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EVIDENCE BRIEF

COVID-19 Omicron Variant Sub-lineage BA.2: Evidence and Risk Assessment (up to date as of April 5, 2022)

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Key Messages

- Ontario is experiencing a BA.2-dominant wave: the proportion of whole genome sequencing samples identified as BA.2 in Ontario increased over the past several weeks: from 12.3% the week of February 13 to 19, increasing to 54.0% the week of March 13 to 19.
- Epidemiological trends in Ontario have demonstrated signs of provincial resurgence since the end of February 2022. Close monitoring of epidemiological trends since March 21, 2022 (date of mask mandate removal) suggests a corresponding temporal association with a subsequent increase in confirmed Coronavirus Disease 2019 (COVID-19) cases, percent positivity, and hospitalizations. The full impact of lifting masking and other measures may not yet be observable, given limited PCR testing eligibility and lagging hospitalization data.
- The Omicron BA.2 sub-lineage is more transmissible than Omicron sub-lineages that dominated prior Omicron epidemic waves (BA.1, BA.1.1). The contributions of increased transmissibility inherent in BA.2, immune evasion, and waning immunity, are unclear; however, growing evidence suggests high viral load may play a role in increased transmissibility of BA.2.
- While still emerging, the evidence suggests BA.2 has similar severity compared to BA.1 in adults. Due to increased transmissibility of BA.2, the absolute number of severe cases would be expected to increase, although high vaccine uptake and immunity from previous infections may attenuate the increase. There is, however, continued risk--as seen in the recent BA.1 wave--that the increased transmissibility of BA.2 may pose a threat to health system capacity with a high number of infections and cases with severe disease. Enhanced and timely access to oral outpatient treatment may mitigate the impact of severe illness on the health care system and the individual.
- With expected increased infections among children associated with increased transmissibility of BA.2, removal of public health measures, and limited vaccine eligibility and two-dose coverage in children less than 12 years, the number of children with severe disease is likely to increase. This may impact pediatric hospital and intensive care unit (ICU) capacity, and also lead to further disruption to in-person learning in Ontario.

- Early evidence indicates that three doses of a COVID-19 vaccine provides greater protection against symptomatic BA.2 infection compared to two doses, but three dose effectiveness wanes. A primary series and a booster dose of COVID-19 vaccine shows less waning against severe outcomes, including hospitalization and death, than for symptomatic infection. COVID-19 vaccination remains an essential component of public health response in the current context, with an emphasis on initiation and completion of a primary series in relevant, under-vaccinated populations, as well as first and second boosters for eligible groups.

- Prevention strategies layered onto a vaccination strategy can mitigate a surge in the current context of a more transmissible dominant variant and when case rates are higher than during much of the pandemic to date. The uncertainty around the prevalence and severity of post-acute COVID-19 syndrome (PACS) and its longer term impacts warrants consideration of strategies to mitigate high levels of population infection. In particular, those at highest risk of severe disease (e.g., immunocompromised, elderly, and racialized and low income populations), ineligible for vaccination (i.e., children less than 5 years) and those impacted by disruptions in educational settings can benefit from population-level interventions.

- Masking with high-quality masks (i.e., good fit and filtration) at a population level is a public health measure that can be effective at reducing transmission, while enabling community settings and activities to continue functioning. This can include re-implementing universal indoor masking in public settings, extending masking directives in high-risk settings (e.g., long-term care), and communication on the importance of wearing masks with good fit and filtration for personal and population-level protection. Optimizing layers of prevention in K-12 schools, including temporary re-implementation of masking requirements indoors and improved air quality can reduce the risk of in-school transmission and related disruption for students, families and educational settings.

Issue and Research Question

There are currently 55 Pango sub-lineages associated with the Omicron variant, with BA.1, BA.1.1, and BA.2 as the most commonly reported.[1,2] Considering the increased transmissibility of the Omicron BA.2 sub-lineage compared to previously circulating VOCs and BA.1.1, it is important to monitor the potential impact the BA.2 sub-lineage might have in Ontario. This evidence brief updates the Public Health Ontario (PHO) report published March 25, 2022,[3] and summarizes available information and evidence on the BA.2 sub-lineage relevant to the risk in Ontario that has emerged since the last report up to April 5, 2022.

Methods

PHO Library Services conducted daily searches of primary and preprint literature using the MEDLINE database (search strategies available upon request). Preprints are research papers that have not undergone peer-review, but are made publicly available to provide the latest data relevant to the rapidly evolving COVID-19 pandemic. Formal critical appraisal of published and preprint COVID-19 literature is out of scope for this PHO variant Risk Assessment. PHO performed grey literature searches daily using various news feeds and custom search engines. English-language peer-reviewed and preprint records that described COVID-19 variants were included. In some of the literature, the term Omicron is used to refer to BA.1 and/or BA.1.1, which have been the dominant sub-lineages in most jurisdictions. Sections from prior risk assessments for which there is no new literature of note, have been removed.

Ontario Risk Assessment

- The current risk of BA.2 sub-lineage transmissibility in Ontario is high, with a low degree of uncertainty. The risk of severe disease in Ontario is low, with a moderate degree of uncertainty; but, due to increased transmissibility of BA.2, the absolute number of severe cases would be expected to increase, although high vaccine uptake and immunity from previous infections may attenuate the increase. Health care system capacity has improved after the decline of the BA.1 wave; however, health care worker absences and surgical backlog may remain challenged during a new period of high transmission. The risk of reinfection is high with a moderate degree of uncertainty in Ontario. Early evidence suggests the degree of vaccine effectiveness is similar for BA.1 and BA.2. The risk of breakthrough infection is high with a moderate degree of uncertainty in Ontario. The risk of impact of the BA.2 sub-lineage on testing is moderate, with a moderate degree of uncertainty. The risk of impact on surveillance is moderate with a low degree of uncertainty. The overall risk assessment may change as new evidence emerges (see Table 1).

- There are limited data on Omicron and BA.2, and their longer-term complications in the pediatric population.[4] Based on the data from Omicron and previous variants, it is likely that the majority of children are at low risk of complications from acute infection. However, some children are at increased risk of hospitalization and severe disease (e.g., unvaccinated children, immunocompromised children), and the numbers with severe disease are likely to increase as the number of infections increase.

- Growing evidence on the risk and prevalence of PACS in adults and pediatric populations shows elevated risk of autoimmune conditions, cardiovascular disease, neuropathology and other chronic, potentially disabling conditions following severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, even after non-severe cases.[5-15] These data are still emerging and span ancestral and SARS-CoV-2 VOCs. It is not possible to know the risk of PACS from the current BA.2 variant; but, there is no evidence to suggest BA.2 infections will not cause PACS in some individuals.

Ontario Epidemiology

- As of December 31, 2021, diagnostic PCR testing was restricted to high-risk populations and therefore representative surveillance only pertains to tested populations, and Ontario case counts are an underestimate. Additionally, rapid antigen testing is more available to the public and these test results are not captured in Ontario's COVID-19 surveillance, further compounding the underestimate of Ontario case counts. The Ontario COVID-19 Genomics Network (OCGN) moved from sequencing 5% of eligible samples to 20% on February 16, 2022, and 50% on March 9, 2022.[16] Based on whole genome sequencing (WGS) results completed by PHO as of March 31, 2022 and the OCGN as of March 30, 2022:[16,17]

    - The proportion of cases identified as BA.2 have had an increasing trend over the past several weeks: 6.3% for week of January 23 to 29, 12.1% for week of February 13 to 19, 25.1% for February 27 to March 5, 2022, and 54.0% March 13 to 19.

    - From December 26, 2021 to March 19, 2022, the weekly growth rate of BA.2 was 1.57 (95% confidence interval [CI] 1.54 - 1.60) times that of BA.1.1.

- Among BA.2 cases from February 20, 2022 to March 19, 2022 linked to Public Health Case and Contact Management Solution (n=2,691), the majority occurred in individuals who had completed their vaccination series, i.e. individuals who were post-booster dose (54.8%) or post-series completion (28.5%), followed by unvaccinated individuals (13.3%). As more individuals in a population become vaccinated, a greater proportion of SARS-CoV-2 infections will occur in vaccinated individuals. However, this does not mean that vaccinated individuals are more likely to get infected.

- Between the week of March 13 to 19, 2022 and the week of March 20 to 26, 2022, the number of COVID-19 cases increased by 26% in Ontario. This is the first week-over-week increase since mid-December 2021.[18] For the same time periods, the number of reported cases increased 32.1% among healthcare workers. The percent positivity (among those eligible for PCR testing) has been increasing since the end of February, and was 19% on April 3, 2022.[19] Despite the severe underestimate of infections due to testing eligibility, we can draw conclusions from the case trends over the last few weeks as the PCR-testing eligible population has been stable since mid-January: we can be confident that the underlying transmission of BA.2 in Ontario is increasing and that we are once again in the midst of a wave. Further, the Ontario Science Advisory Table estimates the province-wide COVID-19 wastewater signal to be nearing and in some regions exceeding the peak concentration seen during the January Omicron wave.[20]

- Hospitalizations, ICU admissions and deaths are lagging indicators, which means they often occur after (e.g. days or weeks) cases are initially reported to public health. As of April 2, 2022, the Ontario Hospital Association (OHA) reported 67.6% pediatric critical care (CC) occupancy (4.2% in CC have COVID-Related Critical Illness [CRCI], 66.7% of vented CC patients have CRCI).[21] As of April 3, 2022, OHA reported 72.0% adult ICU occupancy (9.5% of adults in ICU have CRCI, 54.0% of vented ICU adult patients have CRCI).[22] After plateauing for several weeks, a small increase in the number of hospitalizations was observed in the previous week. ICU admissions and deaths show small week-over-week decline.[23]

Table 1. Risk Assessment for Omicron variant sub-lineage BA.2

Issues	Risk Level	Degree of Uncertainty
Increased Transmissibility	**High**	**Low**
Disease Severity	**Low**	**Moderate**
COVID-19 Re-infection	**High**	**Moderate**
Lowered Vaccine Effectiveness/Breakthrough Infections	**High**	**Moderate**
Impact on Testing	**Moderate**	**Moderate**
Impact on Surveillance	**Moderate**	**Low**

Epidemiology in Other Jurisdictions

Canada

- Surveillance WGS across Canada indicated that of SARS-CoV-2 samples collected the week of March 13, 2022, 100% were Omicron (6.7% BA.1, 43.2% BA.1.1, 50.1% BA.2), but data were still accumulating.[24] This is an increase in the proportion of BA.2 samples compared to the week of February 27, 2022 (99.7% Omicron: 14.1% BA.1, 55.1% BA.1.1, 30.5% BA.2). On April 4, 2022, Canada reported 3,077 new COVID-19 cases, 10 new deaths and 165,224 active cases. The daily percent positivity (over the previous 7 days) was 17.1%, and is a continuation of the increasing trend in test positivity observed since late February/early March. The Public Health Agency of Canada (PHAC) notes that due to changes in COVID-19 testing policies in many jurisdictions starting in late December 2021, case counts will underestimate the total burden of disease.

- On April 1, 2022, PHAC reported that despite cases and severe outcomes having declined since the peak of the Omicron wave, COVID-19 disease activity (e.g., cases, hospitalizations, ICU admissions) remains elevated and is increasing in some parts of the country.[25]

Select Other Jurisdictions

- **Global:** According to GISAID, the 7-day rolling average of BA.2-positive sequences globally on March 27, 2022 was 87% (95% CI 85-88) of submitted sequences.[2]

- **Denmark:** The Danish Health Authority changed their COVID-19 test recommendations in week 10 to limit testing primarily to vulnerable groups and patients admitted to hospital, which is expected to impact trends in the coming weeks.[26] COVID-19 case numbers have continued to decrease from week nine to 12.[27] In week 12, of 3,659 samples with WGS, the Statens Serum Institut reported that 72.6% were BA.2, 26.2% BA.2_H78Y, 0.9% BA.1.1, 0.3% BA.1, and 0.0% BA.3. The Danish Covid-19 Genome Consortium reported 99% of sequenced samples were BA.2 in week 12.[28]

- **United Kingdom (UK):** Effective April 1, 2022, the UK Health Security Agency (UKHSA) will use a revised variant classification system to better indicate which variants have significant changes in biological properties.[29] BA.2 was designated VUI-Jan22-01 on January 19, 2022, indicating it does not meet UKHSA VOC status, but is a variant under investigation. For the week ending March 20, 2022, 89.8% of all sequenced COVID-19 infections from the Office of National Statistics survey were compatible with the Omicron BA.2 variant, and 10.2% were compatible with the Omicron BA.1 variant or its sub-variants.[30] In the week ending March 26, 2022, the percentage of infections compatible with the Omicron BA.2 variant continued to increase in England and Wales, but the trend is uncertain in Scotland and Northern Ireland. In parallel, the percentage of infections compatible with BA.1 decreased in England, Wales and Northern Ireland.

    - **England:** The UKHSA most recent VOC and variants under investigation (VUI) report for England reported that of all WGS cases between March 13 to March 20, 2022, 10.5% were BA.1 (VOC-21NOV-01), 88.8% were BA.2 (VUI-22JAN-01), and 0.7% were other variants. From January 27 to March 16, 2022, BA.2 accounted for over 95% of sequenced SGTP cases, making SGTP a reliable proxy for BA.2. The proportion of SGTP cases increased from 52.1% on February 20, 2022, to 83.3% on March 6, 2022, and 93.7% as of March 20, 2022.[29] Based on data up to March 15, 2022, there is approximately 75.3% greater relative growth for BA.2 compared to BA.1.

- **United States (US):** According to NOWCAST modelling projections, the US Centers for Disease Control and Prevention (CDC) estimated that for the week ending April 2, 2022, 100% of SARS-CoV-2 cases were Omicron (25.3% BA.1.1 [95%CI 21.9, 29.1], 2.5% [95%CI 2.0, 3.2] B.1.1.529, 72.2% [95%CI 68.1, 75.9] BA.2).[31] As of March 30, 2022, the 7-day moving average of daily new SARS-CoV-2 cases (25,732) decreased 3.0% compared to the previous week's 7-day moving average (26,518).[32]

Genomic Features

Comparison of BA.1 and BA.2 shows that BA.2 has 10 unique mutations and BA.1 has 18 unique mutations.[33] Unlike BA.1, which shares nine amino acid spike mutations with most VOCs, BA.2 shares only six amino acid mutations in its spike protein with most VOCs, three of which are found in Alpha variants.[34] The high transmissibility of the Omicron variant combined with other co-circulating VOCs, incomplete vaccination coverage and waning immunity, can result in Omicron evolution and recombination events.[35,36] A few studies are highlighted below:

- Paz et al., conducted a comprehensive phylogenetic study into the emergence, spread and evolution of Omicron sub-lineages BA.1, BA.2, and BA.3.[37] The S gene sequences of 159 Omicron strains from were aligned with 97 Alpha, Beta, Gamma and Delta SARS-CoV-2 strains S gene sequences. Heatmap and Principal Component Analysis revealed that the Alpha, Beta, Gamma and Delta lineages have a closer genetic relation compared to Omicron, and there was much heterogeneity among the Omicron sequences. Bayesian coalescent analyses were used to reconstruct the evolution of the Omicron variant and in agreement with previous studies, Paz et al. conclude that Omicron did not evolve from early VOCs, but instead belongs to a completely different genetic lineage from previous VOCs, with evidence of an ancestral lineage as far back as May 15th, 2020. The authors estimate the Omicron rate of evolution to be 5.61×10^{-4} substitutions/site/year.

- S-gene target failure (SGTF) has been used as a proxy for the Omicron BA.1 and BA.1.1 variants due to the amino acid deletion at position 69 and 70 of the S protein, and S-gene target positivity (SGTP) has been used as a proxy for BA.2 because it is usually missing this deletion. As of March 2, 2022, there were 123 BA.2 sequences in the UK genomic database with a deletion at 69 and 70, out of 93,937 confirmed or probable BA.2 sequences (0.13% of BA.2 cases), which is up from 20/27,179 (0.07%) as of February 16, 2022.[38,39]

- Colson et al., reported identification of two new SARS-CoV-2 recombinant genomes in France comprised primarily of a Omicron 21L/BA.2 variant but with a 3-prime tip from a Omicron 21K/BA.1 variant.[40] The authors note that this recombinant is not detected by their qPCR assays that screen for variants in routine diagnosis.

Transmissibility

Since the last PHO BA.2 Risk Assessment, additional studies have described BA.2 growth advantage over BA.1 and other SARS-CoV-2 variants. It remains unclear to what extent the increased transmission of BA.2 compared to BA.1 or BA1.1 is due to inherent characteristics of this sub-lineage (i.e., viral load, enhanced ability to infect cells, tissue tropism) or due to immune evasion or antibody waning; but growing evidence suggests higher viral load plays a role.

- Lentini et al., described the transition from the BA.1 to BA.2 waves in Sweden based on 174,933 nasopharyngeal samples using a modified RT-PCR assay and WGS.[41] The authors reported that 100% of their Omicron BA.1 negative specimens were confirmed as BA.2 by WGS, and the BA.1-negative specimens had 1.9-fold higher levels of viral RNA than the BA.1 specimens (24.50 vs. 25.43 median N1 CT; P = 1.54x10-180, Mann-Whitney U-test), and the difference was observable across day-by-day time points. In contrast, viral copy-numbers were similar in Omicron BA.1 and Delta cases in mid-December (p=0.77, Mann-Whitney U-test). The authors reported that the BA.2-specific ORF3a:H78Y mutation, which was found primarily in Denmark, was present in approximately 40% (172/425) of BA.2 cases they classified by WGS. The high viral load in BA.2 samples is in agreement with findings reported previously.[42,43]

- Ito et al., used a mathematical model to describe the trajectories of Delta, BA.1 and BA.2 frequencies in Denmark, assuming a constant ratio in generation times and a constant ratio in effective reproduction numbers among variants.[44] Sequences were obtained from the GISAID database. The authors reported the generation times of BA.1 and BA.2 as 0.60 (95%CI: 0.59–0.62) and 0.51 (95%CI: 0.50–0.52) of the length of that of Delta, respectively. They reported the effective reproduction number of BA.1 as 1.99 (95% CI: 1.98–2.02) times and that of Omicron BA.2 is 2.51 (95% CI: 2.48-2.55) times larger than the effective reproduction number of Delta. They reported the generation times of BA.2 as 0.85 (95% CI:0.84–0.86) the length of that of BA.1, and an effective reproduction number of BA.2 as 1.26 (95% CI:1.25–1.26) times larger than that of BA.1. The authors suggested that the duration of quarantine for contacts of a BA.1 or BA.2 patient can be reduced to 60% and 51% of that for Delta, respectively. They also suggest that public health measures against BA.1 and BA.2 need to reduce contacts between infectious and susceptible people respectively by 50% (95% CI: 49–50%) and 60% (95% CI: 60–61%) compared to that against Delta to achieve the same effect of their control.

- According to estimates from the UKHSA using data up to March 15, 2022, there is approximately 75.3% greater relative growth for BA.2 compared to BA.1.[29]

Disease Severity

Evidence of disease severity caused by BA.2 as compared to COVID-19 caused by ancestral SARS-CoV-2 and other variants remains unclear.[45] Early evidence suggests BA.2 has similar severity compared to BA.1 in adults. Evidence since the last PHO BA.2 Risk Assessment are described below.

- According to iterative analyses in the most recent UKHSA variant technical report, the risk of hospitalization following a BA.2 infection appears similar to that of a BA.1 infection (hazard ratio 0.94, 95% CI: 0.88-1.00, up from the previous report estimates of 0.91 (0.85, 0.98) and 0.87 (0.75-1.00).[29,38,39] The analyses used sequenced cases, and adjusted for age, reinfection status, sex, ethnicity, local area deprivation, vaccination status, and controlled for the effect of geography and specimen date.

Vaccine Effectiveness (VE) and Reinfections

Genomic evidence indicates that BA.2 is as different from BA.1 as Alpha, Beta and Delta VOCs were from each other, which makes monitoring of BA.2 VE and reinfections important for assessing the risks associated with a BA.2 wave in Ontario. A review of VE evidence before the BA.2 wave shows that a primary series and a booster dose of COVID-19 vaccine exhibits less waning against severe outcomes, including hospitalization and death, than for symptomatic infection.[46] Early but growing evidence indicates that BA.2 may have a similar level of susceptibility to polyclonal antibody immunity compared to BA.1, and similar VE; however, evidence on VE and reinfections will continue to be confounded by differences in public health measures, history of infections, and recentness of booster programs across jurisdictions. A selection of the several new studies[47-50] that emerged since the last PHO Risk Assessment are described below:

- Altarawneh et al., reported findings from six national, matched, test-negative case-control studies in Qatar estimating the effectiveness of the Pfizer-BioNTech vaccine, Moderna vaccine, immunity from prior infection with pre-Omicron variants, and hybrid immunity from prior infection and vaccination.[51] Effectiveness of prior infection against symptomatic BA.2 infection was 46.1% (95% CI: 39.5-51.9%; 319 days median time between prior infection and PCR test). Effectiveness of two-doses of Pfizer-BioNTech against symptomatic infection was -1.1% (95% CI: -7.1-4.6; 270 days median time between second dose and PCR test), which is well past the duration of protection of two-dose Pfizer-BioNTech against symptomatic Omicron infections. Effectiveness of three-dose vaccination was 52.2% (95% CI: 48.1-55.9%; 43 days median time between third dose and PCR test). Effectiveness of immunity of prior infection and two-dose vaccination was 55.1% (95% CI: 50.9-58.9%). Effectiveness of prior infection and three-dose vaccination was highest at 77.3% (95% CI: 72.4-81.4%). In terms of effectiveness against severe, critical or fatal COVID-19 due to BA.2, >70% effectiveness was observed for prior infection, vaccination, and hybrid immunity, however, some confidence intervals were wide or could not be estimated. The authors state that effectiveness of prior infection, vaccination, and hybrid immunity in the Moderna-vaccine study resulted in similar levels and patterns to those in the Pfizer-BioNTech-vaccine study.

- Kirsebom et al., conducted a test-negative case control study (n=380,739 controls) of VE against symptomatic BA.1 (n=214,171) and BA.2 (n=31,238) infection during a period of co-circulation in England.[52] Amongst those who received two doses of any vaccine (Pfizer-BioNTech; AstraZeneca; Moderna), VE against symptomatic disease within two weeks of the second dose was 63.6% (58.8-67.8%) and 67.1% (54.2-76.3%) for BA.1 and BA.2, respectively. The VE dropped to 17.4% (15.2-19.4%) and 24.3% (20.3-28.0%) after 25 or more weeks for BA.1 and BA.2, respectively. Amongst individuals who received any booster after any primary series, at one week VE increased to 71.3% (69.6-72.9%) and 72.2% (67.0-76.5%) for BA.1 and BA.2

respectively; but, waned to 45.5% (43.8-47.2%) and 48.4% (45.2-51.4%), respectively, at 15 or more weeks post-booster. The authors concluded that there was no evidence that VE against symptomatic disease differed between the BA.1 and BA.2 sub-lineages.

- Marking et al., reported screening results (self-administered naso-oropharyngeal/saliva tests twice weekly for four weeks), anti-Spike IgG and neutralization titers in 375 healthcare workers in Sweden up to 4 weeks after receipt an mRNA vaccine booster in 375 healthcare workers.[53] Comparison of cross-reactive, neutralizing antibody responses revealed slightly but significantly higher titers capable of neutralizing BA.2 as compared to BA.1. Median Ct value of first positive sample were 29.4 in BA.1 and 25 in BA.2 infections, which translates into approximately 100-fold higher level of viral RNA in BA.2 infected individuals early in infection (p=0.06). BA.2 infections also showed a trend towards a longer time to viral clearance, but it was not significant (p=0.13). The median duration of symptoms in BA.2 vs. BA.1 cases was 8 vs 6 days), p<0.01. None of the 22 BA.2 cases were asymptomatic.

- Preliminary analyses by the UKHSA reported that of 186,896 WGS confirmed BA.1 cases between December 27, 2021 and January 16, 2022, 31 of these cases had another subsequent sequenced sample between 20 and 72 days after the previous positive BA.1 test.[29] Of the 31 possible reinfections, 30 were BA.2 by sequencing, which is a short interval for reinfection. Of the 31 reinfections, 12 were unvaccinated children <12 years of age and 7 were unvaccinated individuals >12 years of age. The UKHSA notes these are preliminary analyses, limited by sample size and follow-up time less than 90 days.

Public Health Measures

Since the last risk assessment,[3] Finland increased its vaccine eligibility, while Italy, California, and the Netherlands lifted some public health measures (e.g., mask mandates, restrictions for mega-events, capacity limits, and proof of vaccination). Further, Finland and Germany each made an announcement regarding the high hospitalizations and stressed the importance of focusing on regional measures, people's own measures, and vaccination; however, neither jurisdiction announced that they will be re-introducing mandatory measures at this time.[54,55]

In addition to the routinely monitored international jurisdictions, a jurisdictional scan of public health measures and epidemiology in other Canadian provinces (i.e., British Columbia (BC), Alberta, Saskatchewan, Manitoba, Quebec) was performed. It was found that these provinces started to lift public health measures in February 2022.[56-60] Currently, all included provinces have removed capacity limits and proof of vaccination. BC, Manitoba, and Saskatchewan have all lifted their mask mandate. Alberta still requires masks on public transportation and Quebec requires masks in all indoor settings except for the classroom. In March, Quebec announced that their mask mandate for indoor public settings was expected to be lifted by mid-April; however, the interim director of public health most recently announced that the government has extended the mask mandate past mid-April to at least the end of April amid a rise in COVID-19 cases and hospitalizations.[61] Prince Edward Island has also extended their mask mandate until at least April 28, with masking expected to be maintained beyond that date in some higher risk settings (e.g., health care settings, transit).[62] Despite case counts being an underestimate due to changes to testing strategies, case rates in the included provinces are higher than at most other points since the pandemic began.[24] Since the beginning of March, COVID-19 hospitalizations increased in Saskatchewan, BC and Quebec.[63-65]

Implications for Practice

- During the winter Omicron wave, public health measures were re-implemented in Ontario and across Canada to mitigate the threat to critical infrastructure, including health care system capacity.[66,67] On March 21, 2022 – after having lifted most other public health measures on March 1, 2022 (i.e., capacity limits and proof of vaccination system) – Ontario lifted its mask mandate for most indoor settings, including schools.[68-70] Close monitoring of epidemiological trends since March 21, 2022 suggests a corresponding temporal association with a subsequent increase in confirmed COVID-19 cases and hospitalizations.[23] Confirmed case counts and the test positivity rates are increasing and currently higher than during the pandemic to date and indicative of Ontario being on the upswing of a sixth pandemic wave.[71,72]

- Changes to testing, reporting, and how variables are defined (e.g., COVID-19 hospitalizations and deaths) have necessitated recalibration of epidemiological models and deeper understanding of new data sources (e.g., wastewater). Triangulation across indicators can provide greater confidence in trends and should continue to be used.[73]

- Timely, temporary re-implementation of increased public health measures and continuation of existing measures can help mitigate current epidemiological trends. Due to limitations of individual public health measures (i.e., vaccination, masking, measures to reduce contacts), an approach that layers various measures can be used to mitigate community spread.

    - COVID-19 vaccination remains an essential component of public health response in the current context, with an emphasis on initiation and completion of a primary series in relevant, under-vaccinated populations, as well as first and second boosters for the eligible population. Groups at higher risk for severe outcomes should be prioritized.[74] While vaccination is a key public health tool, because COVID-19 vaccination and previous SARS-CoV-2 infection do not provide sterilizing immunity, a COVID-19 strategy that relies entirely on vaccination and previous infection will not contain transmissions in the context of variants that lower vaccine effectiveness (i.e., Omicron sub-lineage BA.2).

    - To achieve the overarching pandemic response goals of minimizing morbidity and mortality (including PACS), as well as minimizing societal disruption, current provincial and local public health responses could be augmented with interventions aimed at reducing SARS-CoV-2 transmission. For example, options include re-implementing universal indoor masking in public settings, and extending masking directives in high-risk settings (e.g., long-term care).[75,76] Risk communication to the population regarding high levels of SARS-CoV-2 transmission and COVID-19 disease risk may also be helpful, including in the context of collective actions such as community masking.

    - Layers of protection including getting vaccinated, staying home when sick or with symptoms of COVID-19, practicing physical distancing and avoiding crowded spaces, spending time outdoors or in well-ventilated indoor spaces, wearing a well fitted mask, and practicing respiratory etiquette and washing hands should continue to be promoted for all.[77]

    - With limited PCR testing eligibility among children,[78] and given that hospitalization is a lagging indicator and evidence that the majority of children are at low risk of complications from acute infection, there are gaps in surveillance data to inform timely public health action related to Ontario's pediatric population. In the context of a highly transmissible BA.2-dominant wave in Ontario, and given the educational, social and health impacts of cumulative educational disruption for children and families,[79,80] a cautious, temporary approach to re-implementing some less restrictive community-based public health measures can minimize disruption to in-person learning (e.g., due to staying home when infected or symptomatic). Optimizing layers of prevention in K-12 schools, including improved ventilation/air quality, masking indoors, avoiding congregation of large unmasked groups, and access to well-fitted, high quality masks can reduce the risk of in-school transmission and related disruption.[75,81]

- The evidence that a new SARS-CoV-2 VOC could emerge and drastically change the course of the pandemic continues to grow.[34,40] The emergence of the BA.2 sub-lineage when jurisdictions were experiencing the decline of the BA.1 and BA.1.1 waves underscores the need for high quality surveillance, building on past experience related to removal of public health interventions, vaccination, and preparedness for the next stages of the COVID-19 pandemic.

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