Kingston, Frontenac and Lennox & Addington

Regionalized Reopening Proposal

May 1, 2020

KFL&A Public Health

Contents

Background

This proposal plan provides a coordinated and integrated approach to regionalized lifting of restrictions in the context of Ontario's *A Framework for Reopening our Province*[1]. We provide an outline that serves to inform the coordination of a localised public health strategy for easing restrictions in the KFL&A region. The information is derived from a review of recently published and unpublished reports found through systematic scanning of available literature and media reports. It adheres to the principles laid out by the provincial framework and aims to present a responsible, evidence-informed, responsive, effective, and clear plan that is flexible and adaptable to changing circumstances.

There has been a great amount of attention and detail given to establishing public health policies and interventions to disrupt and slow the transmission of epidemic spread. Similarly, consideration must be given to identify transition points in order to mitigate risks related to reopening social activities, businesses and services and prevent a resurgence of infections region by region.

The interventions suggested in this proposal are largely regulated at the provincial level, and as such, this document helps guide strategy from a municipal perspective as applied to the KFL&A region.

Current Status

To help control spread and manage community transmission of COVID-19 in Ontario, a provincial Declaration of Emergency under the Emergency Management and Civil Protection Act was issued on March 17, 2020. This declaration was accompanied by orders to include a range of interventions including closure of non-essential businesses, public places, prohibition of events and gatherings of people, and others. This order was extended and expanded to close all outdoor recreational amenities, such as sports fields and playgrounds on March 30, 2020. These orders have since been extended to last until May 12, 2020[2].

Models adapted to the local context in the KFL&A region predict that with moderate public health interventions, the number of COVID-19 cases requiring hospitalizations on any given day in the KFL&A area would peak at 1400 cases. As of April 30, there have been 59 total cases and 0 deaths. Since April 6, 2020, there has been one new confirmed case of COVID-19 indicating the success of these measures.

Goals

The primary goals of this localized proposal are based in the principles of *A Framework for Reopening our Province*:

- Maintain a steady state of low-level transmission, to ensure sufficient public health and acute care capacity
- Reduce mortality due to COVID-19 and non-COVID-19 causes

The secondary goals of this localized strategy are to:

- Minimize unintended consequences of necessary public health measures (e.g., negative physical and mental health impacts, economic impact to the community)
- Minimize societal disruption, maintain public trust and reduce public panic

Research Evidence

A rapid scoping review of literature was conducted with an aim to:

- Understand whether a localized approach to lifting restrictions is feasible in the current pandemic situation
- Provide guidance for criteria and capacities necessary at a regional level to support a localized approach to lifting restrictions

The specific research question was:

- What factors/criteria/considerations should be in place to move forward with lifting restrictions at a regional level?

Peer-reviewed, non-peer reviewed, pre-published, and grey literature sources were searched. Included sources were mapped to quantify literature sources and demonstrate where information related to easing restrictions is derived from. A narrative synthesis of included sources was also completed. A detailed protocol of the search strategy, data collection and analysis is available upon request. We have summarized key points of the research in this section.

Regional Approach

Several national and international guidance documents for lifting restrictions propose that the adjustment of control measures be considered at the sub-national and/or regional level[3–8]. Specifically, it is suggested that lifting measures begin in areas with lowest incidence[6,7], starting with those with local impact[3], in coordination with different jurisdictional levels[4,5], using a common framework[3,9].

A regional approach facilitates effective action that may be tailored to local conditions[3]. There is recognition that any approach to re-opening will vary according to local community capacity and needs[4]. The decisions related to lifting restrictions rely on a number of complex independent and interrelated factors—epidemiological, social, economic, health systems, and important local community needs — that will best be managed in alignment with local level capacities[3,4]. Actions will require planned coordination across regions to support highly integrated value chains, recognizing containment within geographical boundaries is not possible but may be mitigated[3,5] One guideline suggested that where the

population or individual density is lower (rural versus urban, small/medium versus large cities, small stores versus shopping malls), some measures (e.g., business closures) could be lifted first and could be lifted for part of the workforce before allowing the whole workforce to return to a business[4]. A localized approach also supports monitoring and evaluation activities to assess the impacts of easing of restrictions[3,6,7].

Criteria and Transition Indicators

Across guideline documents, there were epidemiological indicators suggested as criteria for informing decisions about when restrictions might be eased. For example, indicators related to the spread COVID-19 and the degree to which transmission is controlled (e.g., a level of sporadic cases, clusters of cases all from known contacts or importations), as well as indicators related to acute and critical care criteria. Though indicator categories were consistent, the specific definitions of indicators varied across documents.

USA guidelines listed criteria in relation to phases proposed, specifying downward trajectories for: COVID-19-like symptoms, cases, and positive tests in the past 14 days[4,5,8].

Specific transition indicators that were proposed included: continued downward trajectories of indicators listed above with no evidence of rebound[5,8] and if the reproduction number rises above 1[4].

Neither of the two WHO documents or the EU CDC documents proposed specific transition indictors[3,6,7].

An interval of 2 to 3 weeks between relaxation measures was suggested to enable proper risk assessment before proceeding with further easing[6,7,8]. Ontario's framework is similar suggesting an interval between 2 to 4 weeks between decision points and key criteria outlined by the CMOH[1].

Capacity Needs Specified

All guidelines indicated hospital and public health capacity, as well as monitoring incidence and tracking capacity would need to be satisfied as part of any easing strategy [3–7,8].

Health system capacity is related to having sufficient: acute and critical care capacity; personal protective equipment; support for vulnerable groups to have access to care; and an ability to care for all patients, not just those affected by COVID-19[3,4,6,7,8]. The EU CDC also suggested there be sufficient capacity within primary health care systems to care for patients discharged from hospitals or maintained at home in order to cope with the increasing backlog of elective interventions postponed during the pandemic[3].

Public health capacity related to having robust and efficient systems for detection, testing, and isolating[3,6,7]. A key aim is to improve detection/testing with the capacity to conduct contact tracing for all new cases and close contacts such that isolation is swift and prevents community transmission[3,5–7,9,10]. In addition, another priority is appropriate infection prevention and control measures[6,11]. Antibody detection capacity was also suggested, as this becomes available[3,8].

Additional capacity considerations suggested: establishing workplace preventive measures[6,7]; managing importations from travellers[6,7]; clear communication to inform and engage the public[4,6], and accelerating the development of therapeutics and vaccines[5].

Modelling Studies

There are a variety of lockdown strategies that have been modelled as population level interventions to explore the impact on epidemiological curves (please see Appendix for additional information and figures pertaining to specific strategies). According to the literature, there are several recommendations that help inform policy going forward. We have summarized these recommendations below.

Many modelling studies suggest that partial lifting of restrictions, varying the level of control over time, could provide some relief from social distancing, while still limiting disease transmission[12–17]. Strategies should be data driven to ensure that a manageable caseload remains the over-riding priority. Following any policy intervention there should be close monitoring of transmission and health care utilization data in real-time[16–20]. Lifting restrictions should be combined with other non-pharmaceutical interventions, such as increased testing, isolation of cases and contacts, and possibly routine screening of high-risk groups[18,20,21]. High-risk groups (i.e., the elderly and immunocompromised) may need longer periods of strict social distancing[15,17,22]. Determining local capacity for increased testing will be necessary for this approach.

Modelling studies also demonstrate support for a regionalized approach[14,23,24]. Fisman et al provide a model based on Ontario-specific population data which could inform local decision making. They project that dynamic interventions, which respond to changes in health care utilization, could reduce the proportion of the population that is infected and keep expected ICU-cases below provincial capacity[17]. Another group advocates that trials of lifting strategies could focus on activities deemed to have high economic benefit and low health care costs, which are more easily selected and determined on a regional level[24]. Regardless of the intervention, it is important that the region in question have strong case and contact management as well as a robust surveillance system.

It is important to consider limitations associated with the analysis and interpretation of modelling studies. Primarily, it is useful to understand that models are not intended to provide literal predictions but help guide policy through anticipating directionality of trends. It is very difficult to provide accurate real-world projections using abstracted variables for a highly complex multi-factorial problem. Moreover, COVID-19 continues to be an evolving topic of research and there still have gaps in our knowledge regarding transmission dynamics, seasonality, and immunity amongst other variables.

Risk Assessments

Risk assessments are essential for informing how and when to implement the variety of measures to ease restrictions[3,4,6,7,9]. Guidance documents place the role of public health as central for advising and guiding evidence-based actions for lifting restrictions[3,6,7]. Protecting vulnerable populations is an underlying principle[3–7,8] that could be integrated into risk assessments using a "society needs" approach that accounts for the social determinants of health[9]. All easing of restrictions requires "a careful risk assessment and staged approach to balance benefits and harms, adjusting the measures so as not to trigger a resurgence of COVID-19 cases and jeopardize the health of the population"[6(page 1)].

Risk assessments balance epidemiological factors with health system and public health system capacity[4,6,7]. Several guidelines suggest decisions to ease or tighten restrictions should also consider: scientific evidence, real-world experience, economic factors, security related factors, civil liberties, food security, public sentiment and public adherence as part of risk assessments[4,6,9,10].

A collaborative governance approach, which includes multi-sector stakeholders, is suggested to develop a local framework for assessing risk[4,6,9] and settle on appropriate mitigation strategies[3,4].

Lessons from Other Countries

Multiple countries, mostly in Asia, have passed their first peak of COVID-19 and are starting to relax previous measures to contain or suppress the outbreak. Other countries, mainly in Europe, are still waiting to confirm whether they have passed their first peak but have nevertheless released their intentions, or have already moved, into the recovery phase of the pandemic. It should be acknowledged that the definition of "lockdown" varies across national responses with differences related to location, timing and duration of physical distancing measures, as well as businesses and services closures[25].

Several lessons emerge from looking at the relaxation of measures in Asia and the plans for relaxation in Europe[8,27–36]:

- Clusters of cases will continue
- Travel will remain a concerning source of infection while other countries have not controlled their outbreaks
- Relaxation of public health measures should be slow, considered and well-spaced
- Universal masking and physical distancing should continue
- Testing should be expanded to allow for enhanced surveillance
- Case-contact tracing, and isolation and quarantine of clusters should be continued
- Government and public should be prepared to return to more intensive public health measures

Information in this section was adapted with permission from Dr. Joanne Kearon[26]. For a list of selected countries and strategies used, please refer to the Appendix.

Additional Health Outcomes of Pandemic-Related Restrictions

Public health emergency response measures can also cause negative health outcomes, including social isolation, mental health strain, reductions in preventative medical care, and negative economic impacts. Economic status across a population is highly correlated with health status, and prolonged economic struggle may negatively impact the overall health status of a population[37].

Quarantine can have adverse psychological effects, including post-traumatic stress disorder, anxiety and depression. Factors that may alleviate the negative impacts included shorter duration of quarantine, providing clear rational, availability of adequate supplies and appeals to altruism [38]. Children and adolescents with mental health needs are particularly vulnerable without access to mental health resources and peer support [39].

Individuals with chronic health conditions may suffer increased morbidity and mortality following short-term reductions in healthcare access. Several studies report that following decreased health care utilization during the SARS pandemic, there were significant increases in hospital admissions, and mortality from both diabetes and cerebrovascular disease [40,41].

Ethical Considerations

In concordance with *A Framework for Reopening our Province,* ethical principles must inform policy. Managing the COVID-19 pandemic from an ethical perspective will require careful balancing of civil liberty concerns of individuals with community benefit. In keeping with the provincial response there is an emerging consensus that a graduated approach to restrictive measures will be needed — one that

permits a return to some social and economic activity while avoiding undue stress on medical resources and allowing population immunity to build gradually. In developing this strategy, equitable and effective public policy strategies should be guided by ethical principles[42,43]. Broadly, the following ethical principles should be considered:

- Interventions should be evidenced based and proportionate.
- Intrusion into people's lives should be the minimum possible to achieve public safety.
- The unintended effects of public health measures must be carefully assessed, as they relate to socioeconomic wellness of individuals and society. To promote justice, we must mitigate the differential impact of interventions on equity-seeking groups.
- The public has a right to obtain key information that benefits its safety and security. The aims and evidence of the interventions being implemented should be clearly communicated. In communicating plans to loosen public health measures, the public should be aware of the criteria for loosening restrictions, and well as criteria for re-instating measures.

Regional Capacity

In accordance with Ontario's *Framework for Reopening our Province*, decisions to lift restrictions rely on many factors including virus spread and containment, health system capacity and surveillance capacity. The following sections outline the suitability of the KFL&A region to meet criteria for easing restrictions outlined by Ontario's Chief Medical Officer of Health[1].

Demographics of our Region

KFL&A Public Health serves three municipal organizations (the City of Kingston, the County of Frontenac, and the County of Lennox & Addington) with a total population of approximately 200,000 and land area of 6600 square kilometers. Most of the population resides within the City of Kingston (65%), with the balance split equally between the two counties. Approximately 20% of the population is age 65 years and older, making the population in the region older than the Ontario population, with a median age of 44.5 compared to 41.3 (2016 Census). Given the known epidemiological evidence related to more severe symptoms of acute respiratory infection in older adults, the region is vulnerable to surge that will impact and could quickly overwhelm the current primary and acute care systems. Ninety-seven percent of residents are Canadian citizens, 11% are immigrants, and 7% are visible minorities. Nearly 40% of the population has moved within the past five years, half of those being migrants. Ninety-six percent of the population identify English as the language most often spoken at home, with French at 1% (compared to 2% of Ontarians). The most common other languages spoken at home are Portuguese and Mandarin. About 4% of the population identifies as Indigenous.

Co-morbidities

Epidemiological data shows the prevalence of comorbidities (e.g., hypertension, diabetes, respiratory system disease, cardiovascular disease) in severe presentations of COVID-19 patients is higher than in non-severe presentations. Hospitalization rates in KFL&A for respiratory disease and lower respiratory disease were significantly higher than Ontario in 2018 (763.8 vs. 625.2 per 100,000, respectively for respiratory disease and 319.1 vs. 212.2 per 100,000, respectively for lower respiratory disease). For chronic obstructive pulmonary disorder (COPD), the KFL&A region showed significantly higher rates (251.8 vs. 173.3 per 100,000). Also, the region's rates for asthma in 2018 were significantly higher compared with the provincial rate (61.9 vs. 36 per 100,000). Hospitalization rates for diabetes were

significantly higher in 2018 compared with the province (132 vs. 102.8 per 100,000). Hospitalization rates for ischemic heart disease (ISH) and cardiovascular disease (CVD) were lower than the province (227 vs. 300 per 100,000, respectively for ISH and 863 vs. 902 per 100,000, respectively for CVD) (DAD, 2017). The smoking rate in the KFL&A region was 20.2% (CCHS 2015/16).

Priority Populations

High-level priority populations in the KFL&A region include Indigenous residents, low income residents, and the rural population. The 2016 Census revealed 4% of residents self-identify as Aboriginal (63% First Nations, 32% Metis, 1% Inuit), with 1% Registered or Treaty Indian. Twenty-seven percent of the population is rural (2016 Census). Using the Institut national de santé publique du Quebec (INSPQ) Deprivation Index and/or the Ontario Marginalization Index, it is evidenced that residents of more deprived/marginalized neighbourhoods have poorer health outcomes. Median income in KFL&A in 2015 ($69, 930) was similar to the province. Overall, the low-income percentage of the population is comparable to the province at 14%.

In 2018, the United Way KFL&A, in partnership with the City of Kingston, conducted the Urban Point-in-Time (PiT) Homeless Count for Kingston, Ontario (Results of the Urban Kingston 2018 Point-In-Time Count, United Way, 2018). The number of people found experiencing absolute homelessness (those who are unsheltered or 'sleeping rough' and those who are emergency sheltered) was 81, although a total of 152 people were encountered who were homeless (of various types) in 2018. Some of these individuals were using transitional housing, sleeping at someone else's home, or in unknown situations.

Surveillance Capacity

To mitigate risk, it is crucial to have robust surveillance strategies in data. In the KFL&A region, there are many layers of data collection and surveillance that allow for the rapid and efficient sharing of data within the local healthcare systems. Unique strengths of the region's surveillance system are defined by simplicity, stability, and capacity.

The surveillance system is simple in the sense of its structure and ease of operation. Unlike many other regions, there are only two hospital systems in KFL&A, Kingston Health Sciences Centre (KHSC) and Lennox and Addington County General Hospital (LACGH). Active surveillance is simplified to the systematic detection of infection in sentinel groups such as healthcare workers, long-term care residents, and patients presenting to emergency departments, COVID-19 Assessment Centres and admitted to hospitals. These groups each have protocols in place in place to minimize the risk of new outbreaks and risk of nosocomial transmission through effective early identification through testing appropriate cases and contacts.

Stability is another key feature of the surveillance system. Existing infrastructure has been used for syndromic surveillance in the region for many years via the Acute Care Enhanced Surveillance (ACES) system that provides real-time situational awareness of admissions to hospitals in Ontario for reasons that may be related to COVID-19. ACES has a strong record of collecting, managing, and providing data in a reliable fashion. This type of monitoring system is especially important when progressing through phases as it can potentially identify an outbreak much faster than is possible using laboratory results alone.

Testing Capacity

One of the main considerations in moving forward with a plan is ensuring sufficient testing supplies to meet demands. This includes being able to test all cases and have timely results (within 24 hours of identification and sampling), detection of cases quickly after symptoms onset, adequate case management through appropriate treatment and isolation measures, as well as capacity to perform contact tracing in a timely manner.

Current testing facilities in KFL&A include the Community COVID-19 Assessment Centre, hospitals, and long-term care (LTC) facilities aimed at testing sentinel groups. These systems help support the systematic detection of infection in sentinel groups such as healthcare workers, long-term care residents, and patients presenting to emergency departments and admitted to hospitals. These groups each have provincially mandated protocols in place in place to minimize the risk of new outbreaks and risk of nosocomial transmission through effective early identification through testing appropriate cases and contacts.

At this time, KFL&A's testing capabilities are being met due to low levels of COVID-19 transmission in the area, but this could change if significant demands developed in the form of outbreaks or clusters. It is important that we are prepared with adequate public heath supplies and workers to ensure we can respond effectively to higher rates of transmission if they do occur.

It is also beneficial to have access to sufficient serological testing as this would allow us to conduct a seroprevalence study to better gauge the level of infection and immunity in the general public or specific populations.

Laboratory Capacity

The KFL&A region also has capacity to test many samples in a timely fashion given a Public Health Ontario lab based in Kingston and the KHSC Microbiology lab. These labs in the community make it more likely that testing demand can be met even during a surge in cases, and additionally, that turnaround time is quicker allowing for more timely action if needed. To ensure that adequate testing is implemented the local Assessment Centre and Call Centre report the daily number of patient assessments, swabs, and calls, and in addition we receive reported confirmed COVID-19 cases from the integrated Public Health Information System (iPHIS).

Hospital System Capacity

The anticipated burden on the healthcare system due to COVID-19 is difficult to predict. Researchers at the University of Toronto have created models that project expected numbers of hospitalizations based on type of public health measures put in place to combat COVID-19[17]. When adapted to the local context, these models predict that with low-to-moderate public health non-pharmaceutical interventions, the number of COVID-19 cases requiring hospitalization on any given day in the KFL&A area would peak at 1400 cases. However, if more stringent non-pharmaceutical interventions are successful, a peak of around 500 hospitalized cases is predicted.

There are several important caveats to note regarding these models. The intention of the models is not to confer absolute numbers, but to demonstrate the effectiveness of different public health interventions. Furthermore, the outputs are based on provincial data, adjusted for local population size,

but local demographic differences from the Province are not incorporated. It would be inaccurate to rely on the absolute numbers predicted by the model.

Current assets include the region's partnership across local hospital systems (i.e., KHSC and LACGH), close communication with local public health, and ongoing planning to accommodate capacity if it was to hit peak numbers as projected by models. This is further supported by the ability to access real-time bed capacity via an online tool *Power BI* which relays hospital capacities in real-time.

Current plans for alternate health facilities (AHF) are being developed to emergency capacity expansion.

Capacity Related to Specific Vulnerable Settings

Congregate settings pose high-risk for transmission of the virus, challenges in implementing mitigation strategies, and ethical considerations for these groups.

- **People Experiencing Homelessness:**
  - Estimated population in Kingston: 213[44]
  - For individuals who are experiencing homelessness, there is much greater risk of contracting COVID-19 as they have limited opportunities to access washroom facilities to wash their hands and are unable to self-isolate or practice social distancing. The Addictions and Mental Health Services-KFL&A, in collaboration with many local partners, has opened a Self-Isolation Centre which allows those experiencing homelessness to self-isolate while maintaining safe physical distance from others. The centre has full protective equipment for staff. At present, demand has not surpassed available space, and there is ability to expand available beds, however, in fall and winter months there may be increased demand.
- **Inmates at Corrections Facilities:**
  - Estimated population in KFL&A
    - Federal Institutions: 2381
    - Provincial Institutions: 144
  - Correctional facilities are recognized as vulnerable settings and are therefore implementing policies and procedures to limit the spread of COVID-19 based on provincial and federal guidance. Both provincial and federal correction centres are following jurisdictional screening criteria, implementing social distancing of inmates, and limiting people on the premises, including visitors.
- **Residents of Long-Term Care and Retirement Homes:**
  - Estimated capacity in KFL&A
    - 12 LTC facilities with 1517 beds in KFL&A
    - 15 Retirement Homes with 1097 beds in KFL&A
  - KFL&A Public Health has worked closely with long-term care given the high-risk nature of these healthcare settings, with many older adults at risk of severe morbidity and mortality from COVID-19. Adequate supply of PPE has been an ongoing concern. Directives that all workers and residents be tested are logistically challenging, and we should anticipate shortages in testing supplies. As the pandemic continues, we should also plan for increased staffing. To date, there has been one LTC outbreak in KFL&A. We are not presently in a place to lift restrictions for long-term care facilities. As outlined in the checklist, extra precautions will be needed to protect this population for the foreseeable future.

Evaluation Capacity

KFL&A Public Health has a comprehensive complement of staff with specialist evaluation skills and experiences. The Knowledge Management Division is comprised of research associates, epidemiologists and librarians. Additionally, there are three internal research and evaluation specialists in the organization providing consulting and evaluation services. Staff participate in established advisory networks and channels of communication both internally, through a Community of Practice for Evaluation, and externally, through the Ontario Public Health Evaluation Network and the Shared Library Services Partnership. Staff have experience designing, implementing, analyzing and disseminating evaluations at service, programmatic, organizational, and policy levels, both within the organization and through cross-agency collaborations.

To date, the Knowledge Management Division has completed a draft version of a post-pandemic assessment and improvement plan. However, the proposed easing of public health emergency response restrictions will require the development of an evaluation approach to ensure rapid feedback related to the diverse range of activities rolled out as part of this proposed phasing for lifting restrictions. In addition to surveillance and monitoring, evaluation methodology will inform ongoing risk assessments. Real-time evaluation (RTE) uniquely manages risk during the first months of early emergency responses by assessing major operations, checking compliance with broader standards and policies, and informing real-time progress of regionalized initiatives[45]. RTEs offer a flexible methodology that assesses in real time, in the field, to influence initiatives or programs as they happen, to make key changes quickly (i.e., the same week or month).

In the current dynamic efforts to prevent the spread of infection, establishing such feedback mechanisms will enable tailored solutions to mitigate challenges, prevent unintended consequences, and maintain low risks of transmission. Indeed, delayed decision-making based on stakeholder considerations (i.e., political, economic), insufficient resourcing, or poor coordination (all factors related to public health emergency response measures not otherwise captured using surveillance methods) contributes to poor epidemic response[46].

Establishing a RTE approach, supported by an adaptive epidemic response framework, will encourage sustainability of actions, provide inclusive coverage by flagging how population groups are impacted differently, inform emergency risk communication efforts, and guide coordination efforts across the region[45–47]. Lessons learned from regionalized evaluation and surveillance efforts will inform approaches for other agencies, organizations or jurisdictions, as well as broader policy development.

Proposed Response

Decisions about where and when to lift restrictions must be evidence based, data driven and applied incrementally, using a phased approach being sure changes that are proportional to risk –such as is presented in *A Framework to Reopening*. It is important to establish criteria for moving through a gradual ease of restrictions and balance both health and socioeconomic outcomes over the long term. In the current situation, long term means until such time that a vaccine to prevent COVID-19 is made available or that national population immunity reaches a documented level of 70% or more.

Ontario is uniquely positioned to implement innovative tactics for regionalized lifting of restrictions as public health units command highly specialized workforces within established, localized, geographical boundaries. The regionalized workforce is well supported by cooperative advisory networks from across

the province and Public Health Ontario. Just as the implementation of municipal emergency response measures corresponded to regional surveillance indicators of community spread, so too could a phased approach to ease restrictions. A localized approach will permit close monitoring in community context, matched with community capacity to mitigate consequences. A localized approach enables real-time evaluation activities at a smaller, more nimble scale. In turn, with regional evaluation measures in place, we will collect rapid feedback related to specific easing activities and inform risk assessments. A localized approach will accelerate research and knowledge sharing in order to tailor actions to other jurisdictions and/or scale up full policy responses at a provincial level.

The proposed localised response acknowledges that the geography may have to be scaled to a region with sufficient capacity to fulfill surveillance, detection, case and contact management, critical care, communication and evaluation needs to prevent infection resurgence. Not all health units in the province will have sufficient capacity, therefore, localised responses could consider other possible boundaries, (i.e., LHINs).

Integration with *A Framework for Reopening*

In Ontario, the slowdown in the number of cases is due to public health action, not herd-immunity[48]. This means a significant portion of the population remains susceptible to infection. The provincial approach builds on continued implementation of physical distancing efforts, gradually moving to ease restrictions in settings from strict, to moderate, to light physical distancing policies. Without this fundamental prevention measure, the risk of COVID-19 resurgence, regardless of phase, is high.

Continual risk assessments will be required to evaluate the epidemiological risks, health risks and benefits, as well as socioeconomic risks and benefits of lifting restrictions on different workplaces, institutions, educational settings, and social activities.

The Readiness Checklist tool is comprised of three stages corresponding with the provincial framework[1]. The public health checkboxes are listed as criteria that must be met before moving to a subsequent transition phase; the municipal checkboxes are settings where restrictions may be lifted, if they continue to meet listed policy criteria.

	PUBLIC HEALTH ACTION	MUNICIPAL ACTION
PHASE 1: Protect and Support	Criteria and conditions	Criteria and conditions
PHASE 2: Restart • **Stage 1** • **Stage 2** • **Stage 3**		
PHASE 3: Recover		

Once criteria and conditions within each phase and stage are fulfilled and an interval of 2 to 4 weeks has passed, the regional stakeholders in collaboration with the province may decide to move into the next stage. In the event of a resurgence of infection, regional stakeholders will have to impose new restrictions and possibly return to an earlier phase or stage and impose restrictions. Risk assessments will guide this movement in addition to the criteria listed below[1]:

- A consistent two to four week decrease in the number of new daily COVID-19 cases,

- Sufficient acute and critical care capacity, including access to ventilators and ongoing availability of personal protective equipment,
- Approximately 90% of new COVID-19 contacts are being reached by local public health officials within one day, with guidance and direction to contain community spread, and
- Ongoing testing of suspected COVID-19 cases, especially of vulnerable populations, to detect new outbreaks quickly.

Appendix

Modelling Strategies Review:

There are many proposed strategies to lift restrictions as part of a COVID-19 exit strategy. It is clear there is significant risk with lifting restrictions too quickly or aggressively due to potential of new waves of outbreaks. Generally, we classified the various strategies into nine categories:

1. **One-Shot Interventions (i.e., lock-down)**
    - One-time application of restrictive measures with pre-determined date / criteria for complete lifting of restrictions.
2. **Switched System**
    - Switching between enforced strict social distancing and relaxed measures, while accepting slow virus spread.
3. **Data Driven Intermittent Lock-downs**
    - Using real-world and modelling data to trigger intermittent lock-down and release from lock-down. It does not have predetermined cycles.
4. **Contact Tracing and Case Management**
    - Emphasis on extensive contact tracing and case management of all (or nearly-all) cases.
5. **Immunity Testing / Immunity Certificate**
    - Based on achieving herd immunity in a population either from natural immunity or from deployment of a vaccine. Current estimates for the earliest availability of a vaccine are early 2021 [49]. One proposed idea is providing immune individuals a "immunity certificate," allowing exemption from COVID-19 related restrictions.
6. **Regional Scheduling**
    - In parts of the jurisdiction (e.g., cities or municipal health services catchment areas) stringent interventions are released, accepting local viral spread. Controls remain in other jurisdictions until lifted successively[50].
7. **Group Shielding**
    - Physical (social) distancing of high-risk individuals (e.g., age over 70 years, immunocompromised, medical comorbidities, etc.) while allowing lower risk individuals to return to activity [51].
8. **Gradual lifting**
    - Constant application of restrictions with either pre-determined or data-driven gradual lifting of restrictions
9. **Other Non-Pharmaceutical Interventions**
    - Specific interventions not well described in other categories (including school closures, business closures, increasing ICU capacity, etc.)

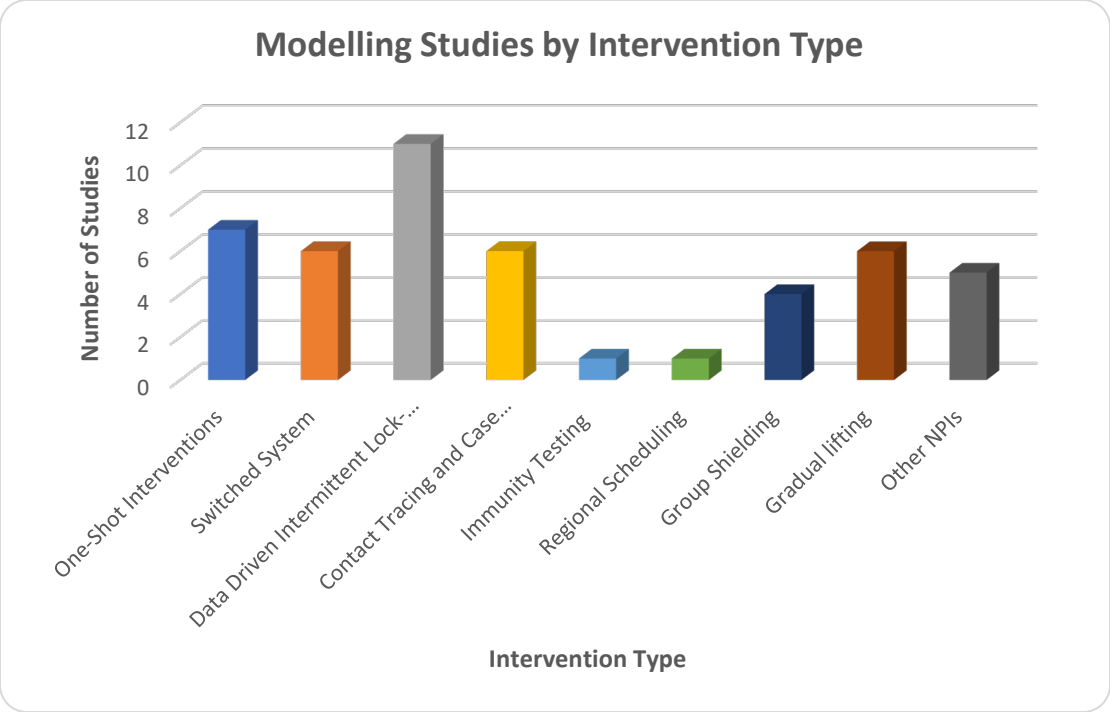

Figure 1: Modelling Studies Included in Review by Type

Lessons from Other Countries

Country	Exit Strategy	Effect of Exit Strategy
China[27–29]	• Lockdown on Wuhan has just been released • Continued universal masking • Continued isolation of mild-moderate cases • Continued broad testing strategy • Prepared to implement focal lockdowns • Continued travel bans and quarantines for travellers	• Continued small clusters of cases, not overwhelming healthcare system • Effect of release of lockdown remains to be seen
South Korea[30–32]	• Relaxing physical distancing measures • Tightening travel restrictions • Continued universal masking • School reopening postponed again (switch to e-education)	• Continues to have clusters, mainly related to travel
Taiwan[30]	• Prevented large outbreak from beginning • Closed borders quickly; never had to physically distance • Maintaining closed borders until other countries have outbreaks under control • Expansive testing protocols • Continued universal masking	• Slowly increasing cases, in controlled fashion
Singapore[30,33]	• Singapore did not have to implement as stringent as measures at first, and believed it was past peak, but now is increasing measures • Continued universal masking	• Recent outbreak in foreign worker dormitories

		• Has had to increase measures, now in lockdown for 1 month
Hong Kong[30,34]	• "Suppress and lift strategy" based on case counts, in two week cycles • Predicts that this will need to be continued for 2 years, until vaccine • Continued universal masking	• Rising number of cases recently, mostly due to travel
Austria[35]	• Was one of the first countries in Europe to lockdown • Currently 13 555 cases and 315 deaths • Has announced plan to reopen small shops and garden centers on April 14 • Will reopen things slowly, with 2 weeks in-between • Continued physical distancing and universal masking • Expect to allow mass gatherings in June	Not yet known
Denmark[36]	• Was one of the first countries in Europe to lockdown, and measures were not as severe • Currently 5830 cases and 237 deaths • Will start by reopening schools and daycares • Continued physical distancing otherwise	Not yet known
Italy[27]	• Continued lockdown now, but may be past peak • Now designating hospitals as COVID or COVID-free • Expanding contact tracing and testing, even of asymptomatic people	Not yet known
USA[8]	• To be implemented by states or regionally • Outlines prerequisites or 'gating criteria' to proceed with de-escalation • Includes: epidemiologic criteria, testing capacity, and healthcare system capacity • Outlines 3 phases • Throughout, encourage hand hygiene, physical distancing, staying home if ill, and wearing a mask in public	Not yet known

Table 2: Summary of Strategies and Outcome by Country -adapted with permission from Dr. Joanne Kearon[26]

References:

1. Government of Ontario. *A Framework for Reopening Our Province*. Toronto; 2020.

2. Ontario Extends Declaration of Emergency to Continue the Fight Against COVID-19. Government of Ontario: News Release. https://news.ontario.ca/opo/en/2020/04/ontario-extends-declaration-of-emergency-to-continue-the-fight-against-covid-19.html. Published 2020. Accessed April 20, 2020.

3. von der Leyen U, Michel C. *Joint European Roadmap towards Lifting COVID-19 Containment Measures*.; 2020. https://www.consilium.europa.eu/media/43076/26-vc-euco-statement-en.pdf.

4. Caitlin Rivers, Elena Martin, Scott Gottlieb, et al. *Public Health Principles for a Phased Reopening During COVID-19 : Guidance for Governors*.; 2020.

5. Gottlieb S, Rivers C, Mcclellan MB, Silvis L, Watson C. *National Coronavirus Response A ROAD MAP TO REOPENING*.; 2020.

6. WHO. *Considerations in Adjusting Public Health and Social Measures in the Context of COVID-19*. World Health Organization; 2020. WHO-2019-nCoV-Adjusting_PH_measures-2020.1-eng.pdf.

7. World Health Organization. *COVID-19 Strategy Update*.; 2020.

8. The Whitehouse, Centre for Disease Control. *Guidelines OPENING UP AMERICA AGAIN*. Washington, DC; 2020.

9. Ryan BJ, Coppola D, Canyon D V, Brickhouse M, Swienton R. COVID-19 Community Stabilization and Sustainability Framework: An Integration of the Maslow Hierarchy of Needs and Social Determinants of Health. *Disaster Med Public Health Prep*. 2020:1-16. doi:10.1017/dmp.2020.109

10. Studdert DM, Hall MA. Disease Control, Civil Liberties, and Mass Testing - Calibrating Restrictions during the COVID-19 Pandemic. *N Engl J Med*. 2020:1-2. doi:DOI: 10.1056/NEJMp2009027

11. *Covid-Strategy-Update-14april2020*. Geneva; 2020. https://creativecommons.org/licenses/by-nc-sa/3.0/igo.

12. Djidjou-Demasse R, Michalakis Y, Choisy M, Sofonea MT, Alizon S. Optimal COVID-19 epidemic control until vaccine deployment. *medRxiv*. 2020:2020.04.02.20049189. doi:10.1101/2020.04.02.20049189

13. German R, Djanatliev A, Maile L, Bazan P, Hackstein H. Modeling Exit Strategies from COVID-19 Lockdown with a Focus on Antibody Tests. *medRxiv*. 2020:2020.04.14.20063750. doi:10.1101/2020.04.14.20063750

14. Shuler RL, Koukouvitis T. Partial unlock caseload management for COVID-19 can save 1-2 million lives worldwide. *medRxiv*. 2020:2020.04.13.20064139. doi:10.1101/2020.04.13.20064139

15. Roy S. COVID-19 pandemic: Impact of lockdown, contact and non-contact transmissions on infection dynamics. *medRxiv*. 2020:2020.04.04.20050328. doi:10.1101/2020.04.04.20050328

16. Yap WA, Raja DB. Time-variant strategies for optimizing the performance of non-pharmaceutical interventions (NPIs) in protecting lives and livelihoods during the COVID-19 pandemic. *medRxiv*. 2020:2020.04.13.20063248. doi:10.1101/2020.04.13.20063248

17. Tuite AR, Fisman DN, Greer AL. Mathematical modelling of COVID-19 transmission and mitigation

strategies in the population of Ontario, Canada. *CMAJ*. doi:https://dx.doi.org/10.1503/cmaj.200476

18. Di Domenico L, Pullano G, Sabbatini CE, Boëlle P-Y, Colizza V. Expected impact of lockdown in Île-de-France and possible exit strategies. *medRxiv*. 2020:2020.04.13.20063933. doi:10.1101/2020.04.13.20063933

19. Ngonghala CN, Iboi E, Eikenberry S, et al. Mathematical assessment of the impact of non-pharmaceutical interventions on curtailing the 2019 novel Coronavirus. *medRxiv*. 2020:2020.04.15.20066480. doi:10.1101/2020.04.15.20066480

20. Donsimoni JR, Glawion R, Plachter B, Weiser C, Wälde K. Should contact bans be lifted in Germany? A quantitative prediction of its effects. *medRxiv*. 2020:2020.04.10.20060301. doi:10.1101/2020.04.10.20060301

21. Barbarossa MV, Fuhrmann J, Heidecke J, et al. A first study on the impact of current and future control measures on the spread of COVID-19 in Germany. *medRxiv*. 2020:2020.04.08.20056630. doi:10.1101/2020.04.08.20056630

22. Bokharaie VS. A Stratified Model to Quantify the Effects of Containment Policies on the Spread of COVID-19. *medRxiv*. 2020:2020.04.10.20060681. doi:10.1101/2020.04.10.20060681

23. Wei ZJ, Wang FY, Guo MP, et al. Dynamic changes of virus load in supernatant of primary CEK cell culture infected with different generations of avian infectious bronchitis virus strains Sczy3 as revealed by real-time reverse transcription-polymerase chain reaction. *Genet Mol Res*. 2015;14(2):6340-6349. doi:http://dx.doi.org/10.4238/2015.June.11.9

24. Leung K, Wu JT, Liu D, Leung GM. First-wave COVID-19 transmissibility and severity in China outside Hubei after control measures, and second-wave scenario planning: a modelling impact assessment. *Lancet (London, England)*. doi:https://dx.doi.org/10.1016/S0140-6736(20)30746-7

25. Bin M, Cheung P, Crisostomi E, et al. On Fast Multi-Shot Epidemic Interventions for Post Lock-Down Mitigation: Implications for Simple Covid-19 Models. 2020:1-14. http://arxiv.org/abs/2003.09930.

26. Kearon J. *Action Plan for COVID-19 De-Escalation and Recovery*. Hamilton; 2020.

27. Parker G, Hughes L. UK looks to Italy and China for clues on lockdown exit strategy. *Financial Times*. https://www.ft.com/content/68df722d-8e35-412a-8932-6a843d66cca5. Published April 6, 2002.

28. China's Wuhan to keep testing residents as COVID-19 lockdown eases. *Channel News Asia*. https://www.channelnewsasia.com/news/asia/covid19-coronavirus-wuhan-testing-lockdown-12630528. Published April 10, 2020.

29. China lifts 10-week lockdown on Wuhan after no new deaths reported for first time in former epicentre. *National Post*. https://nationalpost.com/news/world/as-covid-19-rates-fall-in-global-hotspots-hopes-that-the-virus-pandemic-might-be-slowing-down-on-the-rise. Published April 7, 2020.

30. White E, Hille K, Palma S, Liu N. Asia struggles to find coronavirus exit strategies. *Financial Times*. https://www.ft.com/content/04e9c5fe-52b1-4eb8-bf9c-793d71a0524d. Published April 9, 2020.

31. Bicker L. Coronavirus: How South Korea is teaching empty classrooms. *BBC News*. https://www.bbc.com/news/world-asia-52230371. Published April 10, 2020.

32. McCurry J. Japan and South Korea tighten borders as US faces up to 200 000 Covid-19 deaths. *The Guardian*. https://www.theguardian.com/world/2020/mar/30/japan-and-south-korea-tighten-borders-as-us-faces-up-to-200000-covid-19-deaths. Published March 30, 2020.

33. 233 new COVID-19 cases in Singapore, 7 new clusters including MBS restaurant and McDonald's. *Channel News Asia*. https://www.channelnewsasia.com/news/singapore/coronavirus-covid-19-moh-cases-clusters-mbs-mcdonalds-12635076. Published April 12, 2020.

34. Cheung E, Ting V. Coronavirus: With the smallest new infection count in weeks, Hong Kong's Covid-10 situation "is improving." *South China Morning Post*. https://www.scmp.com/news/hong-kong/health-environment/article/3079222/coronavirus-hong-kong-records-lowest-daily-count. Published April 9, 2020.

35. Fechner I. *Austria's COVID-19 Exit Strategy*. Amsterdam; 2020. https://think.ing.com/articles/austrias-covid-19-exit-strategy/.

36. Baker S. Denmark rushed to lock down before almost every other country; Now its response is so far ahead that it's starting to remove restrictions. *Business Insider*. https://www.businessinsider.com/coronavirus-how-denmark-reached-stage-of-easing-lockdown-restrictions-2020-4. Published April 10, 2020.

37. Laurencin CT, McClinton A. The COVID-19 Pandemic: a Call to Action to Identify and Address Racial and Ethnic Disparities. *J racial Ethn Heal disparities*. doi:https://dx.doi.org/10.1007/s40615-020-00756-0

38. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. 2020;395(10227):912-920. doi:10.1016/S0140-6736(20)30460-8

39. Lee J. Mental health effects of school closures during COVID-19. *Lancet Child Adolesc Heal*. 2020;2019(20):30109. doi:10.1016/S2352-4642(20)30109-7

40. Wang SY, Chen LK, Hsu SH, Wang SC. Health care utilization and health outcomes: A population study of Taiwan. *Health Policy Plan*. 2012;27(7):590-599. doi:10.1093/heapol/czr080

41. Huang Y-T, Lee Y-C, Hsiao C-J. Hospitalization for Ambulatory-care-sensitive Conditions in Taiwan Following the SARS Outbreak: A Population-based Interrupted Time Series Study. *J Formos Med Assoc*. 2009;108(5):386-394. doi:10.1016/S0929-6646(09)60082-6

42. Berlinger N, Wynia M, Powell T, et al. Ethical Framework for Health Care Institutions Responding to Novel Coronavirus SARS-CoV-2 (COVID-19) Guidelines for Institutional Ethics Services Responding to COVID-19 Managing Uncertainty, Safeguarding Communities, Guiding Practice. 2020;2.

43. Nuffield Council on Bioethics. Rapid policy briefing - Ethical considerations in responding to the COVID-19 pandemic. 2020;(March):1-11. https://www.nuffieldbioethics.org/news/responding-to-the-covid-19-pandemic-ethical-considerations.

44. *Housing and Homelessness Report*. Kingston; 2018. https://www.cityofkingston.ca/documents/10180/13882/HousingHomelessReport.pdf/61d0929

6-9329-430f-ac95-58036b53b107.

45. Cosgrave J, Ramalingam B, Beck T. *Real-Time Evaluations of Humanitarian Action An ALNAP Guide Pilot Version*.; 2009.

46. Warsame A, Blanchet K, Checchi F. Towards systematic evaluation of epidemic responses during humanitarian crises: A scoping review of existing public health evaluation frameworks. *BMJ Glob Heal*. 2020;5(1). doi:10.1136/bmjgh-2019-002109

47. Seeger MW, Pechta LE, Price SM, et al. A Conceptual Model for Evaluating Emergency Risk Communication in Public Health. *Heal Secur*. 2018;16(3):193-203. doi:10.1089/hs.2018.0020

48. *COVID-19 :Modelling and Potential Scenarios*. Toronto; 2020. https://files.ontario.ca/moh-covid-19-modelling-potential-scenarios-en-2020-04-20.pdf.

49. Thanh Le T, Andreadakis Z, Kumar A, et al. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov*. April 2020. doi:10.1038/d41573-020-00073-5

50. Vlas SJ de, Coffeng LE. A phased lift of control: a practical strategy to achieve herd immunity against Covid-19 at the country level. *medRxiv*. 2020:2020.03.29.20046011. doi:10.1101/2020.03.29.20046011

51. Ferguson NM, Laydon D, Nedjati-Gilani G, et al. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. *ImperialAcUk*. 2020;(March):3-20. doi:10.25561/77482