Key Messages

- The emergence and spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variant Delta (B.1.617.2, first identified in India) has changed pre-existing assumptions (i.e., based on the Alpha variant [B.1.1.7, first identified in the United Kingdom [UK]) about the prevention and control of Coronavirus Disease 2019 (COVID-19). The Delta variant is more transmissible, reduces the effectiveness of a single dose of current vaccines, causes more severe disease and is currently the dominant strain in Ontario. As a result, the level of vaccine coverage needed for ‘herd immunity’ is now estimated to be at least 90% of the population, and over 100% of the vaccine eligible population.

- Fall scenario planning is complex. While broad scenarios can be developed, how COVID-19 will play out in the Ontario context is highly dependent on a number of factors which we cannot predict (e.g., how Ontarians will behave when restrictions are fully lifted, when vaccines will be approved for currently ineligible children) and which are not mutually exclusive (e.g., waning immunity, unvaccinated individuals, possible new VOCs).

- It is important to consider the biological context of when and why the epidemiology of COVID-19 might shift to increasing incidence, hospitalizations and deaths. For example, waning immunity is most likely to manifest first in long-term care (LTC) residents, older age groups and/or immunosuppressed individuals, due to their vaccination earlier in the pandemic and their underlying health status impacting their initial response to vaccination. Boosters of the same vaccine product for waning immunity may be required in this context.

- Ongoing mutations of the SARS-CoV-2 virus mean future Variants of Concern (VOCs) may emerge, including Variants of High Consequence (VOHCs). Development of a new vaccine product for a global variant with vaccine escape mutations may be required in this context.

- Maintenance of some less restrictive public health measures (e.g. indoor masking in public settings) can support prevention, and may have corollary benefits against expected non-COVID-19 respiratory virus circulation in the fall.

- Further work to incorporate information from other jurisdictions, emerging evidence, modelling projections, and how multiple indicators are combined into a summative assessment, along with specific public health strategies beyond the local level are needed.
Issue and Research Question

To date, Ontario has experienced three pandemic waves of COVID-19 with over 500,000 cases, 28,000 people hospitalized and 9,200 deaths. Vaccination coverage is increasing across Ontario and vaccination targets previously set (i.e., when the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) Alpha variant (B.1.1.7, first identified in the United Kingdom [UK]) was dominant) to progress through a three-step reopening plan have been met, with the transition to ‘full reopening’ remaining.

The emergence and spread of SARS-CoV-2 Variant of Concern (VOC) Delta (B.1.617.2, first identified in India) has changed pre-existing assumptions about the prevention and control of COVID-19. The Delta variant is more transmissible, is associated with lower vaccine effectiveness (VE) of a single dose, causes more severe disease than non-variant strains and is currently the dominant circulating strain in Ontario. In addition to the Delta variant, it is important to anticipate ongoing mutations of the SARS-CoV-2 virus and the impact of future emerging variants, as well as waning immunity and unvaccinated individuals.

With good vaccination coverage in the province, a majority of the population will be protected from severe illness and an approach to fall can consider how to further prevent severe illness in Ontario and preserve health system capacity to support recovery.

This evidence brief summarizes literature on the Delta variant and VOCs in general, and experiences from other jurisdictions to inform a discussion of potential scenarios and their public health risks going into fall 2021 and the next stage of the pandemic in Ontario, when high two-dose vaccine coverage is likely, in-class learning is planned to resume, more activities move indoors, other respiratory viruses re-emerge, and the risk of new global VOCs is present.

Methods

Public Health Ontario (PHO) Library Services conducted searches for peer-reviewed and pre-print literature published from January 2021 onwards in MEDLINE and the National Institutes of Health (NIH) COVID-19 Portfolio (preprints) on July 23, 2021. The full strategy is available upon request. We included English language studies that provide evidence related to the epidemiological impact of the Delta variant, and public health measures to mitigate the impact of Delta and other emerging VOCs. Relevant resources produced by PHO, and those provided by subject matter experts, were also included to inform the Main Findings and provide context to the Discussion and Implications for Practice.

A rapid scan of public health measures and other COVID-19 mitigation strategies planned for the upcoming fall to winter of 2021, in the context of the prevalence of Delta, was conducted between July 22 and 23, 2021 for select jurisdictions (i.e., Denmark, England, Finland, Germany, Ireland, Israel, Italy, Norway, the United States [US], and Australia). Records were obtained through online searches of recent policies, media articles, government websites, official press and reports.

Main Findings

Previous estimates for the level of vaccine coverage needed to begin lifting public health measures were based on the epidemiology of the Alpha variant. The emergence and rapid spread of the Delta variant requires fall epidemiological modelling and risk assessments to be revised using Delta characteristics. Below is a brief summary of recent evidence on the Delta variant.
Delta Variant Epidemiology

- As of June 28, 2021, the majority (56.5%) of COVID-19 cases in Ontario were infected with a variant that tests negative for both N501Y and E484K mutations, signalling the Delta variant becoming dominant in Ontario. Within three weeks, on July 19, 2021, an estimated 83.1% of COVID-19 cases in Ontario were infected with the mutation profile consistent with Delta. This trend is reflected globally. As of July 20, 2021, at least 124 countries across all six World Health Organization regions have reported Delta cases, and it is expected to become the dominant variant globally.

- Emerging evidence has consistently indicated the Delta variant may be more transmissible than the wild-type virus, and the Alpha variant. In addition to increased transmissibility, evidence indicates VE from a single dose may be reduced for the Delta variant compared to other variants, and that complete two-dose vaccination is particularly important to reduce the spread of Delta. When Delta infections do occur, emerging evidence suggests disease severity may be greater than that for other SARS-CoV-2 lineages.

Delta Variant and Critical Vaccination Threshold (‘herd immunity’)

- Currently, Ontario’s three-step reopening plan (created in the context of the Alpha variant being dominant) transitions to full reopening which requires 75% of the eligible population to be fully vaccinated, and no public health unit may have less than 70% of their eligible population fully vaccinated before moving beyond Step 3. This means that some regions of the province may have significant groups of unvaccinated individuals where Delta (or other strains) could easily spread. However, based on the high prevalence, reduced VE with one dose, and increased transmissibility of the Delta variant, the critical threshold for vaccination is now estimated to be at least 90% of the Ontario population, and over 100% of the vaccine-eligible population.

- Additionally, with low global vaccine coverage, and increasing national and international travel to Ontario, there will be a continuous risk of importation that challenges the applicability of herd immunity concepts to the current context.

Delta Variant and Public Health Measures

- Public health measures, such as effective contact tracing, mask-wearing, hand hygiene, and infection protection measures in places such as public transport and crowded indoor spaces, remain important in the control of Delta. A recent modelling study conducted in the UK accounting for Delta characteristics predicted several reopening scenarios, and found that all scenarios resulted in a third COVID-19 wave due to the Delta variant. However, the scenario in which there is a gradual increase in transmission over the summer due to high but waning adherence to public health measures predicted a delayed and smaller third wave, compared to scenarios where public health measures are abruptly stopped which predicted a significant third wave with increased deaths and hospitalizations.

- A modelling study conducted in Australia echoes the importance of continued public health measures to control Delta, estimating herd immunity may not be attainable even in the context of high vaccination rates prior to Delta outbreaks, necessitating ongoing public health measures such as case isolation, home quarantine, school closures and social distancing.
Other Potential SARS-CoV-2 Variants

It is expected that SARS-CoV-2, including its existing variants, will continue to mutate, particularly with high rates of transmission globally due to lack of or limited vaccination. Therefore, fall planning could be impacted by the emergence of a global variant that would pose a threat to a future state of relatively high two-dose coverage (achieved at the time of full provincial reopening). Below are some considerations for potential future VOCs that could impact fall COVID-19 planning for Ontario.

- A novel variant may originate in Ontario, but it is more likely that it will emerge in a part of the world where there is still ongoing high circulation of COVID-19, and that there will be international experience of the variant to inform the provincial response to its arrival to Ontario. As a proxy to this scenario (as no country is currently in this situation of having high vaccine coverage and a new variant with vaccine escape), strategies used by other jurisdictions in response to Delta when there was lower two-dose population coverage are useful.

- The US Centers for Disease Control and Prevention (CDC) has defined a Variant of High Consequence (VOHC) as a variant for which prevention measures or medical countermeasures have significantly reduced effectiveness relative to previously circulating variants, though has not yet identified a VOHC. Possible impacts of VOHC include: significant reduction in vaccine effectiveness; a disproportionately high number of vaccine breakthrough cases; very low vaccine-induced protection against severe disease; significantly reduced susceptibility to approved therapeutics; or more severe clinical disease and increased hospitalizations. A VOHC could also result in failure of current COVID-19 diagnostics, resulting in asymptomatic spreading of a new VOC, and further opportunity for SARS-CoV-2 mutations.

- Evidence from studies conducted in Canada and Ontario reinforce the importance of high vaccination coverage in the context of highly transmissible VOCs, and careful assessment of VOC impact when considering loosening public health measures. Provinces with some of the strictest public health measures, including Ontario, have moderate vaccine coverage but higher VOC prevalence than other area of the country. Full vaccination with both doses is heavily emphasized as a key to reducing cases in the context of VOCs. An Ontario modelling study suggests in order to avoid a next COVID-19 wave following reopening in the context of highly transmissible VOCs, case counts should be low, and public health capacity should be high enough to allow very rapid responses and comprehensive contact tracing, quarantine and isolation of any identified or suspected cases.

- The potential for VE to be reduced against emerging VOCs, overall increased population susceptibility due to unvaccinated or under-vaccinated pockets and waning protection from vaccinations or infection induced immunity must be considered.

Jurisdictional Scan

- No explicit ‘fall planning’ for COVID-19 was identified for the jurisdictions included in this Evidence Brief. For information on public health measures currently implemented in select jurisdictions to control the spread of the Delta variant, see PHO’s environmental scan titled COVID-19 Public Health Measures Related to the Delta Variant.

- Some jurisdictions have existing COVID-19 ‘immunization passport’ programs, where individuals are required to prove their vaccination status to enter certain public settings. Denmark has
always intended to phase out its “coronapas” (corona passport) system, and is planning to phase it out in fall 2021, while other jurisdictions’ plan to maintain their vaccine passport programs to regulate the entry into certain community-based settings (i.e., England, France, Norway, Italy, Israel). In some jurisdictions that are planning to use immunization passports, the intention is to use them if COVID-19 cases increase after re-opening, in order to limit broad public health measures and impact on society.

- Some jurisdictions are anticipating COVID-19 “booster” campaigns in the fall to administer a third dose of the COVID-19 vaccine to certain groups of individuals for whom there was a likely lower response to the initial vaccine series (e.g., frail elderly, immunocompromised individuals).

- Australia and Israel are examples of jurisdictions with plans to transition their COVID-19 response after achieving national vaccination goals. However, it should be noted that Australia’s fall (March to May) and winter (June to August) seasons do not align with the northern hemisphere, where all other jurisdictions included in this review are located.

- On July 2, 2021, Australia’s Prime Minister presented a four-phase National Plan to transition the national COVID-19 response from its current pre-vaccination settings aimed at suppression of community transmission, to post-vaccination settings aimed at prevention of serious illness, hospitalization and fatality, and public health management of other infectious diseases. In the final phases of the plan, COVID-19 will be managed consistent with public health management of other infectious diseases. The phases of the plan will continue to include public health management measures such as hygiene, tracing and testing. Transition through the phases will be achieved as vaccination thresholds (as a percentage of the eligible population, 16+ years old) are met, based on scientific modelling. As of July 2, 2021, the aim is to “continue to suppress the virus for the purpose of minimising community transmission.” The next phase of the National Plan is to “seek to minimise serious illness, hospitalisation and fatality as a result of COVID-19.”

- In 2020, Israel began developing a Traffic Light model for after the country has fully re-opened, which classifies all local councils according to infection levels. Each local council will receive a weekly score between 0 and 10 weighing the following indicators: 1) the number of new patients per week per 10,000 residents, 2) the rate of positive test results in each local council per week, and 3) the rate of growth in the number of new patients in each locality per week. Based on infection levels each region is assigned a colour designation and corresponding set of restrictions. This formal colour designation is “the number of new patients multiplied by the percentage of positive test results received and the infection growth rate”. The rationale for using this formula is to attempt to predict future infection rates and to increase the number of tests as necessary.

Implications for Practice

As Ontario prepares for the next stage of the pandemic, several potential scenarios and public health risks could emerge in fall 2021, when high two-dose vaccine coverage is possible, in-class learning is planned to resume, more activities move indoors, other respiratory viruses re-emerge, and the risk of a new global VOC or VOHC remains. Below are examples of risk scenarios and considerations for fall 2021 in Ontario; however, fall scenario planning and risk assessment is complex. While broad scenarios can be
developed, how COVID-19 will play out in the Ontario context is highly dependent on a number of factors which are uncertain (e.g., how Ontarians will behave when restrictions are fully lifted, severity of influenza season), and which are not mutually exclusive. Further risk assessment and corresponding risk reduction, mitigation and planning efforts are important as evidence and context evolve.

Example: Lower overall associated morbidity and mortality due to vaccination

- The presence of higher case incidence with lower overall morbidity and mortality is a likely scenario if vaccine coverage is high (>90%) and Delta remains dominant. Cases will occur as people move indoors and into more 3 C (crowded places, confined spaces, close contact) settings in the fall, and public health measures are lifted. In this scenario, large workplace outbreaks amongst a largely unvaccinated workforce where public health measures are scaled back, or a more diffuse outbreak spanning more than one health unit amongst a population experiencing homelessness with low two-dose vaccine coverage are possible. Rapid deployment of vaccine to the setting of the outbreak and the surrounding area (with tailored and multi-pronged approaches) to increase overall local vaccine coverage is necessary as part of the response and future mitigation. A recent PHO synthesis describes some potentially relevant strategies such as ring vaccination.

- Testing, case and contact management can further contribute to management of clusters and outbreaks to maintain disease control. One mitigation strategy could be sustained key public health measures (e.g., masking, social distancing, ventilation, hand washing, etc.) in places with lower vaccination rates to limit transmission and communicate the importance of these interventions to the public. It will be challenging to implement public health measures based on vaccination status.

- Considerations include how unvaccinated individuals will be identified or self-identify, if and how vaccination and public health measures can be supported for these individuals. Cases may also occur amongst fully vaccinated individuals but to a lesser extent, and they are generally asymptomatic or mild in severity. However, there is the potential for increased prevalence of long COVID associated with increased case incidence (even with mild severity illness) with unknown long-term impacts on population health and health care system.

- It is important to note that at the time of writing, children under 12 years of age are expected to still be ineligible for vaccination in the early fall, with the potential for widespread outbreaks given the significantly increased transmissibility of Delta. This would be expected to have significant impact in daycare, school and before/after school settings. At the individual-level and within relevant populations, children under 12 years of age will still be at risk of infection and for spreading to older individuals who are not fully vaccinated in the community and are at increased risk of severe outcomes. And if there is a surge in cases, the relatively small percentage of children with severe outcomes could become a significant issue.

- Promotion of vaccination to those who are eligible, particularly those living and interacting with those who cannot be vaccinated or may have a less robust response to vaccination, needs to always be a core public health measure. Challenges to vaccine uptake, including access (e.g., reach out clinics, paid time off for individuals and families to be vaccinated), motivating factors, and misinformation should be addressed proactively and responsively, and ahead of all other
considerations. Preparations should be made for mass vaccination of children when vaccines for ages < 12 years become available.

- Another possibility in this scenario (high vaccine effectiveness among fully vaccinated individuals), is more extensive community transmission among individuals who are not fully vaccinated. For example, widespread transmission among unvaccinated populations of a region (e.g., among regions and/or specific populations where there is low vaccine coverage), creating challenges for local public health units’ management of outbreaks (e.g., high population or remote areas). Provision of vaccination may be more challenging if there are systemic issues related to the low coverage in the impacted population (e.g., religious or conscientious beliefs), or if more tailored resource-intensive approaches are needed to access impacted populations. Public health considerations and mitigation strategies would be similar to those in the previous scenario e.g., ring vaccination. Re-instatement of other public health measures may be met with opposition, and could be perceived as inequitable targeting of populations. Moreover, assessment of actual vaccine coverage in the affected communities may be challenging.

Example: New VOC/VOHC with similar or increased severity, but escapes immunity from current vaccines

- In this scenario, fully vaccinated individuals are susceptible to infection. Cases would increase rapidly, hospital and ICUs would be pushed beyond their capacity, and infections, morbidity and mortality would rise quickly in LTC residents. Rapid province-wide response to the presence of such a variant in Ontario would be needed, as it would spread rapidly in the population if there is minimal protection from vaccination and minimal residual public health measures in place.

- It would take weeks or months for a new vaccine product for a new vaccine-escape variant to be developed and distributed. Detection of the circulation of a new VOC or VOHC in Ontario would benefit from timely public health action while the variant is still at low levels of circulation to prevent spread, while waiting for a new vaccine product.

- New variant information could be communicated in a risk assessment table similar to the table in a forthcoming Delta risk assessment publication by PHO. Further, robust laboratory-based surveillance and sufficient population diagnostic testing is necessary to determine the existence and sustained transmission of that variant.

- Consideration should be given for lessons learned in previous waves for public health measures and where evidence is available to support. For example, a study examining the impact of the tier system used in the UK indicated that stringent public health measures were required to achieve effectiveness. In Ontario, business closures in some local regions but not others in a contiguous, connected urban area were demonstrated to lead to increased mobility for accessing businesses outside one’s region.

Example: Immunity wanes, making people increasingly susceptible to the Delta variant, resulting in increasing cases across Ontario

- There are some populations (e.g., frail older adults, immune system compromised) where initial levels of immunity from vaccination are not as robust as for the general population, and where waning immunity is more likely to occur. Different populations in the province have been
vaccinated at different times, further complicating assessment of the potential for waning immunity. Waning immunity is most likely to first emerge among LTC home residents who were vaccinated the earliest, and are most likely to have had a less robust initial vaccine response, consequently leading to accelerated waning over time. In this situation, cases will occur across the province (i.e., unlikely to remain a regional issue, although may initially be detected in a few regions), but indicators of increased case activity would be contained to this sub-population (vs. relatively stable case activity in the general population). Overall, case counts in LTC home residents in the province may still remain low if there is low community transmission resulting in few introductions into LTC homes.

- Over time, other sub-populations with waning immunity (e.g., community-dwelling older adults) may become apparent, and also require additional strategies to reduce their risk. For example, when vaccine-ineligible children under 12 years of age and the elderly are in the same setting, as seen in multigenerational households. Data on setting and demographic-specific details of cases, as well as severity and transmission by vaccination status will be required to inform action, along with more in-depth analysis of time from vaccination. Evidence for duration of protection from vaccination is still emerging, and potential mitigation strategies (e.g. booster doses) have limited evidence for their safety or effectiveness for this scenario. Re-implementation of public health measures to reduce the risk of exposure of vulnerable sub-populations with waning immunity (e.g., LTC and/or relevant to health care workers/occupational risk) will be necessary if a booster is not approved/appropriate or until a booster is available. Plans for re-escalation of measures in settings with vulnerable populations should be planned for to enact rapidly to prevent exposure and reduce spread and mortality.

Additional Considerations

Vaccine Coverage and Vaccine Effectiveness

- The minimum requirement to exit Step 3 of Ontario’s reopening strategy required all health units achieve at least 70% of the eligible population fully vaccinated. This means there could be up to 30% of the eligible population that is unvaccinated and able to generate significant transmission. Additionally, lower uptake continues among marginalized populations, creating inequities in individuals and communities where ongoing transmission may occur. Most importantly, the 75% vaccination target was sufficient when Alpha was the dominant circulating strain. Based on current estimates of VE and the basic reproduction number ($R_0$) for Delta, the critical threshold for vaccination is likely at least 90% of the Ontario population, and over 100% of the vaccine-eligible population.

- Based on current authorized use of COVID-19 vaccines in Canada, individuals under 12 years of age will not be vaccinated when they are expected to return to in-person learning in September, and are therefore a population where Delta will circulate as more community-level public health measures are lifted. The unknown risk of “long COVID” in children warrants further study, especially given the significant impacts the pandemic has had on children.

- Children are represented in daycare and elementary school settings. Consideration could be given to distinguishing secondary and post-secondary school settings from daycare centres and elementary school settings. Further, consideration could be given to thresholds for COVID-19 cases in daycare centres and elementary schools given the majority of individuals in those
settings will be unvaccinated. It may be useful to survey the vaccination status of eligible household members living with the children attending childcare and elementary schools to identify opportunities to support vaccine confidence and uptake and thereby reduce the risk of chains of transmission extending to households or childcare/school settings. It will be valuable to monitor indicators by age group.

- As a result of having a highly vaccinated population and increasing vaccine coverage, over time, the proportion of cases that are vaccinated will increase, likely in proportion to the vaccine coverage in that age band. This does not mean vaccines are becoming less effective. The proportion of vaccinated individuals who become cases will remain much lower than the proportion of unvaccinated individuals who become cases.

- Surveillance of breakthrough infections in outbreaks could identify an unexpectedly high proportion of cases with severe disease, linking where possible to vaccination status and vaccine product. Ongoing fulsome assessment of vaccine effectiveness, including by demographics, health status, variant, time from vaccination, vaccine product, and number of doses, is also required to inform vaccination strategies in response to increasing transmission.

**VOCs and VOHCs**

- For prompt detection of emerging variants as well as timely trending of the spread of existing variants, the European Centre for Disease Prevention and Control recommends prompt sequencing on a representative sample with sufficient sample size (ideally each week), as well as on targeted samples from high-risk settings or populations (e.g., international travellers, samples of outbreak cases, cases with unusual clinical presentation). This would require whole genome sequencing (WGS) capacity and strategy, such as in place in Ontario. WGS-representative surveillance can be used as part of the provincial indicators for when a new variant (that poses a risk of vaccine escape) has been detected and is starting to circulate in the province.

- For prompt assessment of variants that have established circulation in the province, ongoing WGS surveillance is necessary to identify such variants and their clinical and epidemiological features (e.g., disease severity, protection conferred by previous infection or vaccination, transmissibility etc.) to determine if they are a VOC or VOHC. This would allow for adjustments to vaccination requirements (e.g., booster doses, new vaccine products, dose intervals), strategies and/or coverage; testing and contact management policies; targeted surveillance strategies; and use of public health measures.

- Given the variations in capacities for and strategies of epidemiological surveillance, testing and genomic sequencing in many countries, caution should be exercised in interpreting and applying surveillance data of existing and emerging variants. For example, as of June 27, 2021, only 15 out of 30 (European Union (EU)/European Economic Area (EEA) countries reported an adequate average weekly sequencing volume of ≥ 500 sequences per week or 100,000 SARS-CoV-2–positive cases.

**Health Equity**

- An equity lens can be useful to ensure fall planning does not disproportionately impact populations that have already experienced higher morbidity and mortality.
A comprehensive approach to indicators of fall epidemiology and progress towards reopening may not only assist with early detection of COVID-19 resurgence, but could identify opportunities to reduce the disproportionate impact of COVID-19 on marginalized populations, including people experiencing homelessness, people with low income or experiencing poverty, and racialized communities.

Mitigation measures might disproportionately disadvantage children <12 years old, who are ineligible to be vaccinated, and who have already had significant losses from in-person learning, community programming, etc., and for whom the effects of long COVID are unknown.

An understanding of vaccine uptake in Ontario based on socio-demographic information is important in order to understand how inequities experienced in Ontario during the COVID-19 pandemic also exist in vaccination coverage, and how the subsequent relaxation of public health measures based on vaccination status could potentially exacerbate inequitable outcomes.

Ethical values and processes can be used to develop an ethics framework to support planning and help in fostering trust with the public and supporting social cohesion during recovery from the serious and disruptive second and third waves of COVID-19.

**Discussion and Conclusions**

Vaccination coverage is increasing across Ontario and vaccination targets previously set to progress through a three-step reopening plan have been met, with the transition to ‘full reopening’ remaining. From the public health perspective; however, the emergence and spread of SARS-CoV-2 VOC Delta has changed pre-existing assumptions about the prevention and control of COVID-19 because the Delta variant is more transmissible, causes more severe disease than non-variant strains and is currently the dominant circulating strain in Ontario. With uncontrolled spread in many countries globally, ongoing mutations of the SARS-CoV-2 virus means future VOCs may emerge, including VOHCs. Maintenance of less restrictive public health measures (e.g. indoor masking in public settings) may be useful for prevention, and may have corollary benefits against expected non-COVID-19 respiratory virus circulation in the fall. Scenarios, risk reduction and mitigation strategies are important for fall 2021 in order to maintain and improve upon control of the SARS-CoV-2 pandemic so that Ontario can enter into a sustainable recovery period for all of society.

**References**


