”—said Dr. Vanessa Allen, the chief of Medical Microbiology at PHO, in a comment regarding public-private integration [20]. In previous outbreaks, biologic material was sent from these private laboratories to provincial laboratories, providing information to the national surveillance system [19]. To compare, as early as March, other high performing provinces such as British Columbia had already joined forces with Lifelabs, a private company, in successfully increasing its testing rate per capita, and Alberta had incorporated university labs into its testing capacity ([21,22]).

The idea of integrating surge capacity into public testing systems is not new. The World Health Organization guidelines for Hospital Preparedness for Epidemics urges hospital labs to establish or maintain relationships with private laboratories, and to create Mutual Aid Agreements for the handling of biological material, and the sharing of data [23]. However, reality often does not reflect these suggestions. In March 2000, the Advisory Council on Communicable Diseases informed the government of Ontario that provincial laboratories were under-resourced in terms of personnel and laboratory materials if a greater outbreak of influenza occurred. The letter warned of “inadequate resources, both human and material [...] delays in processing specimens, and inability to make new rapid tests available” and that “delays in turnaround time and lack of new rapid tests which would lead to a rationing of tests and inevitably, mismanagement of the outbreak” [23]. Similar warnings were given during the West Nile and Norwalk virus outbreaks ([19,24]).

During the SARS pandemic in 2004, there was also a shortage of timely laboratory testing to provide diagnoses. The SARS Commission interim report: SARS and public health in Ontario encouraged expansion of the public health laboratory testing system and warned that it would not be “adequate to rely on the hope that private and hospital laboratories will have the extra capacity when needed” [24]. Although Public Health Ontario Laboratory Services has since expanded from one single lab to 11 sites, by the start of the COVID-19 outbreak, public health labs were still unable to handle the capacity needed for a pandemic of this size; hence the need to coordinate with private labs. David Williams, Ontario’s Chief Medical Officer of Health noted the importance of integrating private operations in as a mechanism to ramp up testing capacity, which would later be implemented a few weeks after [25].
3. Health policy processes

Following multiple infectious outbreaks, including the E. coli outbreak in Walkerton of 2000 and the SARS outbreak in Ontario of 2004, a number of reports on the state of public health in Ontario recommended the establishment of an arms-length government agency that would oversee public health on the provincial level—PHO. Despite improvements in the quantity and capacity of PHO laboratories since the SARS outbreak, there was no formal system to integrate public, private, and hospital laboratory data. Instead, infectious disease specialists from all three levels built an informal networking system. This ad hoc communication network between labs is an example of a clientele pluralist network, in that the goal of increasing testing capacity was shared both by the government and private labs, so the responsibility of organizing and mobilizing resources may have been organically delegated to the private sector based on their understanding of the field [26]. This type of policy network may be quicker to set up than state-directed organization, and more adaptable to the uncertain conditions of the pandemic. In the last week of February, during the beginning of the outbreak, Dr. Vanessa Allen, the Chief of Medical Microbiology at PHO, contacted independent labs about their capacity and willingness to provide infrastructure for COVID-19 testing [20]. She requested information about their capacity to test, interest in contributing, equipment status, and standing with the provincial government for formal approval of testing.

Many independent labs were ready to relieve the burden of testing delays due to the warning from Dr. Allen’s letter. PHO was also eager to help these labs verify that their tests were reliable [27]. Although the government of Ontario reduced the standard time needed for approval of independent labs from months to weeks, valuable time was lost and many cases were untested and unaccounted for, perpetuating community spread of the virus early on. This was a timely point as expanding testing to independent labs would be able to complement single source procurement. Even as early as March 20, 2020, physicians were calling for a “military procurement” strategy as hospitals were facing a severe shortage of supplies, including testing kits [28]. Five-days later, a report was published stating that there was a shortage of reagents as global demand soared [29]. On March 26, 11 000 individuals were waiting for test results in Ontario alone, and the Ontario Premier cited lack of resources as a cause; this may have pressured the provincial health authorities to allow private and university labs to participate in the COVID-19 efforts ([20,30]). During this time, Ontario expanded its testing criteria with more swabs taken each day from symptomatic patients, but ultimately, the province’s labs could only process a maximum of 3000 tests/day with delays of 7 or more days for. It was not until the beginning of April when private labs such as Alpha Labs and BioTest Laboratories, and hospital laboratories had become integrated into the testing structure. A news briefing on April 10th 2020 highlighted the government’s priority to “increase its testing capacity by leveraging hospitals, communities and research labs” [31]. Testing capacity increased with labs such as Dynacare running 700 tests per day and Life-labs running 1100 tests per day [20]. By the end of April, Ontario had a network of 23 laboratory sites that were capable of providing COVID-19 testing with testing capacity almost doubling from 8 000 to 14 000 tests per day in two weeks [31].

3.1. Expected or preliminary outcomes

The successful outcomes of the program are reflected in the number of tests processed by the province daily, the average turnaround time for results, and the expansion of eligibility criteria for COVID testing.

In April 2020, during the first-wave’s peak, the COVID-19 TAT was reported to be at 4–7 days [32], 3,000 to 13,000 tests were completed daily, with a high percent positivity rate. By July 29, 2020 and with less than 150 new cases in Ontario per day, the reported testing TAT was 60% by 24 h and 80% by 48 h with 27308 tests completed the day before [33] Fig. 1.

The provincial Ministry of Health regularly updates guidance documents based on recommendations from the Provincial Diagnostic Network Operations Centre, which monitors the spread of infection and allows the province to make strategic decisions, like conducting proactive asymptomatic surveillance testing in long-term care homes and retirement homes [35].

Successive testing updates specifically refer to increased laboratory testing capacity as being a key reason for the broadening eligibility criteria to include more people and incorporate community testing. Initially, testing was restricted and prioritized for high-

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Fig. 1. Graph of COVID-19 tests completed daily, and new COVID-19 cases daily in Ontario [34].
risk, symptomatic, and vulnerable populations. Eligibility criteria largely reflected those put forth in previous pandemic preparedness plans, including the *Ontario Health Plan for an Influenza Pandemic* and the *Canadian Pandemic Influenza Preparedness: Planning Guidance for the Health Sector ([36,37])*. These documents were informed by lessons learned from previous pandemics. For instance, remote, isolated and First Nations communities were disproportionately impacted by the 2009 H1N1 pandemic. Social determinants, like the lack of access to clean running water, were identified as contributors to their baseline health status and vulnerability to outbreaks. As such, the pandemic preparedness plans, and hence COVID-19 testing criteria guidance documents, place these communities on the list of priority populations in the event of supply shortages.

As testing capacity increased, guidelines were broadened to include more groups (Table 1). On May 14th, testing was opened up to any Ontarians with at least one sign or symptom of COVID-19 [38]. On May 24th, a memorandum from the Ministry of Health expanded testing to asymptomatic patients at higher risk of COVID-19 exposure [39]. As of the end of August, between 25 000–32 000 were being processed per day [18].

### 4. Policy implications

An effective outbreak response requires an understanding of normal infectious disease practices and testing capacity, and a threshold to implement an emergency response plan. As seen from Ontario’s handling of the first-wave, the policies enacted post-SARS preparation for future outbreaks did not accommodate one as large as COVID-19 or said policies were not adequately implemented ([19,24]). Previous responses post-outbreak have called for flexibility for quick expansion in testing capacity such as formalizing integration of private labs into the public system, and Ontario’s response to the COVID-19 pandemic will join these calls as a lesson learned. Though there was an adequate initial spearheaded response, the effectiveness of that system was easily overwhelmed and cause more harm than good—as demonstrated by the backlogs resulting in delays in contact tracing. Policymakers for current and future outbreaks should have a clear understanding of the public lab system’s capacity and establish a threshold for when private lab integration would be necessary for secondary aid and when emergency resource procurement plans would be implemented. Administration can also prepare itself for testing surges.

| Date       | Eligibility Criteria Changes |
|------------|-----------------------------|
| March 25th | The Ministry of Health publishes the first COVID-19 testing guidance document [40]. All specimens are to be tested. The document also establishes a priority list of groups whose samples should be tested if there are shortages of testing supplies. These groups are: Symptomatic health care workers and staff who work in health care facilities Symptomatic residents and staff in Long Term Care facilities and retirement homes Hospitalized patients admitted with new or exacerbated respiratory symptoms Symptomatic members of remote, isolated, rural and/or indigenous communities Symptomatic travelers identified at a point of entry to Canada |
| April 8th  | More specific criteria is detailed for: Symptomatic hospitalized inpatients Symptomatic residents and staff in Long Term Care facilities and retirement homes Symptomatic healthcare workers, caregivers, care providers and first responders Symptomatic members of remote, isolated, rural and/or indigenous communities The following groups are added to the priority list: Symptomatic residents and staff in other institutional settings Symptomatic first responders Individuals referred for testing by local public health A list of typical and atypical COVID-19 signs and symptoms is included [41]. |
| April 15th | Guidelines are added for the following groups: Residents and staff of other congregate living settings and institutions (e.g. homeless shelters, group homes) Household contacts of health care providers or first responders Specific priority populations (i.e. patients requiring frequent contact with the healthcare system due to the nature of their current course of treatment for an underlying condition) Essential workers Cross border workers The list of symptoms is updated to include olfactory/taste disorders, diarrhea, nausea, vomiting, and abdominal pain [42]. |
| May 2nd    | Guidelines are added for the following groups: Newborns Cancer patients Hemodialysis patients The list of symptoms is updated to specify that seasonal allergies and post-nasal drip should be considered for patients with runny noses, sneezing, and nasal congestion. Conjunctivitis is also added as an atypical symptom [43]. |
| May 14th   | Testing is expanded to include any Ontarian with at least one sign or symptom of COVID-19. The list of symptoms is updated to include multisystem inflammatory vasculitis as an atypical symptom. Hoarse voice and sneezing are removed from the list [38]. |
| May 24th   | A memorandum is released by the Ministry of Health. Testing is expanded to include asymptomatic risk-based testing for contacts of COVID-19 cases and people at risk of being exposed to COVID-19 through their employment [39]. |
| May 28th   | Guidelines are added for the following groups: Pre-op patients Patients being transferred between different facilities Asymptomatic contacts of patients with lab-confirmed COVID-19 in long-term care, hospitals, institutions, workplaces and community settings |
| June 2nd   | Prisons and correctional facilities are removed from the list of congregate settings. Guidelines are added for serologic testing. Schools are added to the list of priority populations. Guidelines for asymptomatic individuals are updated to take into account the newly released COVID Alert contact tracing app. |
| August 14th|  

| Date       | Eligibility Criteria Changes |
|------------|-----------------------------|

Table 1:
Timeline of Events Related to Testing in Ontario, Canada.
by having procedures in place to accelerate established practices such as accreditation of private labs. In order for these processes to be effective, it is imperative to formalize communication lines such as integration of information systems across different levels of organization, and creation of a dashboard for jurisdictions for parties to be aware of the infectious disease testing capacity usage and resource stocks and shortages at various institutions. By sharing through these channels, it encourages transparency between private-public labs and provides a network across the state for outbreak preparedness.

5. Conclusions

Policies around increasing testing capacity were pillars in managing the COVID-19 pandemic and, more generally, in infectious disease outbreak management. Historically, incorporating testing surge capacity has been called for after various outbreaks such as SARS, but has rarely been effectively addressed post-outbreak. Early in the pandemic, Ontario lagged behind on testing capacity completed due to a lack of key infrastructure and clear lines of communication. Two elements of the new COVID-19 testing program that were implemented to attempt to increase surge capacity are: 1) the expansion of lab testing to private and independent labs; and 2) the centralization of supply to the provincial government. The strategy of centralizing resources was effective early in the outbreak in establishing a clear chain of command, but a lack of reagents still contributed to a lag of unprocessed tests. While no formal lines of communication were originally set up to incorporate private labs into the public health system of testing, the approval and integration of these laboratories were expedited through cooperation of the public health system and the labs themselves. Testing capacity increased, which was reflected in the gradual expansion of testing criteria. The number of tests completed per day has increased from around 4,000 per day in March to 32,000 per day by the end of August. Thus, elements of expansive testing programs can be quickly constructed through cooperation and clear communication. However, building these elements into public health structures regardless of emergency status is pivotal in preparing for future infectious disease outbreaks.

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Declaration of Competing Interest

There are no conflicts of interest to declare.

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