

COVID-19 Scientific Advisory Group Rapid Response Report

Key Research Question: Are there populations of asymptomatic individuals (e.g., population sampling; congregate living including LTC, vulnerable populations; patients being hospitalized, those associated with outbreaks, HCWs) that should be considered priority for screening for COVID 19 infection (with RT-PCR), with the goal of surveillance and preventing spread within these populations?

Context

- It is biologically plausible that SARS-CoV-2 can be transmitted when patients are truly asymptomatic, pre-symptomatic, or mildly symptomatic (potentially from 2.5 days prior to onset of symptoms) or with atypical symptoms, based on the finding that RT-PCR levels are high early in infection. The extent to which RT-PCR positivity in the absence of symptoms reflects infectious virus, and transmissibility in the absence of symptoms that strongly promote droplet generation, remains unclear. Further, there is complexity in what is referred to as 'asymptomatic' by different organizations and authors.
- There is an absence of evidence on when to swab asymptomatic individuals, what site, and how frequently to have effective asymptomatic testing without wasting valuable resources.
- On April 7, 2020, it was acknowledged by Alberta's Chief Medical Officer of Health that asymptomatic transmission in Alberta may be occurring more often than previously thought.
- On April 17, 2020, Alberta's Chief Medical Officer of Health announced that all residents and staff of LTC facilities that have experienced an outbreak will be eligible for SARS-CoV-2 testing, including asymptomatic individuals.
- On April 27, 2020, it was announced that in the context of an outbreak shelters will be testing all clients for COVID-19, as well as symptomatic and asymptomatic close contacts of positive cases.
- A few jurisdictions have begun to suggest adoption of testing asymptomatic individuals; however, there is an absence of evidence to determine how asymptomatic testing should be prioritized within major organizations/jurisdictions.
- There is a lot of interest from Alberta Health to increase SARS-CoV-2 testing. As the SARS-CoV-2 cases increase and efforts to expand capacity of testing in Alberta continue, it is essential that expansion of testing to asymptomatic individuals be prioritized based on evidence and potential impact on slowing the pandemic.

Key Messages from the Evidence Summary

- There is a paucity of high quality evidence around the impact and value of testing truly asymptomatic individuals within a given group or population.
- There is an absence of evidence on when to swab asymptomatic individuals, what site, and how frequently to have effective, sustainable testing of asymptomatic people.
- Early evidence around initiatives testing asymptomatic people (e.g., Iceland, Italy) have reported identification of asymptomatic cases in which the authors conclude that identifying these cases was vital to outbreak control.
- In light of early evidence, different jurisdictions and specialties have suggested revised guidelines to include testing asymptomatic people within a given population, particularly in congregate living and risky work/living conditions when there is an outbreak.
- It will be important to examine the impact of testing asymptomatic people as evidence becomes available, especially given it is unknown how infectious SARS-CoV-2 is in asymptomatic cases.

Committee Discussion

The committee members discussed at length the current state of evidence for the role of asymptomatic transmission in the SARS-CoV-2 pandemic. There was consensus that several important research gaps currently exist in this body of literature and thus there was unanimous agreement that the committee would provide strong considerations to test certain groups of asymptomatic people, in an effort to address knowledge gaps and inform future control efforts. Further, the committee was in unanimous agreement to provide practical considerations to further guide decisions around the testing of asymptomatic people. The committee also noted that one negative swab can not rule out COVID-19, nor guarantee that a patient may not develop symptoms of COVID-19 in the ensuing days to weeks.

Recommendations

The Scientific Advisory Group was unable to provide consensus recommendations on the role of asymptomatic transmission in SARS-CoV-2. While asymptomatic transmission is biologically plausible, the extent to which RT-PCR positivity in the absence of symptoms reflects infectious virus remains unclear due to shortcomings in existing data. The lack of consensus on the importance of asymptomatic transmission in conjunction with no high-quality evidence on the role of testing for asymptomatic individuals/populations leaves the committee in a position to only provide practical considerations. The Scientific Advisory Group supported consideration of ethical frameworks and the precautionary principle in decision making in the context of an evolving risk assessment. This included ethical considerations and unintended consequences of providing a “negative” test result when the sensitivity of the test and optimal timing of the test is unknown in asymptomatic patients.

Research Gaps

- There is a lack of high quality evidence to estimate the impact of asymptomatic individuals on the spread of SARS-CoV-2.
- There is an absence of evidence supporting optimal timing, body sites, and frequency of RTPCR testing of asymptomatic people
- Further data on viable virus detection in asymptomatic cases is required to support estimation of the extent of transmission from asymptomatic individuals.
- There is limited evidence on the impact of mass testing of asymptomatic individuals and no evidence on the impact of testing of asymptomatic individuals within given groups or populations. Particular attention needs to be paid to ascertaining whether individuals are truly asymptomatic, through methods such as collateral history and secondary interviews

To help address these knowledge gaps and inform future outbreak control efforts, subject to laboratory capacity, we suggest strong consideration be given to test the following groups of asymptomatic people (in priority order):

- Asymptomatic residents and staff in Long Term Care/Supportive Living in the context of an outbreak.
- Asymptomatic staff in high risk work conditions, as well as household contacts of cases in the context of an outbreak, cluster or several linked cases under public health review.
- Asymptomatic residents and staff in homeless shelters and similar agencies in the context of an outbreak, cluster or several linked cases under public health review.
- Routine testing of asymptomatic individuals in other populations is not prioritized at this time outside epidemiologic research studies and defined patient groups such as those undergoing transplantation.

Practical Considerations

- Although biologically plausible that SARS-CoV-2 can be transmitted in cases without symptoms or atypical symptoms it currently unknown if transmission from asymptomatic people is a large contributor to the current pandemic.

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- There is an absence of evidence supporting optimal timing, body sites, and frequency of RTPCR testing of asymptomatic people. Single, or 'one-time', testing is likely to be of limited benefit outside of decision support in outbreak management, and does not guarantee that a patient will not develop symptoms of COVID-19 in the ensuing days to weeks. An optimal protocol for sampling and resampling over time is not yet defined but is needed.
- Any testing of asymptomatic individuals needs to be balanced with available laboratory resources (swabs, transport media, testing reagents, laboratory human resources) with attention to maintaining the ability to confirm cases for clinical or public health contact tracing reasons.
- Self-isolation may have a role in preventing asymptomatic transmission, especially in high risk areas/situations.
- Examining the impact and value of testing asymptomatic people with evolving data will inform potential further expansion of this approach to other priority groups.

The below table presents a summary of information across different population groups to be considered before recommendations for testing asymptomatic individuals should be developed.

Considerations for testing asymptomatic people in various patient groups:

| Group proposed for RT-PCR screening without documented symptoms | Is there an elevated likelihood of a positive test in this group (if asymptomatic or subjective symptoms are not assessable) | Is the risk of transmission from an asymptomatic person in this group to others higher than for an average “asymptomatic person” | Notes | Other factors that might mitigate against the need to test this group |
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| <p>LTC residents and staff – during an outbreak</p> | <p>The risk of LTC residents and staff being COVID-19 positive is higher than in the general population as there are ongoing outbreaks in these settings, due to the vulnerability of the population, congregate living setting, and structure of facility for staffing.</p> <p>In a recent study examining LTC outbreaks (Arons et al., 2020), 63% of all patients who were tested had laboratory confirmed COVID-19, with 56% being asymptomatic at the time of testing – though nearly all progressed to having symptoms, over the subsequent week, resulting in only 11% being truly asymptomatic.</p> | <p>“Asymptomatic” residents with dementia or comorbidities, or seniors who are reported to have more subtle and/or atypical symptoms may pose increased risk for transmission.</p> | <p>Symptoms within this population may go undetected for various reasons, including reduced capacity and blunted fever response.</p> <p>The risk of spread in LTC is high particularly in outbreak situations.</p> <p>There are currently outbreaks in 16 Alberta LTC facilities and 16 supportive living/home living facilities (as of April 26, 2020).</p> <p>Asymptomatic testing during an outbreak in LTC has been suggested by Chief Medical Officer of Health, defined as either any one individual testing positive among residents or staff. have COVID-19 including any one resident or any one staff member (Government of Alberta, 2020a). Currently, public reporting of outbreak location in acute and continuing care facilities occurs when there are 2 (or more) positive cases (Government of Alberta, 2020b).</p> | <p>Staff are asked to follow IPC Routine Practices, continuous masking, and symptom screening to reduce their own transmission risk to others. This is also considered protective against transmission from asymptomatic patients/residents.</p> <p>If a resident becomes symptomatic, contact and droplet PPE are recommended for that patient and any close contacts, which are also the recommendations during an outbreak.</p> |

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| Pregnant women being admitted to hospital for delivery | The risk of pregnant women being COVID-19 positive appears to be the same as that of the general population in which they are currently living (e.g., a high prevalence of asymptomatic COVID-19 positive pregnant women was found in NYC because NYC is the current epicenter for COVID-19, with very high community incidence and prevalence | The risk of an asymptomatic pregnant women transmitting COVID-19 to others should be similar to other asymptomatic COVID 19 patients. Theoretic concerns around labour and delivery have been raised due to higher risk with vocalization but this would be variable and difficult to quantify. | Asymptomatic pregnant women interacting with the healthcare system would have risk of transmission comparable to the range of risk from any patient interacting with the healthcare system. | HCWS are continuously masking in a hospital setting, and if elevated risk is perceived prior to patient interaction contact –droplet PPE should be used while awaiting swab results. |
| HCWs & Emergency First Responders (EFR) | HCWs & EFR may be at higher risk for being COVID-19 positive. As of April 27, AHS has tested 15,603 employee, of which 0.88% (n=137) were confirmed positive. To date, 8.8% (n=12) of employees developed COVID-19 through work exposure (13 cases are still under investigation to identify source exposure). With respect to physicians, AHS has tested 933 physicians as of April 27, of which 2.4% (n=22) were confirmed positive. Of the 22 positive physician cases none have been confirmed as developing through work exposure (2 cases are still under investigation to identify source exposure) (AHS CEO, 2020). | With continuous masking, and good hand hygiene, the risk of spread within this population should be low. Attention to continued precautions including physical distancing and masking in staff-staff interaction may be warranted. | Adherence to IPC protocols is harder to observe in certain scenarios for some EFRs (e.g., shared sleeping & kitchen quarters within a fire hall). HCWs and EFRs interact closely with vulnerable patient populations. | HCWs & EFRs are continuously masking which reduces the risk of spread. As well, careful use of PPE and diligent hand hygiene should reduce increased risk to levels near that of the general population near population levels (see Healthcare Worker Risk review). |

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| Patients being admitted to hospital | The risk of patients admitted to hospital being COVID-19 positive is comparable to that of the general population in which they are currently living (i.e., risk increases as the rate of positive cases within the population increases). To date, a study to identify asymptomatic cases in patients without COVID or ILI-symptoms admitted to one of three pilot hospitals across Alberta has identified 0 positive cases of the 615 patients tested. | With continuous masking of HCW, good hand hygiene and physical distancing between patient beds, the risk of spread within this population should be very low. | Risk level varies based on patient characteristics, such as those >70 years old and/or with certain comorbidities including heart disease, hypertension, lung diseases, diabetes, cancer, people with weakened immune systems from a medical condition or treatment, such as chemotherapy (Public Health Agency of Canada, 2020). | <p>Continuous masking and routine practices would mitigate the risk even if asymptomatic patients end up as positive. Visitors are currently restricted from hospitals with the exception of end of life, maternity/post-partum, pediatrics and outpatient/ED/Urgent Care, which allow 1 visitor at a time, thus reducing the excess contacts within hospitals and patient rooms (Alberta Health Services, 2020c).</p> <p>All staff, physicians and contractors are required to complete screening prior to starting a shift, by completing a standard questionnaire to assess health risk when entering the designated hospital (Alberta Health Services, 2020a).</p> |
| Children | Overall, current data suggests that children appear to have lower risk of being COVID-19 positive, may be less likely to transmit infection in the community and typically present with mild symptoms. | The risk of an asymptomatic child transmitting COVID-19 to others should be similar to other asymptomatic COVID 19 patients. | <p>Public health measures such as physical distancing and hand hygiene is challenging in this population, particularly within the home.</p> <p>While children may not be priorities for asymptomatic swabbing, they may still be important in transmitting to at-risk adult groups, and understanding the prevalence of COVID-19 infection may inform public health measures used to control COVID-19 transmission, including school closures</p> | Asymptomatic children within a close family unit should not be prioritized for testing since parent/guardian and child would continue to live together (i.e., test results will not change management). |

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| <p>Higher risk living/ work conditions (including homeless shelters and prisons)</p> | <p>The risk of clients being COVID-19 positive in higher risk living/ working conditions is higher than that of the general public, given the challenges with observing IPC protocols, such as physical distancing.</p> | <p>The risk of transmission from asymptomatic individuals within this population is higher than that of the general population, particularly around challenges with physical distancing within each of these settings.</p> | <p>The timeliness of testing within these populations is crucial; higher risk of close contact in combination with a lack of evidence on when to test potential asymptomatic cases and if it is a single time point or an interval.</p> | <p>For higher risk working conditions, Alberta Chief Medical Officer of Health advises facilities to follow provincial guidelines for non-health-care workplaces. For workplaces experiencing outbreaks (e.g., Cargill, High River), also see Ministry of Health guidelines for workplaces impacted by outbreaks (Smith, 2020).</p> <p>For shelters with clients with possible COVID-19 symptoms, immediate provision of a medical mask and isolation to an individual room when possible to appropriate spacing be maintained. Shelters affected by Covid-19 outbreaks currently are testing all clients at the shelter as well as symptomatic and asymptomatic contacts of COVID-19 positive clients (Government of Alberta, 2020b, 2020c).</p> <p>Alberta Corrections has released some inmates, enhanced health screening measures for new inmates, made priority testing available for corrections officers and stopped the practice of inmates serving weekend sentences to check in to jail (Wakefield, 2020).</p> |
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| Indigenous persons repatriating to community | The risk of developing COVID-19 is comparable to the general population within the population that they currently live. The Indigenous population is known to have higher comorbidities and poorer overall health, which can increase their risk of developing COVID-19. | The risk of transmission from asymptomatic persons within this population is comparable to that of the general population. However, if an individual is repatriating to a community, impact of any potential asymptomatic transmissions may be greater given the living circumstances for many Indigenous peoples. | Risk of transmission, and probable poor and/or critical health outcomes related to COVID-19 is heightened for Indigenous peoples as this population experiences poorer overall health and limited access to health care. | <p>In response to COVID-19, First Nation and Metis communities across Alberta have been engaged with federal and provincial governments and Alberta Health Services to discuss pandemic readiness planning to mitigate health and social impacts. It is important to note that each community is at varying levels of pandemic planning and has unique needs and characteristics, which requires community specific responses.</p> <p>For example, many First Nations have implemented community restrictions, which range from road access controls and security check points to curfews, self-isolation if returning to the community, and in some instances community lock downs.</p> |

Summary of Evidence

Literature for this rapid review was gathered in a search strategy performed by Knowledge Resource Services (KRS) in AHS and a pragmatic search of the COVID-19 literature. KRS searched databases for articles published from year 2020 to April 20, 2020, using a search strategy involving combinations of keywords and subject headings including:

- SARS-CoV-2 or COVID-19
- Asymptomatic or pre-symptomatic
- Testing or screening

Articles identified by KRS in their search were initially screened by title against the inclusion/exclusion criteria listed in Table 1. A total of 81 articles were included within this review based on the inclusion/exclusion criteria, including those identified outside of the KRS search. Key limitations of this review include the speed at which quality evidence can be made available, use of a targeted search strategy to allow for feasibility of rapid review, and exclusion of antibody research (albeit limited quality evidence available currently). The complexity on how the term ‘asymptomatic’ is used within literature could mean some studies were missed; however, synonyms for this term were included as a means to address this. The available literature is quite limited to published letters, descriptive articles and guiding documents.

Research Question

Are there populations of asymptomatic individuals (e.g., population sampling; congregate living including LTC, vulnerable populations; patients being hospitalized, those associated with outbreaks, HCWs) that should be considered priority for screening for COVID 19 infection (with PCR), with the goal of surveillance and preventing spread within these populations?

Asymptomatic Cases & Testing

This section contains a high-level summary of the early evidence around the occurrence of asymptomatic cases and transmission within given populations. For more detail on asymptomatic transmission, please refer to the Asymptomatic Transmission Rapid Review Update (Alberta Health Services, 2020b). To date, there is no available evidence on the impact of testing asymptomatic people and infectious viral loads within given population groups. **Table 2** (see Appendix) outlines the current guidelines of jurisdictions and major organizations as of April 22, 2020, including breakdown of available guidelines for testing asymptomatic individuals in different groups or populations.

General Population

There are an increasing number of reports identifying asymptomatic cases. It had been estimated that between 10%-30% of SARS-CoV-2 patients are asymptomatic (Bai et al., 2020; Li et al., 2020; Mizumoto Kenji, 2020); however, a recent rapid review out of Oxford suggests that asymptomatic cases account for 5%-80% of positive cases, highlighting the need for high-quality evidence to provide guidance on the impact of asymptomatic cases within Canada and/or other comparable jurisdictions (Heneghan, Brassey, & Jefferson, 2020). A preliminary case report of a middle-aged British man who tested positive on February 7, 2020 after attending a conference in Singapore during January 26-27, 2020, with travel to a ski resort in France, suggests that this individual was likely the index case for 13 laboratory confirmed cases in France (n=5), Spain (n=2) and the UK (n=6, including the focal case) (Hodcroft, 2020). The focal case reported no symptoms at the time of testing (Sky News, 2020). Notably, there is a lack of detail provided around the type and duration of ‘close contact’ within the ski resort in France, and concerns about the temporal and spatial overlap between other existing cases and the focal. The two-week quarantine on the Diamond Princess Cruise ship identified an infection rate among passengers of 17.9% (95%CI: 15.5%, 20.2%), of which 50.5% were asymptomatic at the time of testing (Mizumoto Kenji, 2020). A study on Japanese evacuees from Wuhan reported estimates of 33.3% (95% CI 8.3% - 58.3%) of cases as being asymptomatic at testing (Nishiura et al., 2020). Further, a news release reported an outbreak in a migrant hotel in Greece, with a total of 150 individuals testing positive after a pregnant women from the hotel tested positive in hospital (Stavrinou, 2020). Of these, 148 were refugees all of which were asymptomatic. No

denominator is available for the number of individuals tested as a result of this outbreak. A case series out of China examining 24 asymptomatic patients found transmission occurring to cohabiting individuals (Hu et al., 2020). Further asymptomatic clusters and transmissions have been reported in familial and non-familial settings, with some studies indicating transmission occurred prior to development of symptoms (Chan et al., 2020; Feng, Xu, Rong, & et al, 2020; He & et al, 2020; S. Lu et al., 2020; Mao, Wan, He, Hu, & Chen, 2020; Qian et al., 2020; Rothe et al., 2020; Tong et al., 2020; Wei, 2020; Wölfel et al., 2020; Ye et al., 2020). Some authors are suggesting that the standard approach of waiting for symptoms to appear may not be sufficient, especially given the unknown impact asymptomatic individuals have on the transmission of SARS-CoV-2, suggesting that that testing asymptomatic individuals may be beneficial (Day, 2020; Gandhi, Yokoe, & Havlir, 2020; Gostic, Gomez, Mummah, Kucharski, & Lloyd-Smith, 2020; Roxby et al., 2020).

With respect to early evidence around adoption of mass testing of general populations, Iceland began population testing for positive SARS-CoV-2 cases in mid-march and to-date Iceland has screened 10% of its population through either targeted testing or population-screening (Gudbjartsson et al., 2020). The targeted testing group included individuals at high risk for SARS-CoV-2, including those identified as returning from travel from high risk areas, already showing symptoms or were close contacts with a confirmed SARS-CoV-2 case. The population-screening group was an open invitation to all asymptomatic residents of Iceland or those only showing mild symptoms. Positive cases comprised 0.8% of the population sample (95%CI: 0.6%, 1.0%; 100 out of 13,080 participants), of which 43% of SARS-CoV-2 cases were asymptomatic at the time of testing. Importantly, the Iceland study did not follow-up patients to determine how many became symptomatic. The death of a resident in a small municipality in Italy resulted in a 14-day lockdown of the entire municipality and mass testing of its residents at two time points (at the start of lockdown; end of 14-day lockdown). Testing of residents, using nasopharyngeal swabs, at the start of the lockdown period found a 2.6% prevalence of positive cases (95%CI: 2.1%, 3.3%) compared to only 1.2% (95%CI: 0.8%, 1.8%) at the end of the lockdown (Lavezzo, 2020). Of those testing positive in the first testing period, 41.1% were asymptomatic (95% CI: 29.7%, 53.2%). At the second testing period, 44.8% were asymptomatic (95% CI: 26.5%, 64.3%); eight new cases were identified of which five residents were asymptomatic. (Lavezzo, 2020). Further, authors reported no statistical difference in the viral loads collected from symptomatic and asymptomatic residents, and that contact tracing identified that most cases at the latter time-point resulted from community-related infection prior to the start of lockdown or from asymptomatic infections living within the same household (Lavezzo, 2020). Notably, those identified as asymptomatic did not develop symptoms, in the interval between the first and the second survey. Limitations to this study include 15% of participants being lost between the first and second testing period with no discussion of why, and narrow definitions of SARS-CoV-2 symptoms. Findings from these studies and other aforementioned studies on asymptomatic individuals have been identified as indications that mass testing should be implemented when feasible (Day, 2020).

Congregate Living

There is international focus on outbreaks of SARS-CoV-2 within congregate living situations, such as LTC and assisted living facilities. In older, more vulnerable persons, such as those in LTC facilities, immunosenescence (changes in the immune system associated with age that may be associated with less overt COVID-19 manifestations such as fever), co-morbidities (e.g., dementia, chronic cardiopulmonary conditions) and a sedentary lifestyle may mask symptoms (Lin, 2020; Regional Geriatric Program of Toronto, 2020; Tay & Harwood, 2020). A serial point-prevalence study out of Washington state from one LTC centre experiencing a SARS-CoV-2 outbreak after a symptomatic HCW was working in the facility when confirmed positive (rapid release findings originally published by (Kimball et al., 2020)), reported that of the 76 residents (including those already confirmed as COVID-19 positive) assenting to participation in the first point-prevalence survey, 63% (n=48) residents tested positive for COVID-19 at either the first survey or second survey conducted 7 days later. At the time of testing positive for COVID-19 (first or second survey), 56% (n=27) reported no new symptoms (n=15) or changes in chronic symptoms (n=12); however, follow-up 7 days after testing positive resulted in 89% of cases being reclassified as 'pre-symptomatic' (Arons et al., 2020). Notably 56% of residents (n=15) classified as

asymptomatic at time of testing had documented cognitive impairment, which was comparable to the symptomatic group. Limitations to this study include that asymptomatic staff were not tested for COVID-19 and challenges with obtaining accurate symptoms among residents may have resulted in misclassification of the symptom/asymptomatic groupings. Assisted living facilities in Seattle have also reported asymptomatic SARS-CoV-2 positive cases (Roxby et al., 2020), suggesting that simply screening residents with symptoms results in undetected cases of asymptomatic individuals.

This population is particularly of high risk for contracting COVID-19 with severe and even fatal outcomes. Currently in Canada, 50% of COVID-19 deaths occur in LTC facilities. As of April 27, 2020, Alberta has identified 458 positive cases within LTC facilities, representing ~10% of Alberta's total number of cases (Government of Alberta, 2020a). Further, such facilities also experience resource capacity strain through positive staff cases and staff on self-isolation for COVID or influenza-like illness (ILI) symptoms (Gilroy, 2020). These outbreaks have resulted in 'calls to action' to expand SARS-CoV-2 screening to include asymptomatic patients, staff and clinicians within these facilities. Ontario has revised guidelines for LTC facilities to include prioritizing testing of both residents and staff in facilities experiencing an outbreak and to conduct a sampling of residents and staff in facilities without an outbreak for surveillance purposes (Government of Ontario, 2020; Greater Niagara Chamber of Commerce, 2020). Quebec has also revised guidelines to prioritize mass testing of residents and staff within residential facilities, as well as family and intermediate-type contacts (Sante Montreal, 2020); however, it is unclear if this includes asymptomatic individuals. On April 17, 2020, Dr. Hinshaw announced that Alberta would be expanding testing within LTC facilities where an outbreak exists to include such asymptomatic individuals (Calgary Herald, 2020; Government of Alberta, 2020a).

HCWs

With respect to hospital-acquired SARS-CoV-2, a retrospective, single-centre study out of Wuhan reported that of 138 patients with SARS-CoV-2 with pneumonia found that 41% were thought to be hospital-acquired SARS-CoV-2, of which 29.3% were health care workers (HCWs) and 12.3% were hospitalized patients (Wang et al., 2020). In a press release by BBC News, a hospital in Newport, Wales has reported that approximately half of the ED staff have been confirmed as SARS-CoV-2 positive. Further, there remains international supply concerns around shortages or anticipated shortages of appropriate personal protective equipment (PPE), resulting in unsafe working conditions to essential service providers on the frontlines.

As such, HCWs have been considered for expanded testing for asymptomatic individuals (Black, Bailey, & Swanton, 2020; Emanuel & Romer, 2020; Peto, 2020). The mayor of Stamford, Connecticut has announced that universal testing of its emergency response providers (e.g., HCWs, EMS, Fire, Police), given these individuals are at high risk on the frontline and the city feels that identifying asymptomatic individuals is one of the best ways to slow the spread of COVID-19 (NBC Connecticut, 2020). Memphis, Tennessee has also stated that the Memphis COVID-19 Task Force is working towards expanding testing to all frontline providers and will determine the feasibility of broadening the testing of asymptomatic individuals based on the impact seen through their implementation of mass testing HCWs (McCarthy, 2020). That being said, many current guidelines do not prioritize testing of asymptomatic staff in hospital settings, regardless of potential contact with the SARS-CoV-2 virus (BC Centre for Disease Control, 2020a; Iacobucci, 2020). Assuming asymptomatic transmission is a contributor to the ongoing COVID-19 pandemic, HCWs represent a large population of individuals in essential services who may be positive for SARS-CoV-2 without symptoms. Further, screening staff for COVID or ILI-related symptoms has seen large numbers of staff at home on self-isolation, without the ability to know if those staff are truly SARS-CoV-2 positive or not (Dunhill, 2020). Given the priority of such an essential service, there is potential rationale to consider expanding testing to asymptomatic HCWs as a means to reduce resource capacity strain within hospitals (quarantining staff based on confirmed SARS-CoV-2 through mass screening) and potentially reducing the transmission of SARS-CoV-2 via asymptomatic staff to other frontline providers and/or hospitalized patients. Again, high quality evidence on the risk of transmission from asymptomatic cases is still unclear.

Higher Risk Working/Living Conditions

Another area or 'group' that has come to light as potential priority due to outbreaks of SARS-CoV-2 individuals who live and/or work in situations where prevention measures including distancing and self isolation are harder to observe. As described in the General Population section above, as well as the Asymptomatic Transmission Rapid Review (Alberta Health Services, 2020b), early evidence on asymptomatic cases and transmission in familial or close-quarter conditions has become available. A report on an outbreak on the Theodore Roosevelt aircraft carrier confirmed ~13% of the 4,865 crew members were SARS-CoV-2 positive, of which ~55% were asymptomatic at the time of testing. (Correll, 2020; Dunhill, 2020). Notably, the proportion of positive tests and asymptomatic cases are only reported as estimates within news articles without providing the actual number of cases. A preprint study examining the modes of contact and risk of transmission of COVID-19 among close contacts with confirmed cases (n=347) in Guangzhou, China found that among the 4,590 close contacts tested, 129 contacts were confirmed positive, with 6.2% (n=8) remained asymptomatic throughout two weeks monitoring quarantine period. All eight asymptomatic cases were identified by day 10 of quarantine (Lau et al., 2010). The incidence rate among household contacts was 10.2% and incidence of transmission increased based on age (1.8% among 0-17 years; 4.2% 60+years) and clinical severity of the close contact source (asymptomatic: 0.33%; mild to moderate: 3.3-5.6%; severe: 6.2%). Those individuals testing negative and without symptoms were retested every 48 hours until they were confirmed positive or the quarantine period ended. The sensitivity of PCR testing via throat swab increased within each round of testing from 71.9% at the first test to 100% by the sixth test. The specificity at time of the first test was 99.86% and reduced by <0.1% with further tests (Lau et al., 2010). Study limitations include recall bias among source as close contact cases, lack of data to show prognosis over the course of the virus as clinical outcome data was censored, and owing to a low incidence rate of COVID-19 within this sample, a logic regression model was applied over a cox proportional hazards model.

On April 21, 2020, the state of California has modified guidelines to include testing asymptomatic individuals living and/or working in conditions where it is harder to observe IPC protocols (California Department of Public Health, 2020). While high-quality evidence on the role of asymptomatic transmission in outbreaks is not available, the argument can be made that with acknowledging its biological plausibility and early evidence suggesting transmission is occurring, that groups can be affected by a SARS-CoV-2 outbreak as a result of risking working/living conditions.

Pregnant Women

A recent retrospective case review out of New York City hospitals identified 43 pregnant women as confirmed SARS-CoV-2 cases after being admitted to hospital for delivery during the period of March 13-27, 2020, of which 32.6% were asymptomatic at testing (Breslin et al., 2020). As of March 22, 2020, universal testing of women admitted to the labour unit began. Of the 43 positive cases, 7 were identified prior to implementing universal testing and 36 were identified after universal testing began. Notably, there were no SARS-CoV-2 cases in neonates on first day of life. Authors advocate that mass testing of women admitted to hospital for delivery should be considered. Limitations of the study include the case series represent patients presenting to either affiliated hospital, which are also in close proximity to each other, as well as presenting a small series of cases in relation to the high prevalence of SARS-CoV-2 within New York City. In a letter to the editor further detailing SARS-CoV-2 cases within the same two New York City hospital admitted between March 22-April 4, 2020 reported that among 215 obstetric cases in New York City, 29 (87.9%) of 33 positive cases were asymptomatic (Sutton, Fuchs, D'Alton, & Goffman, 2020). It is important to contextualize these findings within their local context, particularly given that NYC is the current epicenter for COVID-19. Using COVID-associated mortality and very crudely adjust the NYC case numbers to the mortality rate in Alberta (2.5%, driven largely by LTC cases) the NYC mortality rate is higher by a factor of 3.8 (9.5%); if we estimate that the real case numbers are likely 4-fold higher yet in NYC implying there is roughly a 200 to 250-fold difference in incident cases when accounting for variance in population sizes. Given that Alberta is now detecting more minimally symptomatic cases that is still likely an underestimation of the differences between the rates in these two areas.

In response to early evidence, the current guidelines from the Indian Council on Medical Research now includes testing for all pregnant women residing in 'hotspots' for SARS-CoV-2 and presenting with signs of labour,

regardless of symptoms presentation. Further advocacy of universal testing in pregnant women admitted to hospital for delivery is growing (Breslin et al., 2020; Sutton et al., 2020).

Children

Several reports and reviews suggest that children are often asymptomatic or present with only mild symptoms, with lower incidence rates of reported COVID-19. Evidence is limited around transmission of SARS-CoV-2 from SARS-Cov-2 positive children (Don't Forget the Bubbles, 2020 ; Fretheim, 2020 ; Gudbjartsson et al., 2020; Health Information and Quality Authority (HIQA), 2020; Morand et al., 2020) . For example, a study on children admitted to the Wuhan Children's hospital reported 15.8% of SARS-CoV-2 children were asymptomatic (X. Lu et al., 2020). Further information on the prevalence of asymptomatic children can be found in the Asymptomatic Transmission rapid review (Alberta Health Services, 2020b). There are currently no available guidelines indicating the priority of mass testing for children.

Homeless Shelters

A case cluster study on an outbreak at a large homeless shelter in Boston found that universal testing of shelter residents and staff identified that 36% of residents and 30% of staff tested positive. Authors reported that the presence of symptoms at time of testing was uncommon (Baggett, Keyes, Sporn, & Gaeta, 2020). Similarly, a recent Mortality and Morbidity Report out of CDC identified that five homeless shelters in the US had a cluster outbreak of SARS-CoV-2 (Boston n=1 [same case cluster of Baggett et al]; San Francisco n=1; Seattle (n=3) (Mosites et al., 2020). Public health teams tested all shelter staff and residents within each shelter, including asymptomatic individuals, to identify and transfer positive cases to the appropriate hospital or community isolation areas. In addition to the aforementioned positive cases out of the Boston shelter, testing in these other shelters identified high proportions of SARS-CoV-2 positive cases among both residents and staff members San Francisco (66% & 16% positive case, respectively) and Seattle (17% & 17%). The authors advocate that testing of all staff members and residents at cluster outbreaks should be considered. No available guidelines were found indicating priority of mass testing in staff and residents of shelters. Study limitations include cross-sectional sample tested, data on present symptoms was not routinely collected and underreporting of cases owing to non-participation of all at risk individuals.

As of April 27, 2020, Alberta's Chief Medical Officer of Health announced that there will be implementation of testing all clients of shelters, as well as testing asymptomatic and symptomatic close contacts of positive cases when experiencing an outbreak.

Prison

A report out of an Arkansas state prison identified an index case within the prison, after which 43 out of 46 male prisons on the unit were confirmed as asymptomatic positive cases of SARS-CoV-2 (Michaels, 2020). Ohio has reported having at least 1,828 SARS-CoV-2 inmates, accounting for more than 20% of positive cases in the state. Ohio officials state mass testing programs allowed for more accurate identification of cases, including asymptomatic inmates (Chappell, 2020). There is limited focus on priority screening within available guidelines; however, this population has received calls to action via the media. Guidelines out of Oregon Health Authority loosely mention testing asymptomatic individuals in correctional services (Oregon Health Authority, 2020). Current guidelines from WHO, US CDC and European correctional services do not include testing of asymptomatic inmates or staff (Centers for Disease Control and Prevention, 2020a; Commonwealth Health Rights Initiative, 2020; World Health Organization (WHO), 2020). As of April 22, 2020, there are 193 positive cases among inmates within correctional services across Canada. At this time there are no reported positive cases in Alberta's correctional facilities (Correctional Service Canada, 2020).

Indigenous Persons Repatriating to Community

Indigenous people and communities have the right to self-determination in their health and health care provision, as supported by the United Nations Declaration on the Rights of Indigenous Peoples, the Truth and Reconciliation Commission's Calls to Action and the Murdered and Missing Indigenous Women and Girls Report's Calls to

Justice. While communities are taking action to strengthen their health systems and build on traditional knowledge, continued barriers to accessing and receiving health care demonstrate pervasive structural inequities. The COVID-19 pandemic amplifies this equity gap. Historical and contemporary colonization and its social sequelae including poverty, food insecurity, crowded housing, intergenerational trauma, and structural and implicit racism are recognized as factors adversely influencing Indigenous peoples' health and well-being and access to care. In a time of pandemic, given the social sequelae in Indigenous communities and adverse interactions with the health system, many Indigenous peoples do not trust Euro-Canadian healthcare systems and are concerned that a community outbreak will result in significant morbidity and mortality. As a result, many Indigenous communities want the ability to repatriate their members back to community. In support of repatriation, communities are requesting testing for asymptomatic members, prior to supporting them to come back into community. Currently, there is no evidence around the prevalence of asymptomatic cases and no guidelines were found for prioritizing testing of asymptomatic Indigenous peoples.

Summary

In summary, there is early evidence that testing of individuals without symptoms has identified asymptomatic SARS-CoV-2 cases; however, most studies do not follow patients over time, leaving questions around whether or not they were pre-symptomatic. There is limited guidance across mass testing within various population groups of interest. The available guidelines prioritize mass testing within congregate living setting and risky work/living conditions when associated with an outbreak. Other groups (HCWs, emergency personnel, and pregnant women admitted for delivery) are receiving calls to action but tend to be recommended as “when feasible”. Further, the prioritization of these groups would be relatively less given universal procedure mask use would mitigate potential risk.

Evolving Evidence

The evidence for this research question is rapidly evolving. This review will be updated as new data from additional trials/studies are made available. It will be important to be able to assess the quality and outcomes of new studies as the value and impact of universal testing is unknown. Currently, a pilot study within Alberta is examining the prevalence of asymptomatic positive patients presenting to three EDs with no COVID-19 or ILI-related health concerns.

Date question received by advisory group: April 20, 2020

Date report submitted to committee: April 24, 2020

Date of first assessment: April 29, 2020

(If applicable) Date of re-assessment:

Authorship and Committee Members

This review was written by Jamie Boyd and scientifically reviewed by Melissa Potestio (external reviewer), Lynora Saxinger (co-chair), Diana Turner (external reviewer), David Hogan (external reviewer), Kristin Klein (external reviewer), and James Wesenberg (external reviewer). The Scientific Advisory Group was involved in discussion and revision of the document: Braden Manns (co-chair), John Conly, Alexander Doroshenko, Shelley Duggan, Nelson Lee, Elizabeth MacKay, Andrew McRae, Jeremy Slobodan, James Talbot, Brandie Walker, and Nathan Zelyas.

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Appendix

List of Abbreviations

AHS: Alberta Health Services

CDC: Centers for Disease Control & Prevention, U.S. Department of Health & Human Services

COVID-19: Coronavirus Disease-2019

HCW: Health care worker

ILI: Influenza-like illness

KRS: Knowledge Resource Services

LTC: Long-term care

SAG: Scientific Advisory Group

SARS-CoV-2 - Severe acute respiratory syndrome coronavirus 2

Literature Search Details

A literature search was conducted by Rachel Zhao from the Knowledge Resource Services (KRS) within the Knowledge Management Department of Alberta Health Services. KRS searched databases for articles published from year 2020 to April 20, 2020, and included: OVID MEDLINE, LitCovid, PubMed, TRIP PRO, WHO COVID-19 Database, BMJ Best practice, Centre for Evidence Based Medicine (CEBM), National Collaborating Centre for Methods and Tools, European Centre for Disease Prevention and Control (ECDC), CADTH, Cambridge Coronavirus Free Access Collection, Cochrane, National Institute for Health and Care Excellence, medRxiv, Google and Google Scholar. The citation tracking method was also applied in Google Scholar. Briefly, the search strategy involved combinations of keywords and subject headings including:

- SARS-CoV-2 or COVID-19
- Asymptomatic or pre-symptomatic
- Testing or screening

Articles identified by KRS in their search were initially screened by title against the inclusion/exclusion criteria listed in Table 1. A total of 81 articles were included within this review based on the below criteria.

Table 1. Inclusion and exclusion criteria for results of the literature search

| Inclusion Criteria* | Exclusion Criteria |
|--|---|
| <ul style="list-style-type: none">- SARS-CoV-2 (COVID-19)- Describes asymptomatic or pre-symptomatic COVID-19 cases- Describes testing of asymptomatic COVID-19 cases- Human studies- Any population- Guidelines- Article is peer-reviewed, is from a reputable source or has described methodology (includes letters, abstracts, reviews) | <ul style="list-style-type: none">- SARS or MERS studies- No outcomes described- Primary focus is on methods of testing without with application to asymptomatic testing- Influenza, RSV, circulating coronavirus, or other contagious virus |

* Letters to the editor, commentaries and press releases were reviewed for primary sources.

| Table 2. Comparison of Current Guidelines on Asymptomatic Testing for Covid-19 | |
|--|---|
| <p>CDC, United States Evaluating and Testing Persons for Coronavirus Disease 2019 (COVID-19) (March 24, 2020)</p> <p>(Centers for Disease Control and Prevention, 2020b)</p> | <p>*CDC guidance for COVID-19 may be adapted by state and local health departments to respond to rapidly changing local circumstances</p> <p>Priority 1: Ensure optimal care options for all hospitalized patients, lessen the risk of nosocomial infections, and maintain the integrity of the healthcare system</p> <ul style="list-style-type: none"> • Hospitalized patients • Symptomatic healthcare workers <p>Priority 2: Ensure that those who are at highest risk of complication of infection are rapidly identified and appropriately triaged</p> <ul style="list-style-type: none"> • Patients in long-term care facilities with symptoms • Patients 65 years of age and older with symptoms • Patients with underlying conditions with symptoms • First responders with symptoms <p>Priority 3: As resources allow, test individuals in the surrounding community of rapidly increasing hospital cases to decrease community spread, and ensure health of essential workers</p> <ul style="list-style-type: none"> • Critical infrastructure workers with symptoms • Individuals who do not meet any of the above categories with symptoms • Health care workers and first responders • Individuals with mild symptoms in communities experiencing high COVID-19 hospitalizations <p>Priority 4: Individuals without symptoms</p> |
| <p>California Department of Public Health, United States Expanding Access to Testing: Updated Interim Guidance on Prioritization for COVID-19 Laboratory Testing (April 19, 2020)</p> <p>(California Department of Public Health, 2020)</p> | <p>Priority 1:</p> <ul style="list-style-type: none"> • Hospitalized patients • Symptomatic healthcare workers • Persons identified for testing by public health contact investigations and disease control activities in high risk settings, including both residents and staff • E.g., congregate living facilities, correctional facilities <p>Priority 2:</p> |

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|---|--|
| | <ul style="list-style-type: none"> • Screening of asymptomatic residents of congregate living facilities prior to admission or re-admission to congregate living facility <ul style="list-style-type: none"> ○ E.g., a hospitalized patient will be screened for COVID-19 prior to discharge to a congregate living facility • Screening of asymptomatic healthcare workers <ul style="list-style-type: none"> ○ E.g., skilled nursing facility workers, hospital workers • Symptomatic persons in essential health and public safety occupations <ul style="list-style-type: none"> ○ E.g., first responders, law enforcement, congregate living facility workers • Symptomatic persons >65 years of age or with chronic medical conditions <p>Priority 3:</p> <ul style="list-style-type: none"> • Symptomatic persons in essential infrastructure occupations <ul style="list-style-type: none"> - E.g., utility workers, food supply workers, other public employees <p>Priority 4:</p> <ul style="list-style-type: none"> • Community-based testing of all low-risk symptomatic persons • Surveillance testing of asymptomatic persons |
| <p>New York State Department of Health, United States Protocol for Testing (April 2020) (New York State Department of Health, 2020)</p> | <p>Until New York State is at full capacity for testing, the Department of Health has issued guidance to ensure that New York State prioritizes the resources to meet the most urgent public health need.</p> <p>Testing for COVID-19 shall be authorized by a health care provider when:</p> <ul style="list-style-type: none"> • An individual has come within proximate contact (same classroom, office, or gatherings) of another person known to be positive (unclear if this includes testing asymptomatic close contacts); or • An individual has traveled to a country that the CDC has issued a Level 2 or Level 3 Travel Health Notice, and shows symptoms of illness; or • An individual is quarantined (mandatory or precautionary) and has shown symptoms of COVID-19 illness; or |

| | |
|--|---|
| | <ul style="list-style-type: none"> • An individual is symptomatic and has not tested positive for any other infection; or • Other cases where the facts and circumstances warrant as determined by the treating clinician in consultation with state and local department of health officials |
| <p>Oregon Health Authority, United States Guidance for providers regarding COVID-19 testing (April 20, 2020)</p> <p>(Oregon Health Authority, 2020)</p> | <p>Recommendations for COVID-19 testing at clinical laboratories: people in the following groups:</p> <ul style="list-style-type: none"> • Residents, staff, children, or other people in a care facility or group living setting (e.g., healthcare facility, residential care facility, school, child care, or corrections). When clinical laboratories have sufficient testing capacity, people in these settings without symptoms can be considered for testing |
| <p>Ontario Ministry of Health, Canada COVID-19 Provincial Testing Guidance (April 15, 2020)</p> <p>(Ontario Ministry of Health, 2020)</p> | <p>Residents Living in Long-Term Care and Retirement Homes:</p> <ul style="list-style-type: none"> • Asymptomatic patients: Please note that the ministry has asked hospitals to temporarily stop transferring patients to long-term care and retirement homes. However, in the unlikely event that a transfer is still required, asymptomatic patients transferred from a hospital to a long-term care home or retirement home must be tested, and results received, prior to transfer. A negative result does not rule out the potential for incubating illness and all patients should remain under droplet/contact precautions in a 14-day self-isolation period following transfer. In the event of a symptomatic resident in an institutional setting, asymptomatic residents living in the same room should be tested immediately along with the symptomatic resident. In the event of an outbreak of COVID-19 in a long-term care home or retirement home asymptomatic contacts of a confirmed case, determined in consultation with the local public health unit, should be tested including: <ul style="list-style-type: none"> - All residents living in adjacent rooms - All staff working on the unit/care hub - All essential visitors that attended at the unit/care hub |

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|---|--|
| | <ul style="list-style-type: none"> - Any other contacts deemed appropriate for testing based on a risk assessment by local public health |
| <p>Alberta Health Services, Alberta Guidance: Testing for COVID-19 Before Provision of Health Services to Asymptomatic Patients (April 21, 2020)</p> <p>(Government of Alberta, 2020a)</p> | <ul style="list-style-type: none"> • Testing of all staff and residents at continuing care facilities with COVID-19 outbreaks • It is not necessary to perform COVID-19 testing on an asymptomatic patient before providing routine, urgent, or emergent health services, or before accepting a patient in transfer from another site |
| <p>Government of Saskatchewan, Saskatchewan Testing Information (April 2020) (Government of Saskatchewan, 2020)</p> | <ul style="list-style-type: none"> • A referral is required to get tested; • If you are not exhibiting symptoms, you do not need to be tested |
| <p>BC Centre for Disease Control, British Columbia Covid-19 Testing (April 2020)</p> <p>(BC Centre for Disease Control, 2020b)</p> | <ul style="list-style-type: none"> • If an individual has no symptoms, even if they are a contact of a confirmed case or a returning traveller, they do not require a test • Who does not need to be tested for COVID-19? <ul style="list-style-type: none"> - People without symptoms - In some cases, a physician or nurse practitioner may decide that a person with symptoms that can be managed at home does not need to be tested |
| <p>Government of Iceland, Iceland Large Scale Testing of General Population (March 15, 2020) (Government of Iceland, 2020)</p> | <ul style="list-style-type: none"> • Free screening for COVID-19 among the general, non-symptomatic, non-quarantined population |
| <p>Indian Council of Medical Research, India Strategy for COVID-19 testing for pregnant women in India (April 20, 2020)</p> <p>(Indian Council of Medical Research, 2020)</p> | <ul style="list-style-type: none"> • Pregnant women residing in clusters/containment area or in large migration gatherings/evacuees centre from hotspot districts presenting in labour or likely to deliver in next 5 days should be tested even if asymptomatic; • Asymptomatic pregnant women should be tested in the health facilities where they were expected to deliver and all arrangements should be made to collect and transfer samples to testing facilities. Women should not be referred for lack of testing facility |
| <p>Department of Health and Social Care, United Kingdom Coronavirus (COVID-19) Scaling up our testing programmes (April 4, 2020)</p> <p>(Department of Health & Social Care, 2020)</p> | <ul style="list-style-type: none"> • Mass-swab testing for critical key workers in the NHS, social care and other sectors • NHS England instructed that any spare capacity can be focused on testing critical key workers, prioritizing those who are in household quarantine because a member of their household is symptomatic |

Reference List

- AHS CEO. (2020). AHS COVID-19 Update: Healthcare Worker Testing Statistics and Healthcare Aide Wage Supplements [Email]. In.
- Alberta Health Services. (2020a, 2020 April 9). COVID-19 Guidance Daily Fit for Work Screening Protocol. Retrieved from <https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-daily-fitness-for-work-screening-protocols.pdf>
- Alberta Health Services. (2020b, 2020 April 13). COVID-19 Scientific Advisory Group Rapid Response Report Retrieved from <https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-rapid-response-asymptomatic-transmission.pdf>
- Alberta Health Services. (2020c, 2020 April 14). Information for People Visiting Patients novel coronavirus (COVID-19). Retrieved from <https://www.albertahealthservices.ca/topics/Page17001.aspx>
- Arons, M. M., Hatfield, K. M., Reddy, S. C., Kimball, A., James, A., Jacobs, J. R., . . . Jernigan, J. A. (2020). Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. *New England Journal of Medicine*. doi:10.1056/NEJMoa2008457
- Baggett, T. P., Keyes, H., Sporn, N., & Gaeta, J. M. (2020). COVID-19 outbreak at a large homeless shelter in Boston: Implications for universal testing. *medRxiv*, 2020.2004.2012.20059618. doi:10.1101/2020.04.12.20059618
- Bai, Y., Yao, L., Wei, T., Tian, F., Jin, D. Y., Chen, L., & Wang, M. (2020). Presumed Asymptomatic Carrier Transmission of COVID-19. doi:10.1001/jama.2020.2565
- BC Centre for Disease Control. (2020a). Interim guidance: public health management of cases and contacts associated with novel coronavirus (COVID-19) in the community. *CPG Infobase*.
- BC Centre for Disease Control. (2020b). Lab Testing. Retrieved from <http://www.bccdc.ca/health-professionals/clinical-resources/covid-19-care/lab-testing>
- Black, J. R. M., Bailey, C., & Swanton, C. (2020). COVID-19: the case for health-care worker screening to prevent hospital transmission. *The Lancet*.
- Breslin, N., Baptiste, C., Gyamfi-Bannerman, C., Miller, R., Martinez, R., Bernstein, K., . . . Goffman, D. (2020). COVID-19 infection among asymptomatic and symptomatic pregnant women: Two weeks of confirmed presentations to an affiliated pair of New York City hospitals. *Am J Obstet Gynecol MFM*, 100118. doi:10.1016/j.ajogmf.2020.100118
- Calgary Herald. (2020, 2020 April 17). Alberta to expand Covid-19 testing to asymptomatic residents and staff at long-term care homes Retrieved from <https://calgaryherald.com/news/local-news/live-at-330-pm-latest-update-from-chief-medical-officer-dr-deena-hinshaw/>
- California Department of Public Health. (2020, 2020 April 19). Expanding Access to Testing: Updated Interim Guidance on Prioritization for COVID-19 Laboratory Testing Retrieved from <https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/Expanding-Access-to-Testing-Updated-Guidance-on-Prioritization-for-COVID-19-Testing.aspx>
- Centers for Disease Control and Prevention. (2020a, 2020 March 23). Interim Guidance on Management of Coronavirus Disease 2019 (COVID-19) in Correctional and Detention Facilities. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/downloads/guidance-correctional-detention.pdf>
- Centers for Disease Control and Prevention. (2020b, 2020 March 14). Interim Infection Control Guidance for Public Health Personnel Evaluating Persons Under Investigation (PUIs) and Asymptomatic Close Contacts of Confirmed Cases at Their Home or Non-Home Residential Settings. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/php/guidance-evaluating-pui.html>
- Chan, J. F., Yuan, S., Kok, K. H., To, K. K., Chu, H., Yang, J., . . . Yuen, K. Y. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person

- transmission: a study of a family cluster. *Lancet*, 395(10223), 514-523. doi:10.1016/s0140-6736(20)30154-9
- Chappell, B. (2020, 2020 April 20). 73% Of Inmates At An Ohio Prison Test Positive For Coronavirus. Retrieved from <https://www.npr.org/sections/coronavirus-live-updates/2020/04/20/838943211/73-of-inmates-at-an-ohio-prison-test-positive-for-coronavirus>
- Commonwealth Health Rights Initiative. (2020, 2020 April 8). COVID-19 and Prisons in the Commonwealth: 'Ensuring an Effective Response'. Retrieved from <https://www.humanrightsinitiative.org/publication/covid19-and-prisons-in-the-commonwealth-ensuring-an-effective-response>
- Correctional Service Canada. (2020, 2020 April 22). Inmate COVID-19 testing in federal correctional institutions, April 22, 2020. Retrieved from <https://www.csc-scc.gc.ca/001/006/001006-1014-en.shtml>
- Correll, D. S. (2020, 2020 April 16). SECDEF: Majority of Roosevelt sailors with COVID-19 are asymptomatic Retrieved from <https://www.navytimes.com/news/coronavirus/2020/04/16/secdef-majority-of-roosevelt-sailors-with-covid-19-are-asymptomatic-flattop-still-wartime-ready/>
- Day, M. (2020, 2020 March 23). Covid-19: identifying and isolating asymptomatic people helped eliminate virus in Italian village. Retrieved from <https://www.bmj.com/content/368/bmj.m1165>
- Department of Health & Social Care. (2020, 2020 April 4). Coronavirus (COVID-19): Scaling up our testing programmes. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/878121/coronavirus-covid-19-testing-strategy.pdf
- Don't Forget the Bubbles. (2020 2020 April 22). Pediatric Patients: DFTB COVID-19 EVIDENCE REVIEW 10TH APRIL 2020. Retrieved from <https://dontforgetthebubbles.com/wp-content/uploads/2020/04/COVID-data-1.pdf>
- Dunhill, L. (2020, 2020 March 23). Exclusive: Intensive care staffing ratios dramatically diluted. Retrieved from <https://www.hsj.co.uk/exclusive-intensive-care-staffing-ratios-dramatically-diluted/7027214.article>
- Emanuel, E. J., & Romer, P. M. (2020 2020 April 19). Without More Tests, America Can't Reopen. Retrieved from <https://www.theatlantic.com/ideas/archive/2020/04/were-testing-the-wrong-people/610234/>
- Feng, Y., Xu, S., Rong, Z., & et al. (2020). Delivery of infection from asymptomatic carriers of COVID-19 in a familial cluster. *International Journal of Infectious Diseases*.
- Fretheim, A. (2020 2020 March). The role of children in the transmission of SARS-CoV-2 (COVID-19) – a rapid review Retrieved from <https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2020/the-role-of-children-in-the-transmission-of-sars-cov-2-report-2020.pdf>
- Gandhi, M., Yokoe, D. S., & Havlir, D. V. (2020). Asymptomatic Transmission, the Achilles' Heel of Current Strategies to Control Covid-19. *New England Journal of Medicine*. doi:10.1056/NEJMe2009758
- Gilroy, R. (2020, 2020 March 19). Already stretched care homes 'must prepare to go beyond' for Covid-19. Retrieved from <https://www.nursingtimes.net/news/older-people/already-stretched-care-homes-must-prepare-to-go-beyond-for-covid-19-19-03-2020/>
- Gostic, K., Gomez, A. C., Mummah, R. O., Kucharski, A. J., & Lloyd-Smith, J. O. (2020). Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. *eLife*, 9. doi:<https://dx.doi.org/10.7554/eLife.55570>
- Government of Alberta. (2020a, 2020 April 23). Chief medical officer updates Retrieved from <https://www.alberta.ca/coronavirus-info-for-albertans.aspx>

- Government of Alberta. (2020b, 2020 April 22). COVID-19 info for Albertans Retrieved from <https://www.alberta.ca/coronavirus-info-for-albertans.aspx>
- Government of Alberta. (2020c, 2020 March 16). Guidance for Providers of Services to Albertans Experiencing (or at-risk of) Homelessness: 2019 Novel Coronavirus (COVID-19) Prevention and Preparation. Retrieved from <https://www.alberta.ca/assets/documents/covid-19-guidance-for-shelters.pdf>
- Government of Iceland. (2020, 2020 March 15). Large scale testing of general population in Iceland underway. Retrieved from <https://www.government.is/diplomatic-missions/embassy-article/2020/03/15/Large-scale-testing-of-general-population-in-Iceland-underway/>
- Government of Ontario. (2020, 2020 April 15). COVID-19 action plan: long-term care homes. Retrieved from <https://www.ontario.ca/page/covid-19-action-plan-long-term-care-homes#section-2>
- Government of Saskatchewan. (2020, 2020 April). Clinical guidelines for testing, management and reporting. Retrieved from <https://www.saskatchewan.ca/government/health-care-administration-and-provider-resources/treatment-procedures-and-guidelines/emerging-public-health-issues/2019-novel-coronavirus/information-for-health-care-providers/testing-screening-treatment-and-medical-directives/clinical-guidelines>
- Greater Niagara Chamber of Commerce. (2020, 2020 April 20). Pilot Surveillance Project to Test Asymptomatic Patients in LTC, Retirement Home, Hospice and Home Care for COVID-19. Retrieved from <https://gncc.ca/pilot-surveillance-project-to-test-asymptomatic-patients-in-ltc-retirement-home-hospice-and-home-care-for-covid-19/>
- Gudbjartsson, D. F., Helgason, A., Jonsson, H., Magnusson, O. T., Melsted, P., Norddahl, G. L., . . . Stefansson, K. (2020). Spread of SARS-CoV-2 in the Icelandic Population. *New England Journal of Medicine*. doi:10.1056/NEJMoa2006100
- He, X., & et al. (2020). Temporal dynamics in viral shedding and transmissibility of COVID-19. *medRxiv*.
- Health Information and Quality Authority (HIQA). (2020, 2020 April 1). Evidence summary for natural history of COVID-19 in children Retrieved from https://www.hiqa.ie/sites/default/files/2020-04/Evidence-Summary_Covid-19_natural-history-in-children.pdf
- Heneghan, C., Brassey, J., & Jefferson, T. (2020). COVID-19: What proportion are asymptomatic? *Oxford COVID-19 Evidence Service*. doi:10.2807/1560-7917.ES.2020.25.10.2000180
- Hodcroft, E. B. (2020). Preliminary case report on the SARS-CoV-2 cluster in the UK, France, and Spain. *Swiss Med Wkly*, 150(9-10). doi:10.4414/smw.2020.20212
- Hu, Z., Song, C., Xu, C., Jin, G., Chen, Y., Xu, X., . . . Shen, H. (2020). Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Science China. Life sciences*. doi:<https://dx.doi.org/10.1007/s11427-020-1661-4>
- Iacobucci, G. (2020). Covid-19: Hospitals can remove 15% cap on testing of NHS staff. *Bmj*, 369, m1339. doi:10.1136/bmj.m1339
- Indian Council of Medical Research. (2020, 2020 April 20). Strategy for COVID19 testing for pregnant women in India (Version 1, dated 20/04/2020). Retrieved from https://icmr.nic.in/sites/default/files/upload_documents/COVID19_Testing_Strategy_for_Pregnant_Women.pdf
- Kimball, A., Hatfield, K. M., Arons, M., James, A., Taylor, J., Spicer, K., . . . Jernigan, J. A. (2020). Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020. *MMWR Morb Mortal Wkly Rep*. doi:10.15585/mmwr.mm6913e1
- Lau, L. L. H., Cowling, B. J., Fang, V. J., Chan, K.-H., Lau, E. H. Y., Lipsitch, M., . . . Leung, G. M. (2010). Viral shedding and clinical illness in naturally acquired influenza virus infections. *The Journal of infectious diseases*, 201(10), 1509-1516. doi:10.1086/652241

- Li, R., Pei, S., Chen, B., Song, Y., Zhang, T., Yang, W., & Shaman, J. (2020). Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2). *Science*. doi:10.1126/science.abb3221
- Lin, Y., Ji, Chunlian, Weng, Weidong, et al., . (2020). Epidemiological and Clinical Characteristics of 124 Elderly Outpatients with COVID-19 in Wuhan, China. doi:<http://dx.doi.org/10.2139/ssrn.3543596>
- Lu, S., Lin, J., Zhang, Z., Xiao, L., Jiang, Z., Chen, J., . . . Luo, S. (2020). Alert for non-respiratory symptoms of Coronavirus Disease 2019 (COVID-19) patients in epidemic period: A case report of familial cluster with three asymptomatic COVID-19 patients. *Journal of medical virology*. doi:10.1002/jmv.25776
- Lu, X., Zhang, L., Du, H., Zhang, J., Li, Y. Y., Qu, J., . . . Wong, G. W. K. (2020). SARS-CoV-2 Infection in Children. *New England Journal of Medicine*. doi:10.1056/NEJMc2005073
- Mao, Z.-Q., Wan, R., He, L.-Y., Hu, Y.-C., & Chen, W. (2020). The enlightenment from two cases of asymptomatic infection with SARS-CoV-2: is it safe after 14 days of isolation? *International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases*. doi:<https://dx.doi.org/10.1016/j.ijid.2020.03.041>
- McCarthy, C. (2020, 2020 April 21). Memphis COVID-19 Task Force wants to start testing asymptomatic people to limit the spread. Retrieved from <https://www.localmemphis.com/article/news/health/coronavirus/memphis-covid-19-task-force-wants-to-start-testing-asymptomatic-people-to-limit-the-spread/522-faeff017-2435-443f-ac27-238acdf2ed03>
- Michaels, S. (2020, 2020 April 13). Want to Know How Fast Coronavirus Can Spread in Prison? Look at Arkansas. Retrieved from <https://www.motherjones.com/coronavirus-updates/2020/04/cummins-unit-prison-arkansas-coronavirus-spread/>
- Mizumoto Kenji, K. K., Zarebski Alexander, & Chowell Gerardo, . (2020, 2020 March 12). Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. Retrieved from <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.10.2000180>
- Morand, A., Fabre, A., Minodier, P., Boutin, A., Vanel, N., Bosdure, E., & Fournier, P. E. (2020). COVID-19 virus and children: What do we know? *Arch Pediatr*, 27(3), 117-118.
- Mosites, E., Parker, E. M., Clarke, K. E. N., Gaeta, J. M., Baggett, T. P., Imbert, E., . . . Peacock, G. (2020, 2020 April 22). Assessment of SARS-CoV-2 Infection Prevalence in Homeless Shelters — Four U.S. Cities, March 27–April 15, 2020. Retrieved from https://www.cdc.gov/mmwr/volumes/69/wr/mm6917e1.htm?s_cid=mm6917e1_w
- NBC Connecticut. (2020, 2020 April 21). Six Stamford Emergency Responders Test Positive for COVID-19. Retrieved from <https://www.nbcconnecticut.com/news/local/six-stamford-emergency-responders-test-positive-for-covid-19/2258813/>
- New York State Department of Health. (2020). COVID-19 Testing: Protocol for Testing. Retrieved from <https://coronavirus.health.ny.gov/covid-19-testing>
- Nishiura, H., Kobayashi, T., Suzuki, A., Jung, S.-M., Hayashi, K., Kinoshita, R., . . . Miyama, T. (2020). Estimation of the asymptomatic ratio of novel coronavirus infections (COVID-19). *International Journal of Infectious Diseases*. doi:<https://doi.org/10.1016/j.ijid.2020.03.020>
- Ontario Ministry of Health. (2020, 2020 April 15). COVID-19 Provincial Testing Guidance Update April 15, 2020 Retrieved from http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_covid_testing_guidance.pdf
- Oregon Health Authority. (2020, 2020 April 20). Guidance for providers regarding COVID-19 testing Retrieved from <https://sharedsystems.dhsoha.state.or.us/DHSForms/Served/le2267.pdf>

- Peto, J. (2020). Covid-19 mass testing facilities could end the epidemic rapidly. *BMJ (Clinical research ed.)*, 368, m1163-m1163. doi:<https://dx.doi.org/10.1136/bmj.m1163>
- Public Health Agency of Canada. (2020, 2020 April 20). People who are at high risk for severe illness from COVID-19. Retrieved from <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/people-high-risk-for-severe-illness-covid-19.html>
- Qian, G., Yang, N., Ma, A. H. Y., Wang, L., Li, G., Chen, X., & Chen, X. (2020). A COVID-19 Transmission within a family cluster by presymptomatic infectors in China. *Clin. infect. dis.*
- Regional Geriatric Program of Toronto. (2020, 2020 April 2). COVID-19 in Older Adults Retrieved from <https://www.rgptoronto.ca/wp-content/uploads/2020/04/COVID-19-Presentations-in-Frail-Older-Adults-U-of-C-and-U-fo-T.pdf>
- Rothe, C., Schunk, M., Sothmann, P., Bretzel, G., Froeschl, G., Wallrauch, C., . . . Hoelscher, M. (2020). Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *The New England journal of medicine*, 382(10), 970-971. doi:<https://dx.doi.org/10.1056/NEJMc2001468>
- Roxby, A. C., Greninger, A. L., Hatfield, K. M., Lynch, J. B., Dellit, T. H., James, A., . . . Neme, S. (2020). Detection of SARS-CoV-2 Among Residents and Staff Members of an Independent and Assisted Living Community for Older Adults - Seattle, Washington, 2020. *MMWR Morb Mortal Wkly Rep*. doi:10.15585/mmwr.mm6914e2
- Sante Montreal. (2020, 2020 April 21). Information and recommendations for Montrealers. Retrieved from <https://santemontreal.qc.ca/en/public/coronavirus-covid-19/#c37517>
- Sky News. (2020, 2020 February 12). UK coronavirus 'superspreader' says his thoughts are with those infected. Retrieved from <https://news.sky.com/story/identity-of-man-linked-to-11-british-coronavirus-cases-revealed-11931336>
- Smith, A. (2020, 2020 April 25). Union calls for Kenny to bring in more protection for front-line food workers. Retrieved from <https://calgaryherald.com/news/local-news/union-calls-on-alberta-government-to-implement-greater-protections-for-front-line-food-workers/>
- Stavrinou, R. (2020, 2020 April 22). Coronavirus hits Greek migrant hotel, infects 150. Retrieved from <https://www.neweurope.eu/article/coronavirus-hits-greek-migrant-hotel-infects-150/>
- Sutton, D., Fuchs, K., D'Alton, M., & Goffman, D. (2020). Universal Screening for SARS-CoV-2 in Women Admitted for Delivery. *N Engl J Med*. doi:10.1056/NEJMc2009316
- Tay, H. S., & Harwood, R. (2020). Atypical presentation of COVID-19 in a frail older person. *Age and Ageing*. doi:10.1093/ageing/afaa068
- Tong, Z.-D., Tang, A., Li, K.-F., Li, P., Wang, H.-L., Yi, J.-P., . . . Yan, J.-B. (2020). Potential Presymptomatic Transmission of SARS-CoV-2, Zhejiang Province, China, 2020. *Emerg Infect Dis*, 26(5), 1052-1054.
- Wakefield, J. (2020, 2020 April 24). COVID-19 has — so far — been kept out of Alberta jails and prisons. Retrieved from <https://theprovince.com/news/crime/covid-19-has-so-far-been-kept-out-of-alberta-jails-and-prisons/wcm/2e5a6bec-1682-47b3-be8e-4308eed0a040>
- Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., . . . Peng, Z. (2020). Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *Jama*. doi:10.1001/jama.2020.1585
- Wei, W., Li Z, Chiew CJ, Yong SE, Toh MP, & Lee VJ, . (2020, 2020 April 10). Presymptomatic Transmission of SARS-CoV-2 — Singapore, January 23–March 16, 2020. Retrieved from <https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm#suggestedcitation>
- Wölfel, R., Corman, V. M., Guggemos, W., Seilmaier, M., Zange, S., Müller, M. A., . . . Wendtner, C. (2020). Virological assessment of hospitalized patients with COVID-2019. *Nature*. doi:10.1038/s41586-020-2196-x

- World Health Organization (WHO). (2020, 2020 March 15). Preparedness, prevention and control of COVID-19 in prisons and other places of detention: Interim guidance. Retrieved from http://www.euro.who.int/_data/assets/pdf_file/0019/434026/Preparedness-prevention-and-control-of-COVID-19-in-prisons.pdf
- Ye, F., Xu, S., Rong, Z., Xu, R., Liu, X., Deng, P., . . . Xu, X. (2020). Delivery of infection from asymptomatic carriers of COVID-19 in a familial cluster. *Int J Infect Dis*. doi:10.1016/j.ijid.2020.03.042