Resumption of Pulmonary Function Testing during the COVID-19 Pandemic

A Position Statement from the Canadian Thoracic Society and the Canadian Society of Respiratory Therapists

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As we progress towards an endemic phase of the COVID-19 pandemic there is a need to re-evaluate which pandemic precautions should be maintained for performance of pulmonary function tests (PFT). Specifically, how should risk be mitigated for patients and health care workers as the dynamics of viral transmission evolve over time. This third update of the Resumption of PFTs in the era of COVID-19 presents the current evidence to support performance of PFT in dedicated laboratories and in primary care settings across Canada.

Throughout the pandemic, health care workers have been at increased risk of exposure to SARS-CoV-2.(1, 2) Conversely, within Canada, there have been no reported cases of SARS-CoV-2 transmission in a PFT laboratory. This likely reflects the cautious approach applied by most PFT laboratories, and that performing PFTs has been mainly limited to well ventilated spaces with high air exchange rates (AERs).

With nearly ~75% of the Canadian population now fully vaccinated against SARS- CoV-2,(3) the risk of COVID-19 in healthcare settings,(4, 5) as well as in the general population is reduced, but not eliminated. Vaccination is most effective at reducing severe illness and death, not virus transmission, but the duration of protection is uncertain. Community spread of SARS- CoV-2 continues in Canada as does uncertainty with respect to future risk as novel variants of concern

emerge. Mandates for vaccination of health care workers vary across the country, and a large proportion of the population is still only partially vaccinated or unvaccinated (including children). Furthermore, there are patients (and health care workers) who remain at high risk of COVID-19 despite being fully vaccinated. The perception of risk varies between individuals and those who attend PFTs need to feel safe and reassured that the level of risk in a PFT laboratory is low and that precautions are being taken to keep them safe.

Acknowledging that the level of risk of COVID-19 in Canada still varies depending on regional and individual circumstances, this update emphasizes the hierarchy of controls that can help to reduce the risk of SARS- CoV-2 transmission in the PFT laboratory as well as when testing is performed in primary care settings. It is very likely that COVID-19 will become an endemic pathogen, therefore PFT laboratory protocols should be flexible such that they can be modified depending on the local level of transmission, vaccination rates or characteristics of any new variants of concern.(6, 7) Clear communication of local transmission rates and COVID-19 protocols is imperative to effectively implement necessary precautions. We emphasize ventilation as a key factor to reduce risk and recommend individual risk mitigation alongside the other controls such as screening and judicious use of appropriate personal protective equipment (PPE).

Ventilation

The opinion of multiple expert panels and reviews, including the Public Health Agency of Canada,(8) has concluded that SARS- CoV-2, and other respiratory viruses, can be transmitted by small aerosols ($\leq$5 μm), warranting airborne precautions.(9, 10) The Public Health Agency of Canada and the US Centers for Disease Control and Prevention (CDC)(11, 12) both advise for improved ventilation to reduce the risk of transmission. The American Society of Heating, Refrigerating and Air-Conditioning Engineers recommends a minimum of 6 AER per hour.(13) Within the context of performing PFTs, aerosol precautions are relevant regardless of whether PFTs are classified as aerosol generating medical procedures (AGMPs) or not.(14, 15) Several studies have recently measured the aerosols generated during PFTs. There is some evidence that the actual PFT maneuver (with inline filter) does not produce more aerosols than breathing/speaking,(16, 17) whereas other studies demonstrate PFTs do generate a greater number of aerosols than tidal breathing and speaking.(18, 19) Importantly these studies confirm that coughing produces more aerosols than tidal breathing. Since approximately 50% of people will cough during/after a PFT(20) the likelihood that aerosols are generated in a PFT laboratory is high. Therefore, the risk posed by PFTs occurs in the period immediately during and after a maneuver when the unmasked patient may cough. A suggested mitigation strategy made by the British Thoracic Society, alongside ventilation, screening and appropriate PPE, is to ask patients who are able to, to immediately replace their masks and to cough directly into their mask/tissue.(21)

Maintaining adequate ventilation is an effective way to reduce aerosol transmission of SARS-CoV-2.(9-12) The use of HEPA filters may further reduce the risk of viral transmission. This precaution is especially relevant when PFTs are conducted in the primary care setting or independent laboratory settings, when AER are not known or when adequate ventilation cannot be assured. Where possible, laboratory staff should consult with building engineers and local infection prevention and control to determine appropriate protocols and policies to ensure

adequate ventilation. AER should be re-checked whenever there are significant changes to ventilation systems. These measures are not only relevant to reduce transmission of SARS-CoV-2 but may also help to reduce the transmission of other pathogens.(9)

The ventilation efficiency within each facility should be used to determine adequate time between tests.(22, 23) Laboratories should have the AER measured by building engineering or can use portable CO_2 monitors to provide an estimate of ventilation efficiency.(24-26) The tables provided by the CDC for both AER and ambient CO_2 can be used as a guide to determine local policies.(25) Physical distance between the technician and patient should be maintained as much as possible. Many institutions and businesses have installed plexi-glass to provide a physical barrier between individuals. This barrier primarily helps to prevent transmission from droplets; however, given the increased risk of aerosol transmission, plexi-glass barriers may be insufficient to prevent transmission and may actually impair effective room ventilation. Previous safeguards, such as the use of disposable bacterial/viral filters to prevent inter-patient transmission must continue to be employed.(27)

Assessing and Mitigating Risk

The level of risk may differ for each patient and health care professional, depending on the community, facility, technologist, and patient factors. Risk mitigation strategies at the individual level are encouraged (see Government of Canada - Table 1: Risk assessment and mitigation considerations by risk factor).(28) Vaccination status, rates of local community transmission and individual risk factors should all be considered to mitigate risk. Patient vaccination status will likely be a major determinant of the level of risk; however, the logistics of coordinating tests around individual vaccination status makes this an unreasonable solution. Relying on bacterial/viral filters alone while conducting PFTs has the potential to increase risk for the health care professional conducting the test, and subsequent patients attending the PFT laboratory. The use of surgical masks is the minimum level of protection required in this setting. With the ongoing uncertainty around SARS- CoV-2 transmission and variants of concerns, the use of N95 masks is still warranted in most circumstances when aerosols are generated.

In situations where there is an increased level or risk to either patient or the health care professional, individual point of care risk assessment should be conducted. If the level of risk is high, extra precautions such as leaving extra time between patients (or testing at end of day), testing in an isolated space (negative pressure room, or room with a higher AER), and/or the use of a higher level of PPE are recommended.(27)

Personal Protective Equipment

PPE is a critical part of infection prevention and control; however, PPE should be considered the last line of defence within a broader 'hierarchy of controls' framework. Since SARS- CoV-2 is likely transmitted by small aerosol particles, we continue to recommend that fit-tested N95 respirators be worn by health care professionals conducting PFTs. Given that there are no longer PPE shortages in Canada, there should be no barriers to accessing appropriate PPE, as needed.

There is limited evidence directly comparing N95 to surgical masks to prevent transmission of SARS- CoV-2.(29-31) A recent meta-analysis of 6 studies concluded there is insufficient data to definitively determine superiority of one type of mask.(29) Furthermore, most studies compare

N95 and surgical masks for protection against influenza and were not specific to SARS- CoV-2. A single centre study published in pre-print found FFP3 (N95 equivalent) masks provided 30-100% protection against SARS- CoV-2 acquisition on COVID-19 wards.(32) Conversely, an in-vitro study found that for low-risk settings, surgical masks and N95s provided similar protection.(33) In the majority of cases, where both health care workers and the patient are vaccinated and community transmission of SARS- CoV-2 is low, gown, glove, face shield, and properly worn surgical masks should be sufficient to protect both the PFT technologist and patient.(33) Aerosol precautions, including N95 masks, must be taken when mandated by local authorities, or in communities with community spread of SARS- CoV-2 transmission. All health care workers should be permitted to make individual point of care risk assessments and ought to be provided appropriate PPE (including N95 respirators and eye protection) if the perceived level of risk is high. For some PFTs, nebulized treatments such as methacholine challenges, and CPET without a filter in-situ should be considered high risk procedures and aerosol precautions (such as N95 masks and longer intervals between tests) should be taken irrespective of vaccination status or level of community virus transmission.

Screening and Testing

For the duration of the pandemic, screening protocols prior to an appointment, at entry into a facility and in the PFT laboratory have been in place. However, we note that these screening protocols are not very effective as a large proportion of transmission occurs in asymptomatic individuals. Symptomatic and COVID-19 positive patients have arrived for PFT appointments, despite screening protocols. Furthermore, COVID-19 symptoms have changed with each variant making it more challenging to effectively conduct screening. The requirement for patients to have a negative PCR COVID-19 test prior to their PFT appointment may be an unnecessary barrier to people who require pulmonary function testing. Nonetheless, screening for acute respiratory symptoms, documenting vaccination status, and individual level of risk (i.e., immune-compromised patients) is important and could be included on PFT requisitions to help mitigate risk.

Prioritization and Testing Backlogs

As many laboratories continue to experience high volumes of testing backlogs, patients should continue to be prioritized such that those with urgent or immediate need for PFTs are tested promptly.(34) Medical directors of PFT laboratories will continue to play an important role in helping to prioritize patients, and to liaise with referring physicians to better understand the urgency of individual cases.

Should Canada experience additional waves of SARS- CoV-2 infections, or other emerging pathogens, it will again be necessary to carefully prioritize patients for PFTs. The current backlog of PFTs presents an opportunity to advocate, at all levels of government, for the need for expanded access to PFT laboratories for objective diagnosis of lung disease, to evaluate severity and for disease control.

Learner Participation

Competence in performing and/or interpreting PFTs is a requirement for training of health care professionals working in PFT laboratories. It is therefore important that learners who require

opportunities to refine their competencies relating to PFTs can safely do so in a supervised testing environment.

In the early stages of the pandemic, learner access to PFT laboratories was limited as educational programs and their clinical partners aimed to protect the learners, PFT laboratory staff, and patients, and to conserve PPE. As pulmonary function testing resume, questions about learner access to labs may occur.

The decision to permit learners to perform PFTs requires consideration of the perceived risk to the learner, laboratory staff and patients, and the educational needs of the learner. Educational programs should ensure competency in infection control practices prior to sending learners to a clinical environment. With respect to performing PFTs, appropriate infection control practices will be based on the local context (e.g., community transmission rates, local vaccination rates, and site environmental controls) as outlined in this document. Learners in the PFT laboratory must have access to and be properly fitted for appropriate PPE and adhere to infection control practices.

Conclusions

As we approach an endemic phase of the COVID-19 pandemic, there will be ongoing risks imposed by the SARS- CoV-2 virus. A return to pre-pandemic infection control practices in PFT testing will not provide acceptable risk mitigation, and it remains important to ensure ongoing adherence to the recommended hierarchy of controls, most notably appropriate room ventilation with adequate AER. Adaptations to PFT laboratory protocols due to the COVID-19 pandemic present an opportunity to update PFT laboratory protocols moving forward to provide ongoing risk mitigation for transmission of the SARS- CoV-2 virus and other emerging pathogens.

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