May 17, 2021

Dear Mr. Michael Swinwood, B.A., LL.B, Elders Without Borders,

This report constitutes my responses to the expert report that was prepared by Dr. Matthew Hodge, MD, PhD, on behalf of Her Majesty the Queen in Right of Ontario. It also contains my response to the query of how free I feel to speak on these matters.

Sincerely,

Dr. Byram W. Bridle, PhD
Associate Professor of Viral Immunology

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List of Abbreviations	
ACE2	angiotensin converting enzyme 2
COVID-19	coronavirus disease that emerged in 2019
Ct	cycle threshold
DNA	deoxyribonucleic acid
IFR	infection fatality rate
LAMP	loop-mediated isothermal amplification
NAT	nucleic acid test
NAAT	nucleic acid amplification test
PCR	polymerase chain reaction
RNA	ribonucleic acid
RT-PCR	reverse transcription - polymerase chain reaction
SARS-CoV-2	severe acute respiratory syndrome-coronavirus-2
TMA	transcription-mediated amplification
VOCs	variants of concern

1. Dr. Byram W. Bridle's Credentials and Role in the COVID-19 'Pandemic'

I am an Associate Professor of Viral Immunology in the Department of Pathobiology at the University of Guelph. My academic appointment as an independent researcher and faculty member began in January 2012. I received a MSc and PhD in immunology and completed a post-doctoral fellowship in viral immunology. My research program focuses on the development of vaccines to prevent infectious diseases and treat cancers, as well as studying host immune responses to viruses. I teach several courses at the undergraduate and graduate level on the topics of immunology, virology, and cancer biology. I am also involved in training Canada's next generation of multidisciplinary researchers, especially in vaccinology. With respect to the novel coronavirus disease that emerged in 2019[1] (COVID-19), which develops in a subset of individuals infected with severe acute respiratory syndrome-coronavirus-2[2] (SARS-CoV-2), I received funding from the Ontario government (COVID-19 Rapid Research Fund, Ministry of Colleges and Universities) and federal government (Pandemic Response Challenge Program, National Research Council of Canada) to develop vaccines against COVID-19. I also hold numerous grants in support of my cancer research and basic viral immunology research programs, including but not limited to, the following sources: Canadian Institutes for Health Research, Natural Sciences and Engineering Research Council of Canada, Canadian Cancer Society, and Cancer Research Society. Since the COVID-19 pandemic was declared I have been actively involved in the public dissemination of fact-based, balanced scientific information to assist people with making fully informed decisions. This has included ~150 media engagements ranging from radio shows, published articles, and appearances on televised news programs spanning the local to international scope. I was also an invited keynote speaker for two international conferences that focused on COVID-19 and served as an invited member of several COVID-19-focused discussion panels. Additional qualifications can be found in my curriculum vitae that was attached to my first report.

2. A Notable Development Since Dr. Bridle's Initial Expert Report was Submitted

The problem of COVID-19 sits at the interface of immunology and virology, both in terms of the disease pathogenesis and the primary solution being sought, which is acquisition of immunity by most Ontarians. Indeed, one of the ways to achieve immunity is via vaccination. Notably, vaccinology is a sub-discipline of immunology. Remarkably, however, very little to no consultation of immunologists has or is being conducted by epidemiologists when they run their predictive models. Indeed, Dr. Hodge has admitted on page 3 of their report "the need to make decisions with imperfect information". Epidemiological models are only as accurate as the information that is plugged into them and the average epidemiologist that has been conducting the modeling of COVID-19 in Canada has only most superficial understanding of immunology. Mistakes such as failing to acquire accurate data regarding the natural acquisition of immunity to SARS-CoV-2 and underestimating the duration of immunity by misinterpreting the waning of spike protein-specific antibodies in circulation as a sign that memory B cells are no longer present, have likely contributed to the failure of epidemiological models in Canada to accurately predict outcomes. Quantifiable outcomes such as numbers of cases of COVID-19 and associated deaths have typically been vastly overestimated. I have acquired a reputation for bluntly answering questions about COVID-19 based purely on the ever-accumulating scientific facts. Consequently, I am now inundated on an almost daily basis with queries from people within Ontario, the rest of Canada, and even around the world. Many of these individuals have indicated that they are desperate to talk to someone that they perceive to be willing to speak plainly and truthfully to them. Sadly, this issue has become overwhelming for me since what I would term Canada's "AstraZeneca COVID-19 vaccine fiasco"; I can no longer respond

to each individual query. The "fiasco" being referred to is this: Health Canada provided emergency use authorization for AstraZeneca's COVID-19 vaccine, despite published data showing that its overall effectiveness was lower than Pfizer's and Moderna's vaccines that had already been approved for emergency use. AstraZeneca's vaccine was also shown to be only 10% effective against the South African variant, with the cut-off for approval being 50%. It also proved to be less effective in a head-to-head comparison with Pfizer's vaccine[3]. At the time that Canada started to roll out the AstraZeneca vaccine, its use had been suspended in at least twelve European countries until undesirable potential side-effects could be investigated. Indeed, after relying on these other countries to perform a proper safety assessment, public health officials in Canada had to admit there was a link to rare but potentially fatal blood clots. On this basis the AstraZeneca vaccine was deemed too dangerous to administer to Canadians under the age of 55. The public health messaging at that point was that the vaccine was suitable for Canadians over the age of 55. In addition to them being in a higher risk demographic, it was claimed there were no indications of blood clotting issues for older people. Of course, the reason for this is that the relatively few countries that approved the AstraZeneca vaccine, like Canada, had wisely decided not to give their highest risk demographic their worst-performing vaccine. As such, it was not a matter of the AstraZeneca vaccine not having a risk of causing blood clots in older people, it simply hadn't been studied. A lack of data on adverse events is not the same as having proven the safety of the vaccine. Most recently, after several Canadians died from the AstraZeneca vaccine, it was removed from Canada's COVID-19 vaccine repertoire due to the ever-growing safety concerns. Approximately 250,000 Ontarians have now been left with having received a single dose of the AstraZeneca vaccine, with no clear guidance of what to do moving forward. This was a blatantly obvious example that, after more than one-year, public health officials in Canada continue to struggle with the management of the pandemic, especially as it applies to issues related to immunology. The fear, anger, and distrust in public health messaging caused by Canada's 'AstraZeneca vaccine fiasco' has been profound, especially in Ontario, where the greatest number of Canadians have been left only partially vaccinated. Notably, one of the most revealing issues that emerged from the public health messaging surrounding the use of the AstraZeneca vaccine in Canada was an admittance that the risk of COVID-19 to most Canadians is exceptionally low, especially for those under the age of 55. Although this was not explicitly stated, it was indirectly confirmed by Health Canada. The basis for this is the fundamental premise in medicine that one never applies a treatment for a disease if the risks associated with the former exceeds the risks associated with the latter. Indeed, Canadians were told by Health Canada that the severe adverse events associated with AstraZeneca's COVID-19 vaccine were "very rare"[4]. So, the fact the vaccine was recalled because it was deemed to be too risky for use in Canadians means the risk to Canadians from COVID-19 is something less than 'very rare'.

3. An Oppressive Environment for Disseminating Balanced Scientific Information

In preparing this report I was asked to ponder the question of how free I have been made to feel to disseminate frank, science-based assessments of COVID-19 policies imposed by the government of Ontario. This is a critical question since freedom of speech and engagement in respectful scientific debates are supposed to be hallmarks of democracies. Unfortunately, I have experienced some substantial intimidation over the past year while attempting, as a public servant, to address questions posed to me by the media, other scientists, physicians and other health care professionals, and members of the lay public. I will provide two examples here. In doing so, it is important to note that I do not feel comfortable naming the two individuals at the heart of these incidents for fear of potential reprisals that could have a negative impact on the remainder of my professional career. I understand this may be construed,

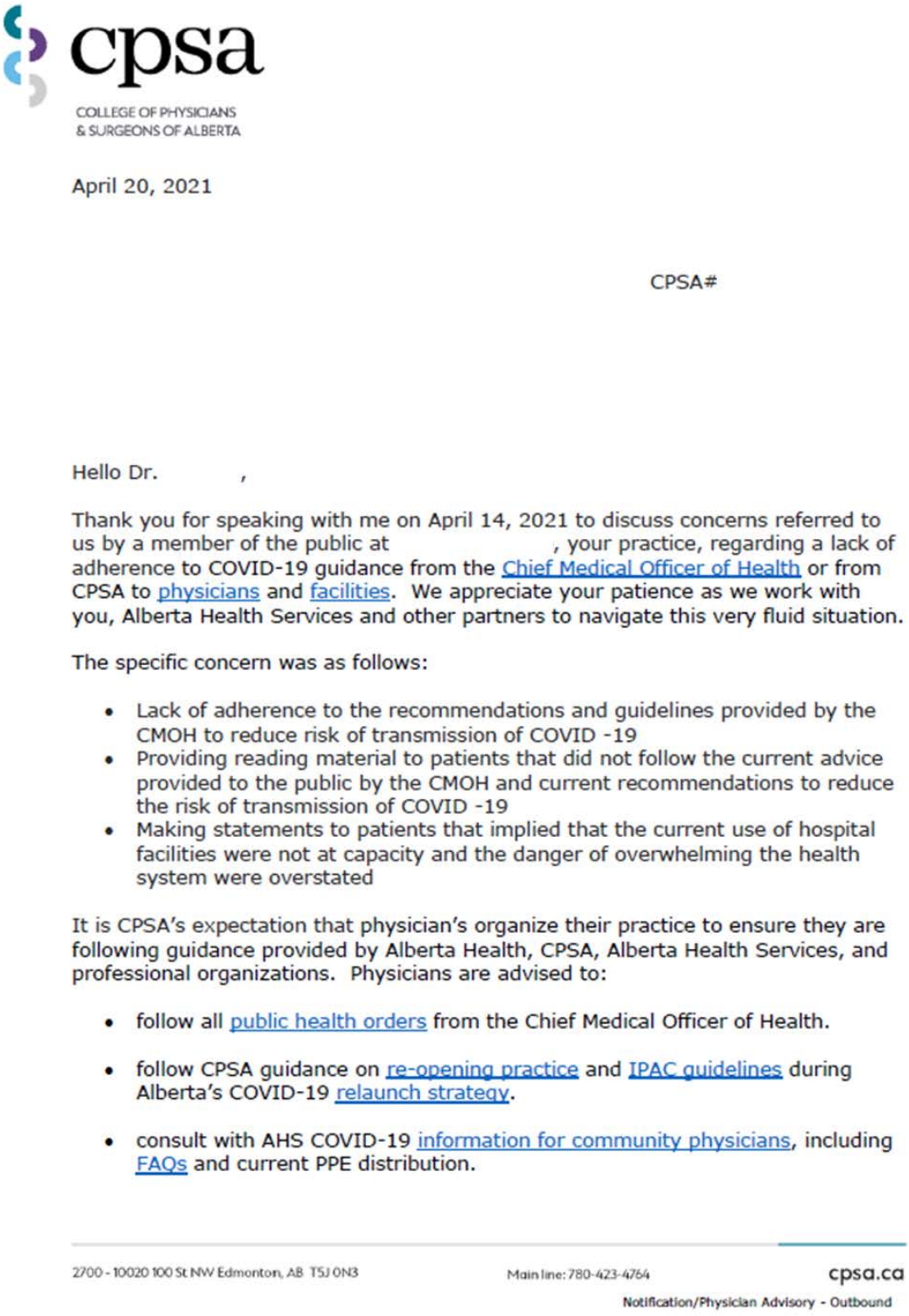
therefore, as circumstantial evidence. However, I recognize that I am providing this information under oath and am stating that I am telling the truth, the whole truth, and nothing but the truth. Incident #1: a senior member of the administration of my university held a 30-minute on-line meeting in which I was berated for the duration in front of two of my colleagues. I was told that my media engagements were being monitored and it was recommended that I consider withdrawing from some of these activities and think about the impact of my statements in the context of the public health narrative that has dominated the COVID-19 pandemic. Incident #2: in a recent on-line department meeting at my university, I was told to be very careful about my public messaging by a senior colleague in front of all my faculty colleagues, including my Chair, the staff and graduate student representatives, and the Dean of my college who was a guest. Both these incidents, especially the first, made me feel like the tenets of academic freedom and freedom of speech had been deliberately crushed. Indeed, these tenets were critical factors in my career choice. This type of intimidation has caused excessive stress, including making me lose many hours of sleep. For a while afterwards, I was even second-guessing some of my messaging during media interviews, wondering if senior members of my administration would approve or disapprove. With this said, I do think it is important to point out that, for the most part, my institution has been supportive of allowing me to exercise academic freedom. Specifically, my department Chair, college Dean, and university President and Provost, have all clearly stated support of my right to academic freedom. Unfortunately, I have seen many other scientists, physicians and other regulated professionals feel uncomfortable to freely express their views about COVID-19 due to fear of reprisal. This instillation of fear to speak openly has recently been amplified by the release of a notice from the Ontario College of Physicians and Surgeons[5]. Among many fears that it has instilled, is a fear to provide balanced fact-based information to patients about COVID-19 vaccines. For example, many physicians and surgeons now feel uncomfortable relaying information about emerging safety concerns surrounding the vaccines for fear that it may be misconstrued by the Ontario College of Physicians and Surgeons as promoting anti-vaxxer sentiments. This is in direct contradiction of the commitment and requirement to obtain fully informed consent prior to the administration of an experimental vaccine. Personally, I am in a somewhat privileged position to speak openly about COVID-19 because I am a tenured faculty member at an academic institution. However, as already stated, I was not spared from intimidation. Indeed, my fears include the potential for reprisals from colleagues and/or administrators who have some control over the publication of scientific manuscripts and/or the awarding of research funding. My research program depends on my ability to secure grants and publish results. Notably, much of the scientific review process is performed with relative anonymity. The bullying of expert professionals in Canada is being noticed by the public[6]. With free-speakers among the expert scientific and medical community largely limited to professors with tenure and retired physicians, who feel very uncomfortable themselves, the pool experts that are available to challenge the current public health narrative is extremely limited. My concern is that this is causing intimidation of potential witnesses and could prejudice any legal proceedings related to COVID-19. I meet weekly with a group that has grown to approximately 50 scientists, physicians and other health professions across Canada to discuss issues related to COVID-19. This group recently formed, and its membership is growing quickly. I have heard many stories from members of this group about them feeling frightened to express opinions about COVID-19-related health policies. Indeed, me and only two other colleagues have agreed to serve as the 'voices and faces' of this group when it is organized enough to begin disseminating balanced scientific information to the public. Sadly, most of the membership feel it is essential that they shield themselves from the public eye to avoid reprisals. Although it was done at very short notice, to demonstrate that the extent of this problem extends beyond myself, I received the following comments from colleagues across Canada:

"*With respect to intimidation or suppression, I have been lucky. The main incidence I can think of related to a University of British Columbia Senate Meeting. As a senator, during a meeting earlier this year when the University was contemplating having face-to-face class again in September 2021, I applauded the intent of the senior administration for taking this action, and described the very low risk that this posed to our students and staff. After the meeting, I was notified by the Dean of Graduate and Post-doctoral Studies, Dr. Susan Porter, by e-mail that I should not have said what I had, and that I might be violating scholastic integrity in the university by mentioning work that was unpublished and not peer-reviewed (the work was accepted and published in JCI Insights about 2 weeks later). She contacted the clerk that recorded the minutes of the Senate Meeting and asked by my remarks be struck from the public record. This was done, but I did not make a point of disputing this, since my comments had been heard already by the full Senate*."
Dr. Stephen Pelech, Professor of Neurology, Department of Medicine, University of British Columbia

"*I had posted something on my Facebook page only urging people to do their own research and questions things to make the decision that is best for them. It went to my dept. head then the chief of staff wrote a letter to our Dept. Basically telling us to keep in line. I've also been spoken to as was reported to our chief of staff (he said off the record) but he told me in no uncertain terms to not speak of anything against public health at work otherwise he would have to let the college look into it.*"
An anonymous anesthesiologist (for fear of reprisals)

Please see figure 1 on the next three pages for a letter that intimidated another colleague…

Figure 1: A three-page letter sent to a physician colleague from their licensing body. The physician requested anonymity for fear of reprisals.



cpsa

COLLEGE OF PHYSICIANS
& SURGEONS OF ALBERTA

April 20, 2021

CPSA#

Hello Dr. ,

Thank you for speaking with me on April 14, 2021 to discuss concerns referred to us by a member of the public at , your practice, regarding a lack of adherence to COVID-19 guidance from the Chief Medical Officer of Health or from CPSA to physicians and facilities. We appreciate your patience as we work with you, Alberta Health Services and other partners to navigate this very fluid situation.

The specific concern was as follows:

- Lack of adherence to the recommendations and guidelines provided by the CMOH to reduce risk of transmission of COVID -19
- Providing reading material to patients that did not follow the current advice provided to the public by the CMOH and current recommendations to reduce the risk of transmission of COVID -19
- Making statements to patients that implied that the current use of hospital facilities were not at capacity and the danger of overwhelming the health system were overstated

It is CPSA's expectation that physician's organize their practice to ensure they are following guidance provided by Alberta Health, CPSA, Alberta Health Services, and professional organizations. Physicians are advised to:

- follow all public health orders from the Chief Medical Officer of Health.
- follow CPSA guidance on re-opening practice and IPAC guidelines during Alberta's COVID-19 relaunch strategy.
- consult with AHS COVID-19 information for community physicians, including FAQs and current PPE distribution.

2700 - 10020 100 St NW Edmonton, AB T5J 0N3 Main line: 780-423-4764 cpsa.ca

Notification/Physician Advisory - Outbound

Figure 1 (continued):

- consult with other CPSA resources for physicians and facilities during COVID-19, including advice on virtual care.

Safety is a priority for everyone and we must all take action to decrease risk of exposure to COVID-19, to patients and staff alike. We ask that you modify your practice to ensure you meet current guidelines during this dynamic situation. In follow-up to your conversation with CPSA, we have noted the following in regards to the original concerns:

- you have indicated that your practice is following all the recommendations and guidelines provided by the CMOH, CPSA and AHS, including screening, appropriate distancing, use of masks when providing direct patient care, hand sanitizer availability, plexiglass to protect staff and patients, use of telephone visits to minimize in person visits where possible and appropriate cleaning processes
- you have purchased an air purifier to help ensure safety for your staff and patients
- you have provided patients with information regarding the effectiveness of masks in reducing the risk of transmission of COVID 19 as well as the potential risks of long term use of masks
- it was your intention to provide information to allow patients to make informed decisions about the effectiveness and safety of this public health measure
- it was not your intention to increase patient anxieties or fears by providing this information
- you did not intentionally encourage patients to act contrary to the current public health orders
- you have indicated that your personal experience with patients who have contracted COVID 19 is limited and may have influenced your perception of the significance of the pandemic
- your practice focuses on a holistic approach to patient medical concerns with an emphasis on lifestyle choices to enhance personal health and improve immune responses
- it is our expectation that physicians will not make comments or provide advice to encourage the public to act contrary to public health orders and recommendations
- we expect physicians to be guided by the laws, code of ethics and professional conduct, or regulatory standards when offering these opinions
- you have indicated that it was not your intention to not comply with this expectation
- as we discussed, in this time of uncertainty it is possible that patients may be suffering from an information overload and find information that jeopardizes their sense of safety to be very distressing
- you may wish to consider how such information is provided and if it is in the best interest of the patient to be presented with further uncertainty and inconsistencies
- you have indicated that you will provide me with the information you have provided to patients and I look forward to receiving this information

Figure 1 (continued):

- I have forwarded you several links that talk about the effectiveness and safety of masking that may be helpful to you going forward

We recognize this is an extremely difficult time for patients and physicians. It is uncertain how the next several months will unfold. If you need any support, please do not hesitate to contact us. We are here to answer questions and support you in navigating through these complex times.

Please be aware that failure to comply with direction from the Chief Medical Officer of Health will be referred to CPSA's Complaints Director for the consideration of a formal investigation of conduct.

Best regards,

X mwickland-weller

Dr. Monica Wickland-Weller, MD
Senior Medical Advisor
Signed by: Monica Wickland-Weller

MWW/ml

Please see the two-page letter in figure 2 from another colleague.

Figure 2: letter regarding intimidation during the COVID-19 pandemic.

May 17, 2021

To whom it may concern –

As Professor of Immunology in the province of Ontario for the last 30 years I can tell you with confidence that this last year in Canada has been nothing more than a political pandemic where intimidation, misinformation and shaming have been prominent.

My area of expertise lies at the interface of immunology and genetics. I have won numerous awards for my research in this area including the Governor General's Award for Innovation in 2017, and a prestigious NSERC prize that will be announced later this year. I will be the first Canadian ever to be given both of these awards.

I hold numerous patents, including one early in my career for a vaccine against pleuropneumonia in swine. I clearly see the value of vaccination and am a strong supporter of safe vaccination programs once all clinical trials are completed and independently reviewed. My research over the years has focused on various animals species which is highly relevant to this pandemic and others which generally arise from animal reservoirs.

Additionally, I have been teaching immunology at the graduate and undergraduate level for the past 30 years, and am fully aware of all angles of this discipline, including the human immune system. One of the topics that I cover each year is immunity to infectious disease which is highly pertinent to covid-19.

The published peer-reviewed data are clear that the vast majority of Canadians recover from covid-19 with immunity. Very rarely do individuals get covid-19 twice. It is a small group of elderly and those with co-morbidities that are at the highest risk, and unfortunately their situation has been poorly handled. There have been fewer than 10 deaths of anyone under 20 in the country since the beginning of the pandemic yet schools and universities have been essentially shut down. This has resulted in undo mental stress and abuse. When the enacted solutions are worse than the pandemic problem the country is headed in the wrong direction.

Covid-19 cases have been reported based on PCR tests run at high thresholds without any clinical data to support the diagnosis. While caseloads appeared to be increasing (largely due to increased testing) the death rates have decreased with each successive wave. In fact, peer reviewed literature has shown that 90% of those living in the Vancouver area have antibody to SARS-CoV-2 suggesting herd immunity is much higher than expected or is being communicated to the Canadian public. Unfortunately, since antibody has not been monitored across Canada these data are not available in other regions but are likely to be similar. Recommendations to back up the PCR with clinical observations, and to test antibody as an indicator of immunity were recommended to the government and the health authorities. These recommendations were ignored.

Several colleagues and I also recommended that the use of the AZ vaccine be suspended many months ago. This too was strangely ignored. We now feel the impact of that on Canadians. This recommendation should have been made known to the public.

It is now clear that outdoor transmission estimates were also erroneous with current estimate at between 0.1-1 percent and not 10% as first reported by the CDC. Asymptomatic transmission is also known to be rare.

These kind of mistakes and misinformation have caused Canadians to be locked in their homes and restricted in their movements for the last 15 months.

When physicians and credible scientists, including myself, have written to the Premiers and their CMOH, our words were ignored. Often times we received no response whatsoever, but we know they received the information since I was informed of that from my local MPs. When we tried to get the mainstream press, including CBC and CTV to let the Canadian public know that a team of doctors and professors had invited the Premier of Ontario, to an open forum discussion to help move Canada safely and effectively out of the pandemic that too was ignored. The same occurred in the provinces of Alberta and Saskatchewan.

I personally have a mask exemption and yet my picture appeared on the front of a local newspaper (Guelph Today), saying that "anti-maskers dare to show their face" at a council meeting. Since when are citizens to be shamed and humiliated for attending a local council meeting, to which they were invited? I even showed my mask exemption before being admitted into the meeting. To further add to the problem, the photo in Guelph Today, was picked up on the university Facebook page where I was again criticised for not wearing a mask. Yet, not one person asked me if I had a mask exemption. I rarely go out now because without a mask a person is frowned upon, pointed at and ridiculed, even though there is no definitive proof that masks significantly prevent the spread of the virus, particularly not the various kinds of facemasks worn by the public. This is intimidation and prejudice against the group unable to wear masks.

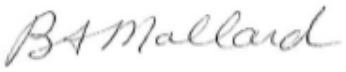
Following this incidence, I was then contacted by a certain corporation (which shall remain anonymous) telling me not to let my picture appear without a mask again in public since it might negatively impact their business to have a university professor without a mask. This was clear intimidation.

I have also been told by certain other faculty members to only speak the government/public health narrative, and that it would only cause chaos to let the public know about my concerns about the information provided to the public on covid-19. I think Canadians are smart enough to judge the information for themselves and have a right to hear all points of view that can be backed up by facts.

I think the Canadian public will be dismayed when it comes to light that there were safe and effective treatments, including ivermectin, which should have been used to treat and prevent covid-19. What happened to the old adage, "Do no harm".

These ongoing issues have created an extremely oppressive environment where open debate about critical issues relating to SARS-Cov-2 have been stifled.

Sincerely,



Dr. Bonnie Mallard
Professor of Immunogenetics

4. Rebuttal to Dr. Hodge's Report

Dr. Hodge's report failed to rebut a single point in my original report. As such, it is assumed that the scientific arguments made in that report were deemed to be sound. As such, my rebuttal is limited to the general responses made in Dr. Hodge's report. It was noted that much of the opining in the report from Dr. Hodge was not backed up with peer-reviewed published scientific data. For example, sections 7, 12, 14, 16, 19-21, second section #20, and sections 23-27 and 29 did not contain a single citation. Nonetheless, my responses follow:

5. Errors in Terminology that Confounded Interpretations

Section 1, page 2: "*My work there includes caring for dozens, if not hundreds, of people with **COVID-19 infections** over the past thirteen months.*" It is important to note that COVID-19 is not a source of infections. COVID-19 is an atypical pneumonia that occurs in a subset of people that have been infected with SARS-CoV-2. In other words, SARS-CoV-2 can potentially cause infections, which sometimes translates into the disease known as "COVID-19". Many hospitalized patients in Ontario have tested positive for the presence of genomic material from SARS-CoV-2 using the PCR test (see my initial report for a full explanation of why this test is inherently flawed and does not represent the 'gold standard' virology assay). Not all of them have required treatment for COVID-19. Examples of why this may have been the case include scenarios like hospitalization for other reasons with a positive PCR test in the absence of severe disease being secondary, being admitted to a hospital out of an abundance of precaution but with the patient failing to progress from mild or moderate to severe COVID-19, etc. As such, it is unknown how many of Dr. Hodge's patients had COVID-19 and how many merely had evidence of partial SARS-CoV-2 genomes by the PCR test. Unfortunately, this misunderstanding in medical terminology also raises questions about subsequent opining on cases of disease versus potentially positive test results that might be indicative of infection. Indeed, the term "COVID-19 infection" is used throughout the report. To reiterate, SARS-CoV-2 is the virus that has the potential to infect an individual; COVID-19 is a disease that develops in a subset of people that have been infected with SARS-CoV-2. As such, when "COVID-19 infection" is used, it is impossible to discern whether this refers to people that received diagnoses of COVID-19 based on a positive PCR test result plus confirmation by a physician of the presence of signs and/or symptoms indicative of COVID-19, whether it refers to a positive PCR test result only, which in and of itself is not indicative of COVID-19, or something in between. To better understand why medical terminology as it relates to infectious diseases must be used with clarity, one must understand how testing for the presence of SARS-CoV-2 is being done in Canada and how the results are being (mis-)interpreted.

A common way to detect the presence of a virus in a clinical sample is to use what is called a nucleic acid test (NAT). These kinds of tests work by detecting the presence of the genetic material (*i.e.* genome) of the virus. Indeed, viral genomes are composed of building blocks known as nucleic acids. Commonly used NATs fall under the umbrella term 'nucleic acid amplification tests' (NAATs). These tests incorporate a step that amplifies or increases the amount of the virus-derived genetic material, thereby making it easier to detect. There are different kinds of NAATs, including but not limited to 'reverse transcription - polymerase chain reaction' (RT-PCR), 'transcription-mediated amplification' (TMA), and 'loop-mediated isothermal amplification' (LAMP). However, since RT-PCR is the most common method being used in laboratory-based testing during the pandemic, that will be the focus of this discussion.

A specific form of PCR is most prevalent for detecting SARS-CoV-2. It is known as 'real-time RT-PCR'. A real-time PCR is also known as a quantitative PCR and it monitors the amplification of a targeted piece of genetic material. Importantly, it can, in theory, provide information about the relative amount of virus-derived genetic material that was present in a sample (*i.e.* few versus many viral particles).

A PCR test is designed to detect genetic material made of deoxyribonucleic acid (DNA). However, the genome of SARS-CoV-2 is made of ribonucleic acid (RNA). As such, the PCR test cannot be performed until a reverse transcription step is performed, which copies the genetic code of the viral RNA into DNA, which is much more stable than RNA. The PCR can then be performed, which involves using what are called 'primers' that are designed to bind to unique sequences that are present in a viral genome. The primers are short pieces of DNA that are designed to bind at either end of a segment of the viral genome. If the primers bind, a molecule known as a 'polymerase' will use the viral genome as a template to extend the primers until the target gene segment has been completely copied. This works by varying the temperature of the sample. A high temperature is used to get double-stranded DNA to separate into single strands. Next, an 'annealing' temperature is used to allow the primers to bind to the single strands of DNA. Finally, a third temperature is used to promote 'extension' of the primers until the targeted gene sequence has been copied. This constitutes a single cycle of the test. Multiple cycles are employed to increase the copies of the targeted gene segment exponentially. A fluorescent dye is usually added to the sample that incorporates into the targeted gene segment. If enough gene segments get amplified, a special machine can detect the amount of the fluorescent dye. The amount of dye usually correlates with the number of viral genomes in the clinical specimen. An important piece of information derived from the RT-PCR test is the 'cycle threshold' (Ct) value. The Ct value is the number of cycles that the test had to be run for the fluorescent signal to exceed background levels.

There are many steps involved in the optimization of RT-PCR tests before they can be used. If properly designed, a good-quality PCR test can be sensitive enough to detect very small quantities of viral genetic material. However, when it comes to RT-PCR testing for SARS-CoV-2, caution must be exercised when interpreting results. Importantly, poorly optimized RT-PCR tests can have high background signals. Further, the greater the number of cycles used in a RT-PCR assay, the greater the chance of erroneous non-specific amplification of non-targeted genetic material. The National Collaborating Centre for Infectious Diseases in Canada published the general guide for interpreting results of RT-PCR tests for SARS-CoV-2 shown in table 1[7].

Ct Value	Indication	Interpretation
<25	High levels of SARS-CoV-2 genomic load	Patients with higher SARS-CoV-2 genomic loads are more likely to develop severe outcomes and require intubation and severe outcomes. Patient needs to be monitored.
25-30	Moderate levels of SARS-CoV-2 genomic load	
>30	Low levels of SARS-CoV-2 genomic load	Low SARS-CoV-2 genomic load can be found early in infection when viral replication has just begun. Additionally, it can indicate the later phases of infection after the virus has been cleared and has left behind remnants of its genomic content. Interpretation requires clinical context.

Table 1: Guide to interpreting results of RT-PCR test results.
The Collaborating Centre for Infectious Diseases in Canada published the general guide for interpreting results of RT-PCR tests shown in this table. (https://nccid.ca/publications/understanding-rt-pcr-tests-and-results/)

In addition to the potential for false signals at high Ct values, note that high values can also be indicative of detection of non-viable viral particles. It is important to note that SARS-CoV-2 particles can exist in two basic forms: 1. Replication-competent; this is the form with the potential to cause COVID-19. 2. Replication incompetent; this cannot cause COVID-19. Following clearance of SARS-CoV-2 from the body, full and/or partial genomes of SARS-CoV-2 can remain for many days. One key reason for this is that some phagocytic cells, which are a component of the innate immune system, can be long-lived. The three primary phagocytic cells in the body are neutrophils, macrophages, and dendritic cells. Neutrophils are the 'first responders' of the immune system. They rapidly infiltrate sites of SARS-CoV-2 infection and begin to phagocytose (*i.e.* consume or internalize) SARS-Cov-2 particles. The neutrophils, which are short-lived, then recruit macrophages and dendritic cells to the site of infection. Note that dendritic cells also reside at strategic sites of infection where they can immediately begin to phagocytose SARS-CoV-2. The macrophages and dendritic cells are much larger than neutrophils and can phagocytose relatively large quantities of the virus and can be relatively long-lived. One of the reasons for this is because these two cell types are critical for activating T cells and B cells, which are the key effectors against viral infections. Phagocytosis of SARS-CoV-2 is a mechanism to kill and remove the virus from the body and to activate other immunological effector cells. As such, these can be a source of SARS-CoV-2 genomes that could be amplified by a RT-PCR test. However, these genomes would not have the potential to cause COVID-19. Persistence of whole or partial genomes that are not associated with infectious particles is well-documented for a variety of viruses, including measles[8], Middle East respiratory syndrome-coronavirus[9], and other coronaviruses[10].

A very recent scientifically peer-reviewed article argued that a reasonable cut-off for cycle numbers for good-quality RT-PCR tests for SARS-CoV-2 is **thirty-four**[11]. However, most RT-PCR tests for SARS-CoV-2 exceed 34 cycles[12]. For example, Public Health Ontario runs the test at 40 cycles. Their definition of a negative result is if there was no fluorescent signal detected at the end of the full 40 cycles. Any signal detected at the end of 38 cycles is declared to be a positive case. Remarkably, if they detect the viral genome at 39 or 40 cycles, they define the result as a 'probable case' for public health reporting.

Jonathan Gubbay, a medical microbiologist with Public Health Ontario, has been quoted on their website as saying the following: "In Ontario, we use PCR as the gold standard of testing for COVID-19 because it is able to successfully detect tiny amounts of the virus (sensitivity) with a low chance for error (accuracy) compared to other types of lab tests."[13]. The problem is that PCR tests do not represent gold standard assays for determining if potentially infectious viruses are present. Instead, the gold standard assay for this is the inoculation of cultured cell lines and then looking for evidence of infection (*e.g.* cytopathic effect, which means killing of cells[14]. An *in vitro* biological assay like this can then be used to correlate Ct values with infectivity of SARS-CoV-2. However, this type of gold standard functional test has not actually been standardized to date in Canada. Interpreting the RT-PCR test is challenging, to say the least, without a functional test to compare it to. Of particular concern in the context of the high cycle numbers being used by labs such as those at Public Health Ontario (*i.e*. 40 cycles, with 38 being defined as 'positive'), is the fact that several studies have been conducted to determine the highest Ct value at which SARS-CoV-2 could be successfully cultured in cells. The results were 25[15], 26[16], 22-27[17], 30[18]. This suggests that tests with CT values above 22-30 are almost certainly not indicative of the presence of replication-competent SARS-CoV-2. The conclusion is that it is erroneous to declare samples with high Ct values, especially those above 30, as being positive for infectious SARS-CoV-2. It was even concluded in a study by La Scola B, *et al*., concluded that patients testing 'positive' with Ct values above

33-34 could likely be discharged from hospitals[19]. This means that a very large but unknown number of positive cases reported in Ontario were likely not true positives.

RT-PCR-based testing in Ontario is not standardized. Across the province labs use different sample preparation methods, protocols, and gene targets. Variability in CT values (up to 8 cycles). This has prompted Public Health Ontario to discourage the reporting of Ct values <35 alongside test results. Indeed, Ct values <35 are only available upon special request[13].

The types of specimens and the quality of their collection can Influence the results of RT-PCR tests. Public Health Ontario recommends this for sample collection for use with the RT-PCR assay: "The gold standard for sample collection method is the nasopharyngeal swab, a swab inserted deep into a person's nose. However, other sample types exist including combinations of a nose and throat swab and also saliva samples.".[13] This is of concern because the United States Centres for Disease Control and Prevention "does not recommend NAATs that use oral specimens (*e.g.,* saliva) for confirmatory testing and instead suggests the use of specimens that are considered optimal for detection, such as nasopharyngeal, nasal mid-turbinate, and anterior nasal swabs."[20].

It is important to note that the problems associated with laboratory-based RT-PCR assays for the detection of SARS-Cov-2 are likely worse for point-of-care tests that rely on similar technology. Indeed, the United States Centres for Disease Control and Prevention acknowledge that "Sensitivity varies by test, but laboratory-based NAATs generally have higher sensitivity than point-of-care tests or tests that can be used anywhere."[20]. Further, the United States Centres for Disease Control and Prevention and the United States Food and Drug Administration note the following limitations of RT-PCR tests for SRS-CoV-2: 1. The presence of viral RNA in the sample might not indicate the presence of infectious virus, 2. The presence of viral RNA does not necessarily imply that SARS-CoV-2 is the causative agent of COVID-19, 3. The test cannot rule out diseases caused by other bacterial or viral pathogens, 4. The test is not suitable for screening blood and blood products for the presence of SARS-CoV-2, 5. If the virus mutates in the predetermined target region, the test is invalid[21].

Conclusion: PCR testing, especially when done in the absence of referral to a physician, in the absence of the gold standard virology assay, and in the context of high Ct values (*i.e.* greater than 22-30 cycles), is an inaccurate way to diagnose cases of COVID-19. A substantial, but unknown number of cases of COVID-19 that have been reported in Ontario and throughout the rest of Canada were never true cases of disease.

6. Scientific Understanding of SARS-CoV-2 has Progressed but Public Health Polices have not Kept Pace in Key Areas

Section 7, page 3: "As a preliminary observation, my opinions are informed by… … the need to make decisions with imperfect information".

Response: This is an unsettling statement. Admittedly, when the COVID-19 pandemic was first declared, there were little scientific data available to inform decisions. However, the scientific understanding of SARS-CoV-2 and COVID-19 has been progressing for more than one year. Indeed, there has been an avalanche of information accumulating. However, the same strategies are repeatedly being applied to the problem. Canadians would likely feel more assured if they knew that public health officials were

replacing their assumptions with peer-reviewed, published scientific facts as they become available. Further, public health officials should be actively encouraging scientific studies to address every uncertainty that they have. In as much as it is possible, decisions should follow the science. Dr. Hodge, as an expert in epidemiology and biostatistics had an opportunity in their report to show Canadians the epidemiological model(s) being used to inform public health policies and to clearly delineate which data are being plugged into the model that are based on sound scientific data versus assumptions. Requests to view these models seem to go unanswered. Indeed, using Canada's COVID-19 vaccine rollout as another example, the National Advisory Council on Immunization published the 'scientific' basis for their decision to extend intervals between vaccine doses to an unprecedented four months[22]. Remarkably, this was published in a journal produced by the University of Toronto Press that is not listed in any major medical journal databases (*e.g.* PubMed) and the majority of supporting data were pre-prints or 'data on the ground', which means non-peer reviewed, not published, and often not coming from a properly controlled scientific study. Most egregious, the entire premise of the scientific justification was a single figure showing data generated by an epidemiological model. Remarkably, not a single detail about this model was provided. Indeed, the main text stated "This data model (currently being prepared for publication as at the time of writing)…". Readers were left to assume that the theoretical epidemiological model was appropriate. It is not a good sign when scientific justifications for Canada's public health policies cannot be published in well-recognized scientific journals that can be easily found by the international scientific community. It would be helpful if the government of Ontario could make their guiding epidemiological models publicly available.

7. SARS-CoV-2 is Not a Problem of Pandemic Proportions

Section 8, page 4: "COVID-19 is a deadly infectious disease"

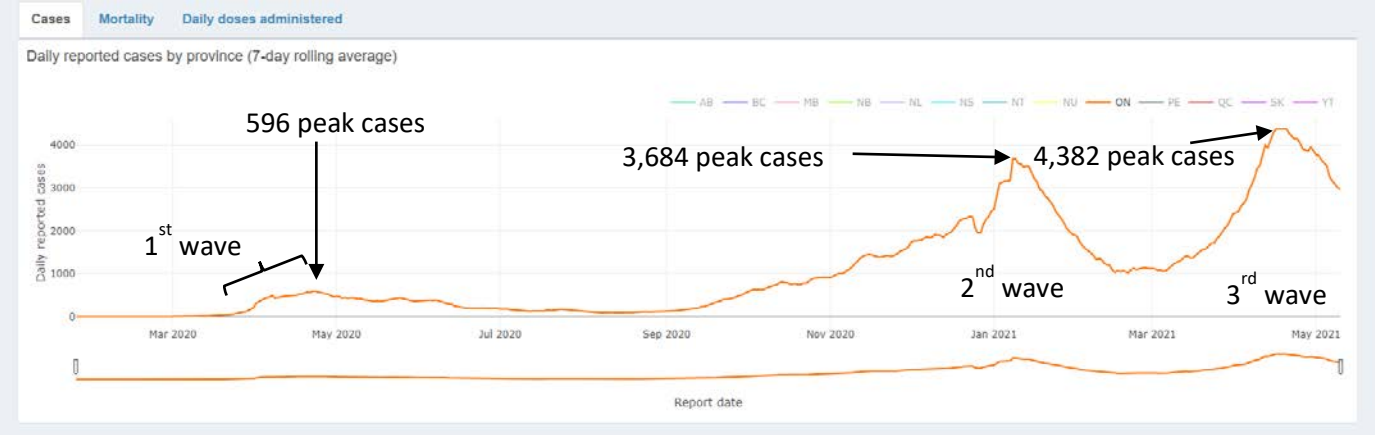
Response: Unfortunately, no published, peer-reviewed data were cited to justify this statement. Infection fatality rate (IFR) is a way to assess how dangerous a pathogen is. It is calculated based on the number of people that die from among the total number that were infected. Early in the declared COVID-19 pandemic, it was estimated that the IFR for SARS-CoV-2 was ~10-fold higher than for a serious outbreak of an influenza virus, or ~1%. Indeed the IFR for a bad 'flu' season can be as high as ~0.1%[23].

It is important to note that calculating an accurate IFR requires having accurate data for the denominator in the equation, which is the total number of people that have been infected. Exacerbated by Canada's lack of testing for evidence of seroconversion (*i.e.* when pathogen-specific antibodies are present in an individual, which indicates they were infected) against SARS-CoV-2, it has been impossible to ascertain how many Canadians have been infected. However, as data have accumulated in countries that did practice due diligence in this area, the total number of infections that have occurred keeps getting re-adjusted to higher numbers. This is due to phenomena such as the large number of people that were infected but did not realize it because they never became ill. As a result, the actual IFR for SARS-CoV-2 has been steadily declining. Remarkably, as the data regarding total infections has become more accurate, the IFR for SARS-CoV-2 has dropped to only ~0.15%[24]. It is likely that this IFR will drop even further as the extent of unnoticed infections is further elucidated. Indeed, a recent study found that ~90% of randomly tested healthy adults in British Columbia had been exposed to SARS-CoV-2. This suggests that the denominator for determining the true IFR is likely substantially higher than previously appreciated, which would mean the IFR is less than 0.15%[25]. Further, this IFR includes the high-risk frail elderly and

immunocompromised. For Canadians who are outside of these high-risk demographics, the IFR would be much less than 0.15%.

As of April 1, 2020, the population of Ontario was 14,745,040[26]. As seen in figure 3a, there have been two complete waves of reported cases of COVID-19 and as of writing, the third wave is declining. Unfortunately, Ontario has refused to document the severity of 'cases', which can potentially range from asymptomatic (in which case they should not be defined as having COVID-19 because there is no apparent disease) to mild to moderate to severe but non-lethal to severe and lethal. As such, one is unable to appreciate that the cases have progressed towards lower average severity over time. Where this is evident, however, is in figure 3b which shows ever-declining fatality associated with cases of COVID-19, despite dramatic increases in the peak number of daily cases with each successive wave. A reasonable and probable explanation for this is that those who were most susceptible to COVID-19 died in the first wave, which is to be expected for any potentially lethal infectious pathogen. Remarkably, only four Ontarians under the age of 20 have had their deaths attributed to COVID-19 over the past sixteen months (figure 4). Among all Ontarians under the age of 60, only 490 (out of a total of 11,178,413 people[27]) have had their deaths attributed to COVID-19 in the past sixteen months (figure 4); and this includes people who had pre-disposing medical conditions.

(A)



(B)

Figure 3: COVID-19 case and mortality data for Ontario.

(A) This graph shows the number of daily 'cases' of COVID-19 in Ontario. Note that the definition of a case is controversial due to issues related to how these are defined. (B) The number of daily deaths attributed to COVID-19 in Ontario. These data were downloaded on May 11, 2021 from the COVID-19 dashboard, for which data are curated by the COVID-19 Canada Open Data Working Group, Dalla Lana School of Public Health, University of Toronto (https://art-bd.shinyapps.io/covid19canada/).

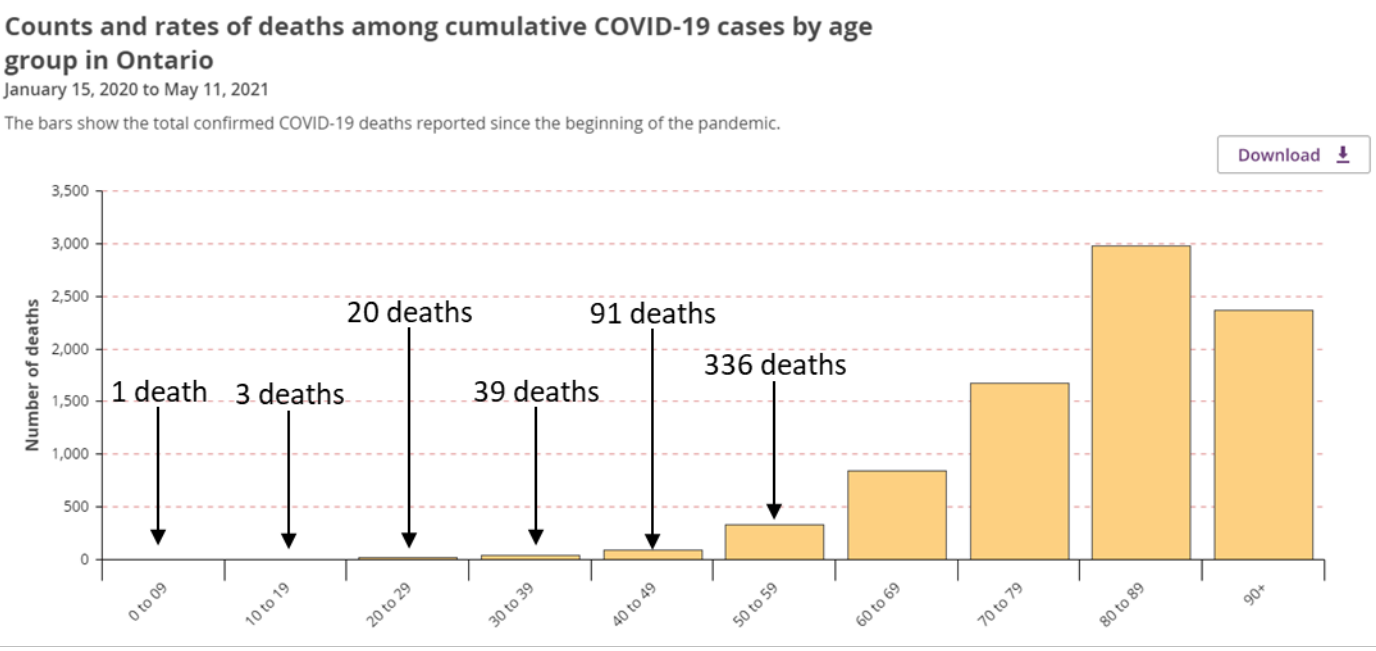


Figure 4 : Cumulative deaths in Ontario that were attributed to COVID-19.
This graph shows cumulative deaths by age group. These data were downloaded on March 11, 2021 from the website for Public Health Ontario (https://www.publichealthontario.ca/en/data-and-analysis/infectious-disease/covid-19-data-surveillance/covid-19-data-tool?tab=ageSex)

The dynamics of spreading of SARS-CoV-2 and its decreasing harm to the population of Ontario over time is typical of infectious diseases. SARS-CoV-2 has not demonstrated novel or unprecedented population dynamics. From an immunological perspective, the data in figures 1 and 2 are indicative of an infectious agent that has been running a typical course in the population. Its harm is decreasing over time. Mortality data for Ontarians under the age of 60 demands that a proper risk-benefit analysis be performed to place the high cost of pandemic-associated public health policies into a proper context. For example, in the year 2019, 543 Ontarians died due to motor vehicle accidents[28]. These deaths would also be preventable with the implementation of stay-at-home orders. Further, many chronic fatal diseases (*e.g.* cancers, heart disease, *etc*.) have been relatively neglected in favour of diverting resources to COVID-19 lockdown measures. This will result in irreparable future harm in the form of increased death rates that have yet to be determined. And this does not account for other deaths indirectly caused by COVID-19 policies, including suicides due to increased mental health issues, *etc*. Indeed, the government of Ontario needs to determine if their current policies have placed a premium on lives lost due to COVID-19 over those lost to other causes. Revising or revoking lockdown policies could result in a net saving of lives in Ontario.

Statistics from the Public Health Agency of Canada highlighted settings that have been associated with severe COVID-19, as measured by deaths[29]. Based on these data, the high- and low-risk settings for acquisition of lethal COVID-19 have been obvious. As expected, based on their enrichment for high-risk demographics (*i.e.* the frail elderly, immunosuppressed and others with pre-existing complicating medical

conditions), 97% of the total deaths attributed to COVID-19 were associated with long-term care and healthcare facilities (as of March 20, 2021[29]). In stark contrast, locations frequented by people in low-risk demographics have been associated with extremely few deaths attributed to COVID-19. For example, food, drink, and retail settings have accounted for only three deaths. To put this into a perspective, these data are for a population of 38 million people[30] spanning fifteen months. Remarkably, an average of two to three Canadians have died from lightning strikes in each twelve-month period since the year 2002[31]. So, over the fifteen months of the pandemic, three deaths due to COVID-19 have been attributed to food, drink, and retail settings. In that same amount of time prior to the pandemic, up to four Canadians died from lightning strikes. It is notable that stay-at-home orders would have prevented these deaths, plus the many more serious injuries that are caused by lightning strikes each year, most of which occur in Canadians under the age of 54. But again, a failure to conduct proper cost-benefit analyses in Canada during the pandemic has inadvertently resulted in greater value being attributed to lives lost due to COVID-19.

More evidence of the futility of locking down both low- and high-risk individuals has been provided by the situation that has been documented in Texas, USA, which serves as an important case study[32]. Specifically, Texas relinquished their lockdown order and moved to an unrestricted state as of March 10, 2021. This even included hosting the home opener game of Major League Baseball's Texas Rangers against the Toronto Blue Jays on April 5, 2021. Their stadium was filled to capacity, with 38,238 fans in attendance. As of the writing of this report (May 11, 2021) the feared avalanche of hospitalizations and deaths not only failed to materialize but these parameters decreased (figure 5). The lives of most Texans are back to near-normal, including having their businesses and restaurants fully operational. Notably, this was accomplished in the absence of nonpharmaceutical interventions.

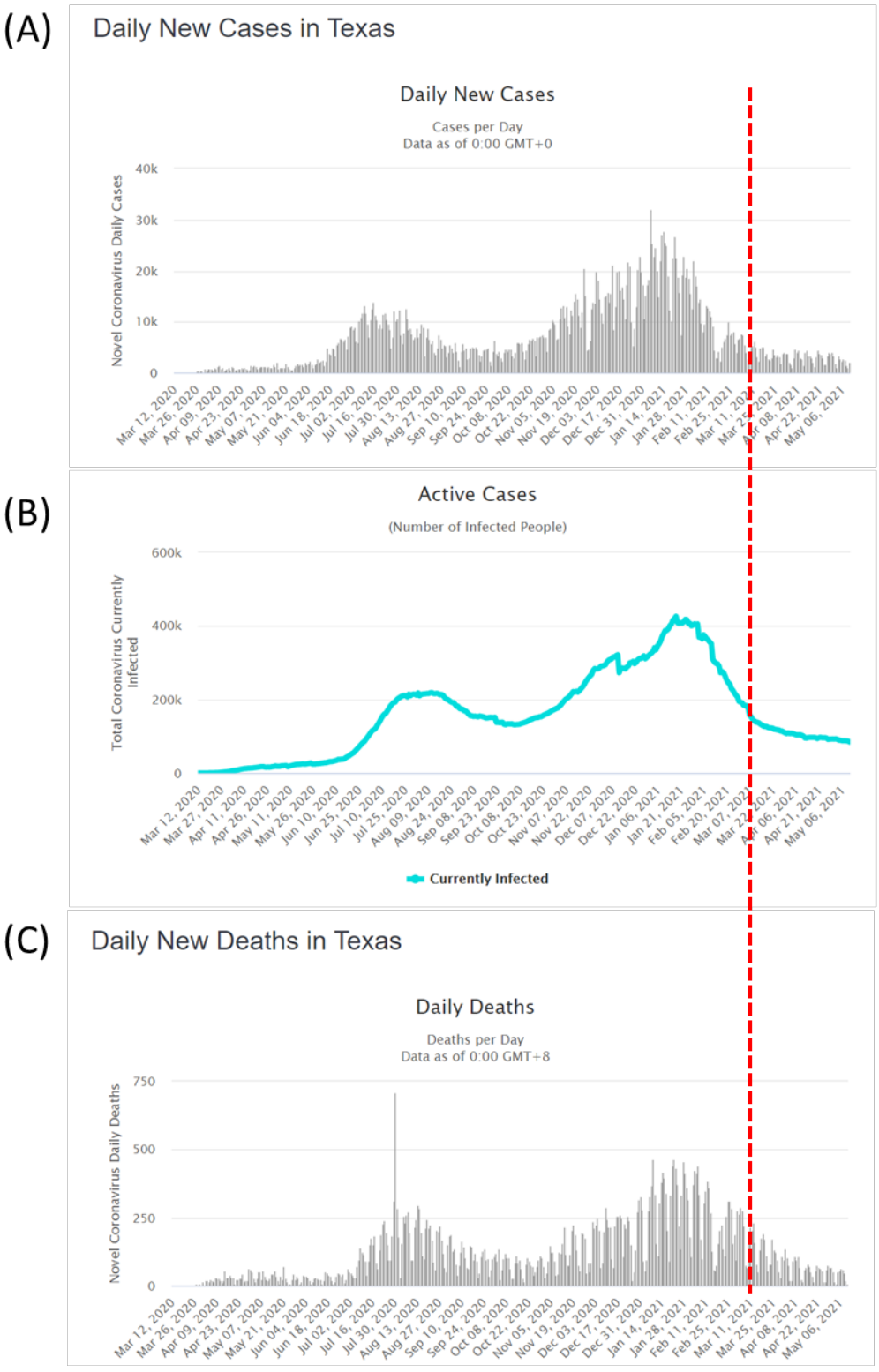


Figure 5 : Cases of COVID-19 and associated deaths have continued to decline after lifting of lockdown restrictions in Texas, USA.

Texas, USA lifted COVID-19 lockdown measures on March 10, 2021 (**red dotted line**). Since that time, in the absence of nonpharmaceutical interventions (A) daily new cases of COVID-19, (B) active cases on COVID-19, and (C) daily new deaths attributed to COVID-19 have declined.

Conclusion: The IFR for SARS-CoV-2 was vastly overestimated at the beginning of the declared pandemic. It is now approaching the range of a serious influenza outbreak, but with severity of disease limited to a more restricted demographic (*i.e.* unlike influenza viruses, SARS-CoV-2 is not particularly dangerous to the very young). An IFR of only 0.15% is not suggestive of an infectious disease of pandemic proportions. This is further supported by case fatality data that clearly suggest that COVID-19 is not a serious issue for most Ontarians. A more logical approach to managing the pandemic would have been and still would be to implement the standard, historically successful public health policy of isolating the relatively few high-risk individuals, not the entire population. In fact, places like the state of Texas in the USA have demonstrated that lifting of COVID-19-associated restrictions can even be done successfully without any nonpharmaceutical interventions. Excessive slowing of the development of SARS-CoV-2-specific immunity among the majority of Canadians who are at low risk of developing anything more than moderate COVID-19 probably has and continues to allow deaths to occur among the high-risk demographics who otherwise would have been protected following the acquisition of 'herd immunity' in Canada. Certainly, the evidence suggests that food service establishments have not been a substantial source of severe cases of COVID-19, based on there being only three reported deaths associated with this, plus the retail setting anywhere in Canada. Closing businesses that are not associated with a substantial risk of transmission of severe COVID-19, and causing many of them to go bankrupt, seems to be counterproductive.

8. Propagation of Misinformation about SARS-CoV Variants of Concern

Section 10, page 5: "*Ontario's context has evolved with increases in the prevalence of variants of concern ("VOCs"). VOCs are reported to be more transmissible and* ***cause more severe illness***".

Response: The spike protein of some of the VOCs has mutated in a way that allows it to bind to angiotensin converting enzyme 2 (ACE2; the entry receptor that SARS-CoV-2 uses to infect cells) with greater affinity. Although this can promote transmission, **there is no evidence that the current VOCs cause more severe illness**. In fact, the very citation[33] that was used to support this claim from Dr. Hodge states the following in the abstract: "The authors… …saw no clear evidence for a change in disease severity". Further, the authors concluded that immunity against the parental SARS-CoV-2 would likely confer protection from severe COVID-19 following infection with a VOC by virtue of cross-reactivity of antibodies and T cell responses against conserved components shared by all current VOCs. In fact, Dr. Hodge has speculated throughout their report that the only way to ensure safety from VOCs is to enforce strict isolation. However, the historically successful strategy to deal with a pathogen, especially one that has an IFR <<1%, and that is only a major concern for a very limited, well-defined demographic, is to let the low-risk individuals learn to live with the virus, thereby naturally acquiring protective immunity and, by doing so, abrogating the risk for those for whom the pathogen may be lethal. To understand this latter strategy, some basic virology and the concept of natural acquisition of immunity need to be discussed.

Many viruses mutate over time. This includes coronaviruses. Indeed, these viruses have an error-prone mechanism of copying their genome. This provides a strategy to adapt to novel environmental pressures. Of concern for SARS-CoV-2 is the potential for randomly generated mutants to sufficiently alter the structure of their spike protein to be able to evade the narrowly conferred spike protein-specific immunity conferred by all the first-generation COVID-19 vaccines while maintaining the ability to infect cells. These are known as 'variants of concern' (VOCs) Since the beginning of the pandemic, large numbers of mutant viruses have been identified. However, three core lineages of the variants are of current

concern[34]: 1. B.1.1.7, also known as the UK variant[35], 2. B.1.351, also known as the South African variant[35], 3. P.1, the Brazilian variant[36]. SARS-CoV-2 from the B1.351 lineage can largely bypass the immunity conferred by AstraZeneca's COVID-19 vaccine. However, the Pfizer and Moderna vaccines remain effective against all three lineages for the VOCs.

Importantly, naturally acquired immunity against SARS-CoV-2 has been shown to be both long-lasting and protective. Notably, this type of immunity would be expected to be particularly protective against emerging VOCs because it is very broad, meaning that it targets multiple components of SARS-CoV-2, with both T cells and antibodies induced as effector mechanisms. Indeed, evidence of the breadth of naturally acquired immunity has recently been published[25]. In contrast, current vaccine-induced immunity targets a single protein, with a strong bias towards antibody-mediated responses. Notably, the B.1.1.7, B.1.351, and P.1 variants of SARS-CoV-2 are of concern because of their altered spike proteins, particularly in the 'receptor binding domain' (*i.e.* the portion that binds to the ACE2 molecule on host cells), which is the primary target of neutralizing antibodies. So, although there is evidence of some monoclonal antibodies failing to recognize the spike protein in some VOCs and some convalescent sera (*i.e.* sources of antibodies) being less able to neutralize the VOCs, T cells can effectively recognize conserved regions of the spike protein as well as other viral proteins.

Since SARS-CoV-2 has shown such a propensity to mutate, it is reasonable to expect this virus will become endemic. Indeed, should a variant emerge that can completely bypass the spike-specific immunity conferred by the current vaccines, additional immunizations will be required with re-designed vaccines, especially for those without naturally acquired broad-based immunity.

Conclusion: The goal in Canada should not be to get everyone vaccinated *per se*. Instead, the goal should be to get as many Canadians immune to SARS-CoV-2 as possible. There are two ways to achieve this: 1. Vaccination, 2. Natural acquisition of immunity. The great news is that Canada might be closer to the natural acquisition of herd immunity than what was previously appreciated[25], likely due, in large part, to the ongoing spread of the virus after the implementation of ineffective masking and misguided physical distancing policies that failed to account for the physics behind aerosol-mediated transmission of SARS-CoV-2. Like many other viruses, including other coronaviruses and influenza viruses, SARS-CoV-2 will likely become endemic, meaning that we may encounter new versions of the virus on a regular and long-term basis. As such, it is imperative that we learn to live with SARS-CoV-2 rather than attempting to hide from it; just like we have done with the other respiratory pathogens that we have accepted as a trade-off for living our lives outside the confines of lockdowns.

9. Vitamin D as a Reasonable Alternative Preventive Measure and Treatment for COVID-19

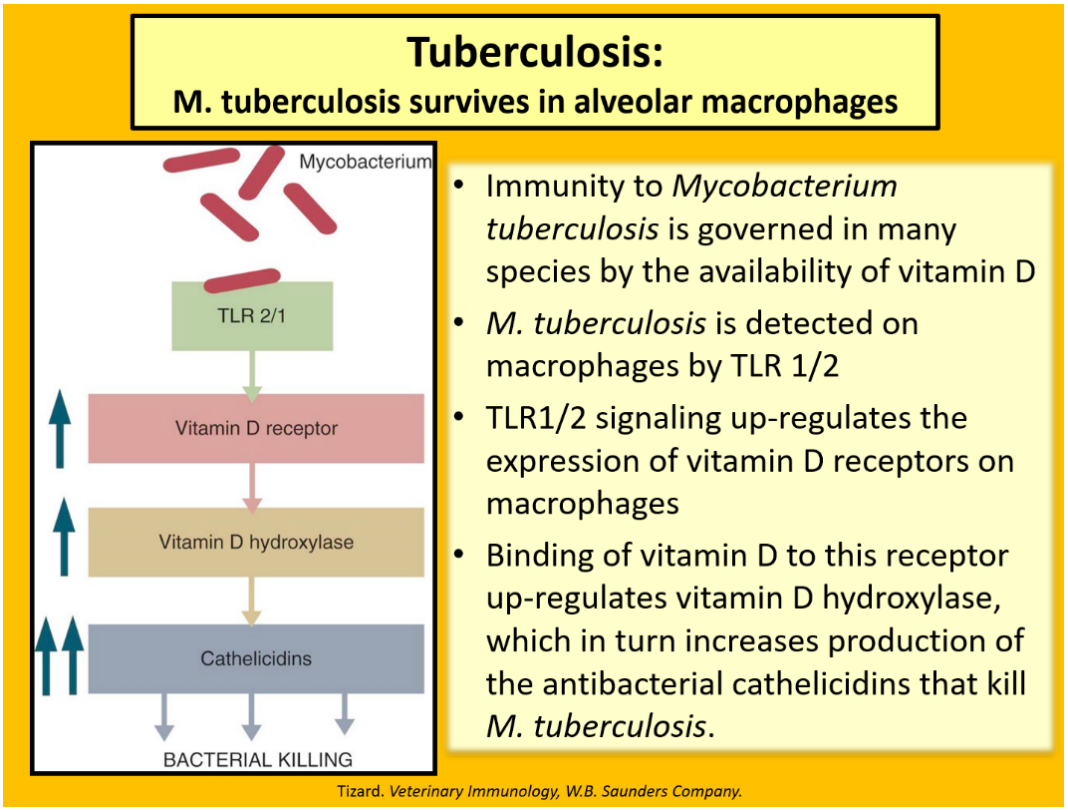
Section 29, page 13: Dr. Hodge stated "It may be theoretically possible to argue that contact tracing would be a reasonable alternative, arguing that if an infection occurred, then patrons could be contacted and advised to self-isolate, be tested or other public health advice." It was then argued that this does not represent a reasonable alternative.

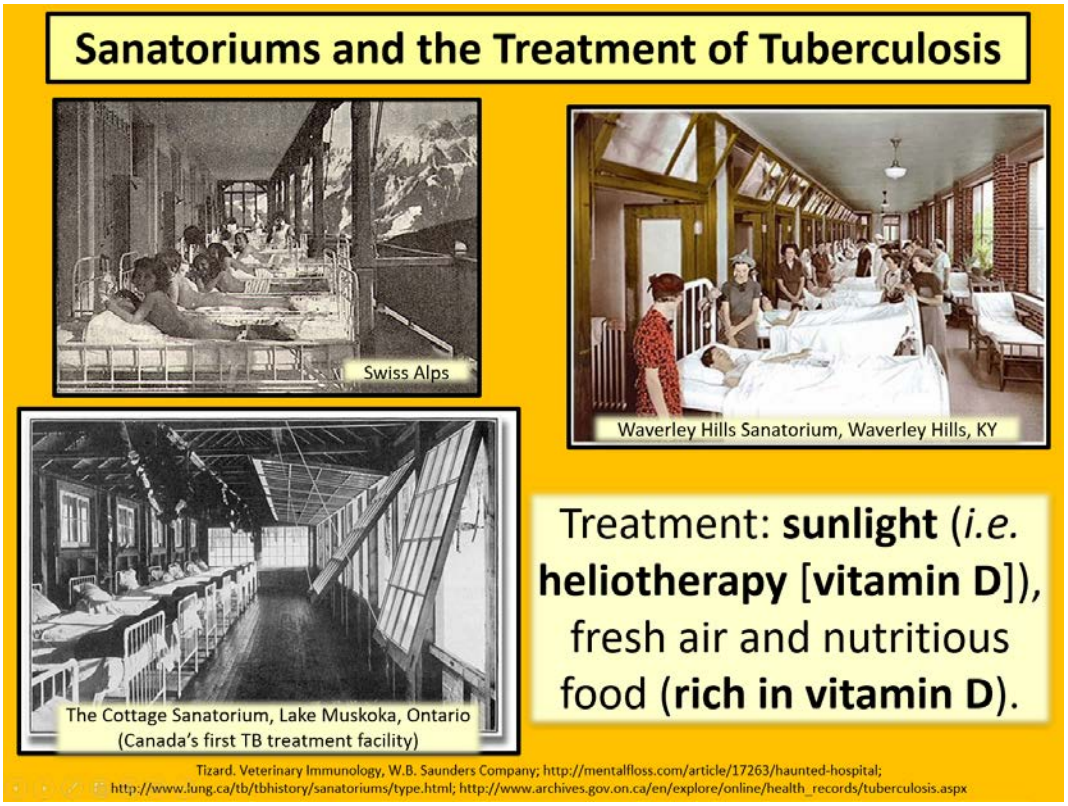
Response: Dr. Hodge failed to consider the many other alternatives, including treatments and preventives for COVID-19 that proven to be safe and effective. Indeed, the science underpinning validated treatments and preventive measures has exploded over the past year. My original report described in detail, the

overwhelming science in support of the use of ivermectin as an effective early treatment strategy for reducing severity of disease, reducing admissions to hospital, especially intensive care units, and for preventing deaths. Indeed, since my first report, a peer-reviewed scientific article was published that summarizes the cutting-edge data regarding the effective use of drug combination therapies. This paper is entitled "Early Ambulatory Multidrug Therapy Reduces Hospitalization and Death in High-Risk Patients with SARS-CoV-2"[37]. There are also simple preventive measures that are available, including supplementation with vitamin D.

As an immunologist, I routinely teach the benefits of vitamin D in the context of the function of the immune system. Indeed, my students find it very interesting to have the subject introduced in the historical context of sanitoriums that were used during outbreaks of tuberculosis. As an example, two of my lecture slides are shown in figure 6. They describe the mechanism whereby vitamin D, provided by sunlight-mediated production in the skin or via diet, is an essential molecule to promote killing of the tuberculosis-causing bacterium by macrophages, which are a major component of our innate immune system. Notably, the bacterium that causes tuberculosis is an intracellular pathogen, like SARS-CoV-2, highlighting the relevance of this mechanism used by macrophages in the context of viral diseases such as COVID-19. Remarkably, federal Health Minister Patty Hajdu publicly dismissed vitamin D as playing a role in protection against infectious diseases such as that caused in some people by SARS-CoV-2[38]. It is troubling to see a non-scientist with broad-reaching control over the health of Canadians readily dismiss a basic, fundamental immunological fact that is based on decades of high-quality scientific research. Indeed here are 77 peer-reviewed scientific articles that demonstrate the importance of vitamin D to the proper functioning of the human immune system to kill SARS-CoV-2: [39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115]. Note that each one of these papers deals specifically with COVID-19 and there are many more articles that are currently in pre-print version or undergoing the scientific peer review process. These studies clearly demonstrate that vitamin D insufficiency follows a seasonal trend in northern countries such as Canada. This is due to a lack of exposure to sunlight, which allows vitamin D to be naturally produced in the skin. These studies also show that vitamin D sufficiency is strongly associated with lower risk of developing COVID-19, less severity of COVID-19, reduced hospital admissions, faster recovery if admitted to a hospital, and, importantly, a reduced risk of COVID-19-induced death. The broader literature showing the benefits of vitamin D supplementation in the general context of intracellular pathogens is massive. It is shocking that such a large body of scientific evidence has been ignored and/or dismissed by public health officials in Canada. Unfortunately, this aversion to following the weight of the science has likely been very costly to Canadians. Recommending proper supplementation with vitamin D, especially during the 'low vitamin D' season that spans mid-Fall to mid-Spring would have been an extremely simple and inexpensive strategy to promote the health of Canadians during the declared pandemic. According to the massive body of scientific evidence, public health officials, by not promoting the use of vitamin D, have caused Canadians to miss an effective preventive strategy. As a result, Canadians have suffered substantially greater COVID-19-induced morbidities and mortalities. Indeed, many proactive physicians were trying to promote this[116]. None of this science is novel for infectious respiratory pathogens. The benefits of vitamin D supplementation are even better defined in the context of annual outbreaks of influenza viruses[117, 118]. It is imperative that public health officials stop blinding themselves to the overwhelming scientific evidence that demonstrates there are multiple, effective natural (*e.g.* vitamin D) and drug-based strategies for preventing and effectively treating COVID-19.

Figure 6 : Two Lecture Slides Used in a Basic Immunology Course to Teach the Importance of Vitamin D in the Effector Functions of Macrophages





10. Asymptomatic Transmission of SARS-CoV-2 is Negligible, Nor Can Individuals Who Had COVID-19 Cannot Re-Transmit the Virus

Section 18, page 9: Dr. Hodge insinuated that people who are asymptomatic following infection with SARS-CoV-2 can be substantial transmitters of the virus to others. However, no published scientific data were presented to substantiate this. The single citation indicated that the information was contained on a previous page due to space limitations. However, there were no space limitations and it is unclear which prior citation is being referred to. Regardless, the scientific data that do exist fail to support Dr. Hodge's claim.

The definition of an asymptomatic individual is a person who is known to be infected with a microorganism but fails to develop symptoms associated with a disease. Indeed, we are all 'asymptomatic carriers' in the sense that we harbor vast numbers of bacteria and viruses in and on our bodies. However, these normal microbiomes usually do not cause us any disease, unless we become immunosuppressed or 'safe' microbes get transferred to anatomical locations where they can potentiate disease (*e.g.* fecal-to-oral transfer of some strains of *Escherichia coli*). So, in the context of SARS-CoV-2, an asymptomatic carrier would be defined as an individual that is infected with the virus but fails to develop COVID-19.

Viral culture studies suggest that pre-symptomatic individuals can potentially shed infectious SARS-CoV-2 one to two days before the onset of symptoms and continue to be infectious up to seven days thereafter[119]. However, a study of the prevalence of SARS-CoV-2 in ~10 million people in Wuhan, China found no evidence of asymptomatic transmission[120]. In the United Kingdom, the 'Scientific Advisory Group for Emergencies' recommended that "Prioritising rapid testing of symptomatic people is likely to have a greater impact on identifying positive cases and reducing transmission than frequent testing of asymptomatic people in an outbreak area"[121]. Consequently, they have asked their government to change their testing policy by moving away from asymptomatic testing.

The World Health Organization notes that "Most PCR assays are indicated as an aid for diagnosis, therefore, health care providers must consider any result in combination with timing of sampling, specimen type, assay specifics, clinical observations, patient history, confirmed status of any contacts, and epidemiological information"[122].

On its own, a positive result on a PCR test to detect SARS-CoV-2 is insufficient to diagnose COVID-19, yet this has become routine in Ontario and the rest of Canada. In addition to the potential for false positive tests, true positive results can also be obtained from genomes of SARS-CoV-2 particles that are no longer infectious. An example of the latter would be an individual who has mounted an effective immune response and may have remnant replication-incompetent viral particles or partially degraded viral genetic material inside relatively long-lived phagocytic cells that have killed the virus. Indeed, following clearance of SARS-CoV-2 from the body, full and/or partial genomes of SARS-CoV-2 can remain for up to several weeks. One key reason for this is that some phagocytic cells, which are a component of the innate immune system, can be long-lived. Phagocytosis of SARS-CoV-2 is a mechanism to kill and remove the virus from the body and to activate other immunological effector cells. As such, these can be a source of SARS-CoV-2 genomes that could be amplified by a PCR test. However, these genomes would not have the potential to cause COVID-19. Persistence of whole or partial genomes that are not associated with infectious

particles is well-documented for a variety of other viruses, including measles[8], Middle East respiratory syndrome-coronavirus[9], and other coronaviruses[10].

Too often, a positive PCR test for the presence of SARS-CoV-2 is being used, on its own, to define positive cases of COVID-19. However, the presence of a portion of the viral genome in an individual, on its own, does not necessarily equate with disease (*i.e.* COVID-19). To be declared COVID-19, the infection would also have to be associated with expected signs and/or symptoms. The latter is known as a clinical diagnosis and would be based on evaluation by a physician, in conjunction with the test results. A gold-standard test for infectivity of a virus is a cell-based functional assay that determines the potential to cause cell death. However, such an assay is not in routine use in Canada. The absence of a test of the infection-potential of a virus further confounds any meaningful interpretation of positive results in asymptomatic people. Drawing conclusions based solely on the results of laboratory tests, would take the diagnosis of diseases out of the hands of physicians, and place the onus for this on technicians employed by testing laboratories. Further confounding this issue is the fact that cases of COVID-19 can be claimed in the absence of confirming infection with SARS-CoV-2 (this is known as "ICD code U07.2 COVID-19, virus not identified")[123]. Worse, the definition of a case of COVID-19 has changed over time in Canada. Indeed, the government of Canada has stated the following on their website: "Previous versions of the COVID-19 case definition are available upon request. Please email COVID19Surveillance@canada.ca to request a copy or for more information."[123].

Positive PCR tests for SARS-CoV-2 in asymptomatic people are often based on high Ct values, which, in and of themselves, raise the question of whether these individuals harbor infectious viral particles. The low prevalence of positive PCR tests in asymptomatic people often does not differ much from the false positive rate. These issues combined with the absence of a functional cell-based assay to prove infectivity renders results of asymptomatic testing nearly impossible to interpret accurately. Indeed, the World Health Organization, agreeing with many health professionals around the world, has emphasized that spreading of SARS-CoV-2 by asymptomatic individuals is rare and an emphasis should be placed, therefore, on testing people with signs or symptoms of illness, not those who are apparently healthy[124]. Of particular concern in the context of the high cycle numbers being used by labs in Ontario (*i.e*. up to 38 cycles being defined as 'positive' by Ontario Public Health[13]), is the fact that several studies have been conducted to determine the highest Ct value at which SARS-CoV-2 could be successfully cultured in cells. The results were 25[15], 22-27[17], 30[18]. This suggests that tests with Ct values above 22-30 are not indicative of the presence of replication-competent SARS-CoV-2. The logical conclusion is that it is erroneous to declare samples with high Ct values, especially those above 30, as being positive for infectious SARS-CoV-2. Indeed, figure 7 shows results of a published study that depicts the frequency at which asymptomatic people tested positive for SARS-CoV-2 relative to that observed for people with symptomatic infections[125]. Remarkably, if the cut-off for positive test results was set to Ct values of 22-30 (*i.e.* the point beyond which samples fail to yield potentially infectious virus particles), the vast majority of 'positive test results' would be rendered negative. It was even concluded in a study by La Scola B, *et al*., that patients testing 'positive' with Ct values above 33 could likely be discharged from hospitals[19]. This means that an unknown number of positive cases reported in Ontario were likely not true positives, especially if individuals were asymptomatic. This is further supported by evidence that asymptomatic people have detectable SARS-CoV-2-specific memory T cells after exposure to the virus, which would be inconsistent with a risk of them spreading the virus to others[126].

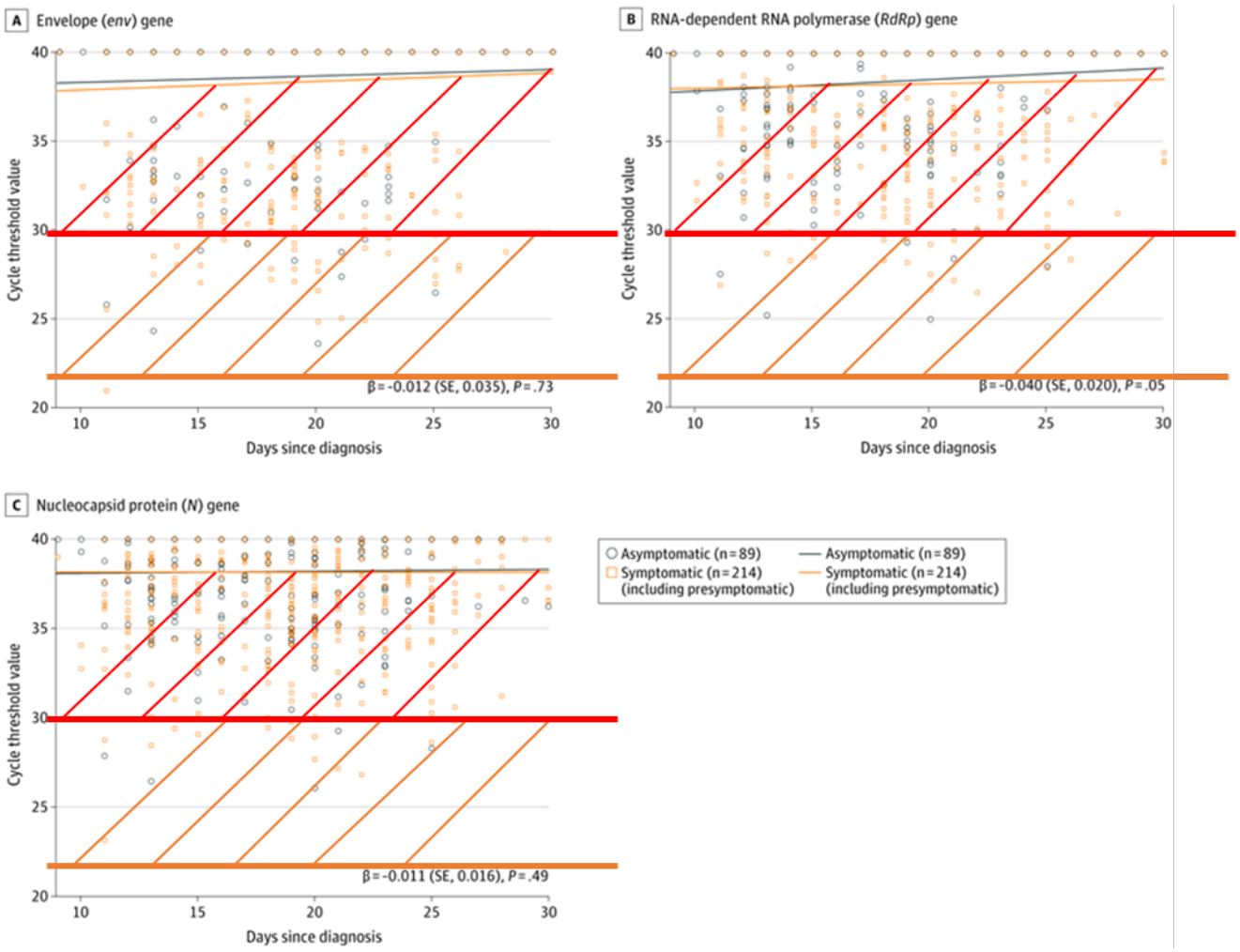


Figure 7: Most 'positive' results for the SARS-CoV-2 PCR test are negative based on the gold standard virology assay.
Shown are graphs from figure 2 of a paper published in the *Journal of the American Medical Association*[125]. The argument being made was that the frequency at which asymptomatic people tested positive for SARS-CoV-2 was like that observed for people with symptomatic infections. However, new cut-offs for a positive test result were placed at 22 (orange line) and 30 (red line) PCR cycles. These are the limits (depending on the laboratory) at which replication-competent SARS-CoV-2 can no longer be recovered from samples according to the gold standard functional virology assay. When this is done, it is apparent that most the results would be negative (*i.e.* these samples would fail to transmit infectious SARS-CoV-2).

Importantly, false positive test results, which have a greater risk of happening among asymptomatic people, have been shown to have numerous negative consequences in terms of physical and mental health, and causes financial losses[127].

When people get infected with a respiratory pathogen, their immune system detects the virus as something that is dangerous and worth responding to. Rapid innate immune responses provide early effector mechanisms to being clearing the virus from the body. The innate arm of the immune system will also induce an adaptive immune response. The primary effectors against viruses in the adaptive arm of the immune system are cytotoxic T cells that can kill virally infected cells to prevent them from serving as

a 'virus-production factory', and B cells, which can produce antibodies to neutralize the virus and prevent it from entering cells. The most notable characteristic of the adaptive immune response is that it results in the generation of immunological memory. This allows a host to respond much more rapidly and to a much greater magnitude when re-exposed to the same pathogen. The result is that the virus gets cleared so rapidly that there is usually no disease.

Note that some non-immunologists have erroneously concluded that memory conferred by natural infection with SARS-CoV-2 is not long-lasting. However, this has been based on assessments that show declining concentrations of virus-specific antibodies. The antibodies are produced by B cells. The antibodies are merely proteins in circulation with limited half-lives. They will be cleared from circulation over time. The relevant measure of memory is detection of memory B and T cells. A memory B cells can rapidly initiate the production of massive quantities of antibodies upon re-exposure to the pathogen.

Several published studies have shown that the immune response against SARS-CoV-2 infections is robust, effective, broadly targets multiple components of the virus and confers memory that lasts at least as long this aspect has been able to be studied within the context of a novel pandemic[128, 129, 130, 131, 132, 133].

Conclusions: Testing of asymptomatic people for the presence of portions of the SARS-CoV-2 genome does not make medical nor economic sense. Positive test results from asymptomatic individuals cannot be interpreted in a clinically meaningful way. Although asymptomatic transmission is possible, it is improbable that it is occurring in substantial numbers and does not represent a significant risk of causing COVID-19-related hospitalizations or deaths in others. The scientific evidence demonstrates that immune responses following infection with SARS-CoV-2 are protective and long-lasting. There is no evidence that people who previously tested positive for SARS-CoV-2 represent a substantial risk of causing COVID-19-related hospitalizations or deaths in others.

11. The Futility of Low-Cost Masking in the Context of SARS-CoV-2 Spreading via Aerosols

Dr. Hodge's report repeatedly mentioned masking as an essential measure to curb the spread of SARS-CoV-2, including suggesting two times that removing a properly fitted mask for eating and/or drinking is potentially dangerous in a public setting.

Response: With respect to not removing a properly fitted mask for eating and/or drinking, it would be appreciated if a demonstration could be provided to educate Canadians how to eat and drink while masked. In terms of the other arguments made by Dr. Hodge, it was noted that the references to support masking were very outdated; going back to the beginning of the pandemic when it was thought that the primary mode of transmission of SARS-CoV-2 was via large water droplets coming from the respiratory system. It is now widely recognized that SARS-CoV-2 is effectively spread via aerosols coming from the respiratory system[134, 135, 136, 137, 138]. A pulmonary (*i.e.* lung-derived) aerosol is a suspension of fine water droplets suspended in exhaled air. Many people who wear glasses will be familiar with these aerosols. Indeed, when a person exhales onto the lenses of their glasses to polish them with a cloth, the liquid being deposited is due to the condensation of the lung-derived aerosol. Also, these aerosols can be readily visualized when exhaling into cold air, which causes the fine droplets to condense (*i.e.* drop out of the gaseous phase). Indeed, this condensation effect of cold air minimizes the distance that respiratory aerosols can travel since the condensed water droplets are relatively large. However, in

warm air these aerosols are invisible and can potentially travel long distances depending on the rate of ambient air flow. The masks in common use among Canadians (*e.g.* surgical and cloth masks) lack standardization, users are not required to undergo fit-testing, and even if these were done, they would still lack the ability to prevent the spread of aerosols. Low-cost masks do not seal properly around the face, with leaks commonly occurring around the nose and at the joints of the jaw. Due to simple physics in which air will follow the path of least resistance, most exhaled and inhaled air will leave and enter via these gaps in the masks. This is further exacerbated by anything that increases these gaps. An example would include a beard, which would separate the mask from the chin, thereby replacing the mask material with a coarse-haired filter with massive pore sizes relative to the size of a virus. Anyone who wears glasses and a mask can attest to the venting issue around the nose, as it often causes the lenses to fog. It seems illogical to force a person's pulmonary exhaust to flow over their eyes, since this is a known route of infection for SARS-CoV-2 and could, therefore, potentiate spreading of the infection in an individual. It was shown that ocular tissues express entry receptors for SARS-CoV-2 and conjunctivitis is common among people diagnosed with COVID-19, sometimes even preceding the onset of signs and symptoms of respiratory distress[139]. As such the eyes could potentially serve as both a portal of entry and a source of person-to-person transmission.

Air venting past the ears, which is the other common location of leakage with low-cost masks, means that aerosols are generally directed behind a person. However, public health policies usually recommend that people turn away from other individuals if they must pass within proximity. If anything, this simply increases the chance of someone being exposed to pulmonary aerosols with a higher flow rate. The principles of distributing pulmonary aerosols over the eyes and behind a person also holds true for face shields. This highlights how poorly thought out masking policies are. Even if low-cost masks were properly sealed around the neck and face, SARS-CoV-2-laden aerosols and still readily pass through the relatively large pore sizes of the filtering material. Indeed, a study published in 2019 found that the low-cost masks had pore sizes ranging from 80 to 500 µm in diameter[140]. Water droplets that come from the lungs are defined as 'large droplets', 'small droplets' or 'droplet nuclei' and range in size from >60 µm, 10-60 µm, and <10 µm in diameter, respectively[141]. Coughs and sneezes will discharge droplets of all sizes. However, regular breathing and talking primarily discharges small droplets and droplet nuclei. Notably, SARS-CoV-2 has a diameter of only ~1 µm. This means that virus-laden droplets in pulmonary aerosols will have a maximum diameter of ~62 µm, with the vast majority being much smaller (remember that the pores in low-cost masks are ≥80 µm. As such, low-cost masks fail to stop the spread of SARS-CoV-2. One of the biggest challenges in relaying the science is the 'invisibility' of the microbial world. To place this into a context that is easier to picture, this would be akin to thinking that a person is locked inside a house when the walls have huge gaping holes (*i.e.* the leakage points were there proper seals are lacking) and the front door is open (*i.e.* representing the pore size of a mask). The reality of this scenario is that the person is free to come and go as they wish.

Also, aerosols from the lungs can travel beyond two meters and the directionality will be dictated by air currents[142]. Although the viral load that a person would be exposed to from aerosols would decrease with distance, the long-range potential of aerosols highlights the arbitrariness of 2-meter physical distancing policies. Also, buildings with poor ventilation, which encompasses most buildings in Canada, facilitate the build-up of aerosols over time, which further confounds the value of two-meter distancing[143].

Demonstration of inadequate sealing of low-cost masks around the face are shown in figures 8 and 9. The relative size of SARS-CoV-2-laden water particles and pores of low-cost masks is shown inf figure 10. Figure 11 shows how readily aerosols can pass through masks, even when having to pass through five three-ply surgical masks. Figure 12 shows the personal protective equipment required to safely work with containment level-3 pathogens such as SARS-CoV-2.

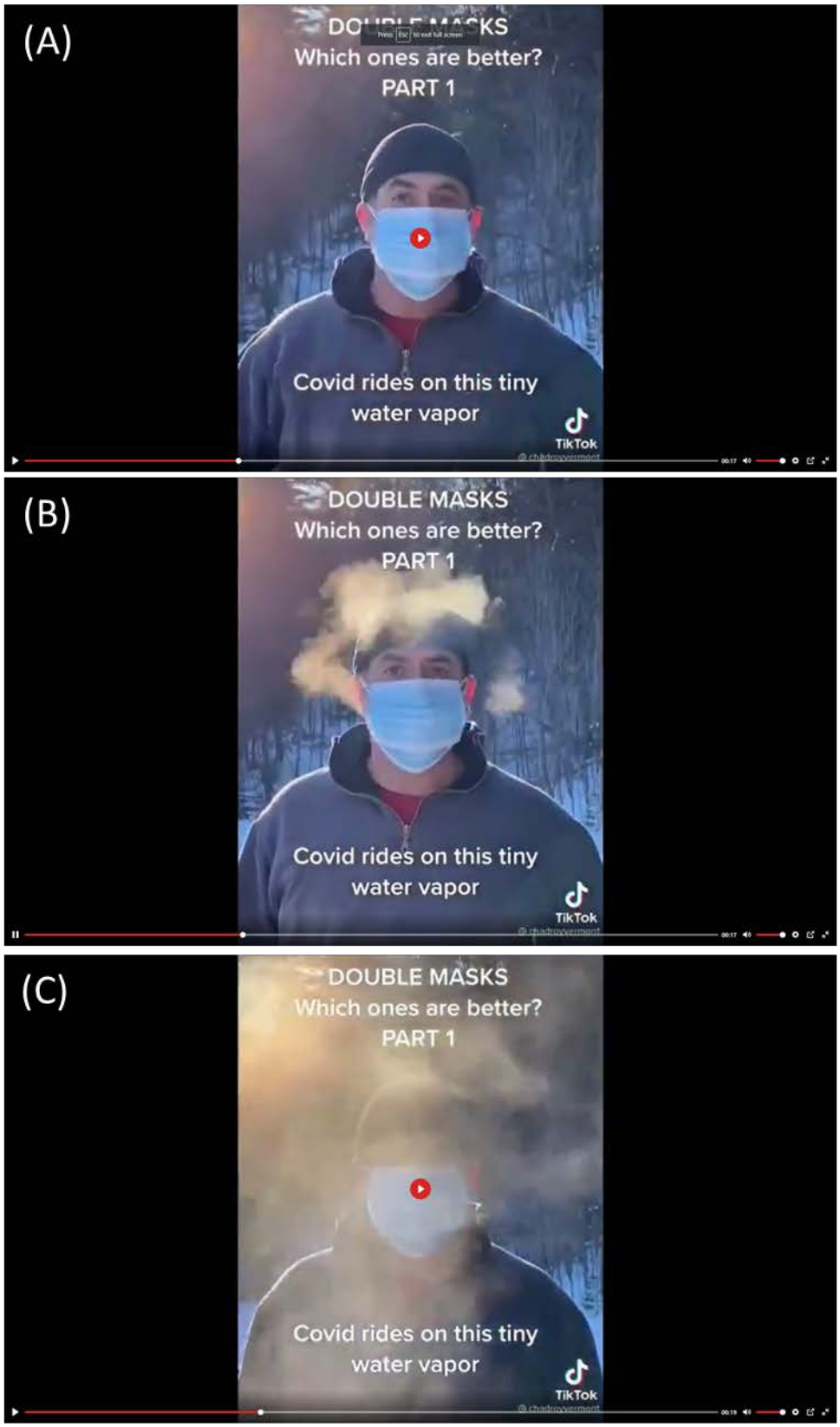


Figure 8 : The leakiness of low-cost masks.

These are screen shots taken from a video showing cold-mediated condensation of a pulmonary aerosol when exhaling while wearing two three-layer surgical masks that had the metal bar pinched over the nose. (A) at the end of the inhalation. (B) During exhalation aerosol exiting the lungs is condensing in the cold air. (C) At the end of the exhalation, the profound amount of aerosol released from the mask after a single exhalation is evident.

(A)

(B)

Figure 9: The leakiness of low-cost masks.

These are screen shots taken from a video showing fogging of eyeglasses when wearing a three-layer surgical mask. (A) While inhaling, the metal bar over the nose is pinched to maximize the 'seal'. (B) During exhalation aerosol exiting the lungs is condensing on the lenses of the glasses, causing them to fog.

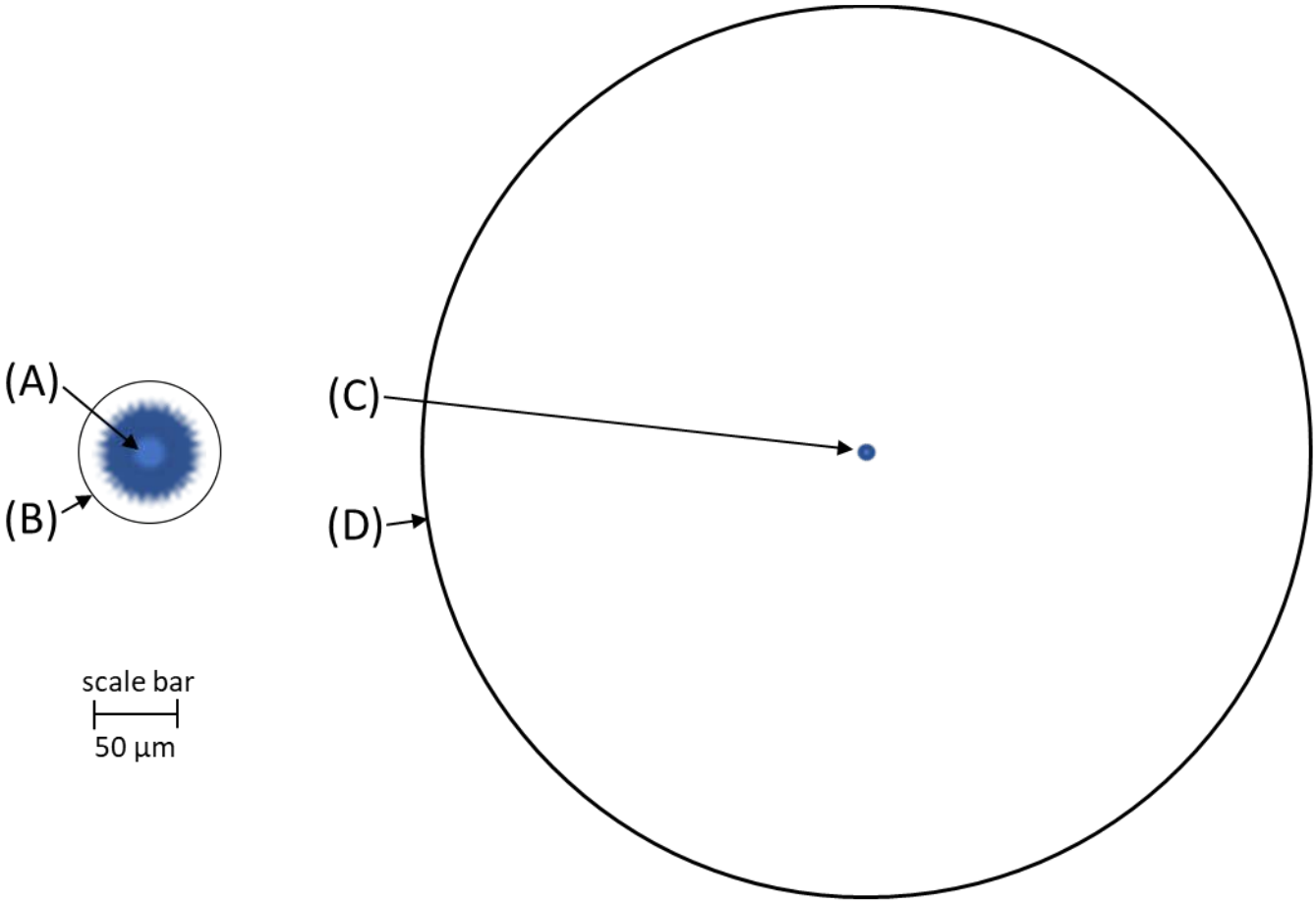


Figure 10 : The relative size of SARS-CoV-2-laden water particles and pores of low-cost masks.
SARS-CoV-2 particles have a diameter of ~1 µm. Water droplets in air exhaled from the lungs can be classified into three sizes. Large droplets are >60 µm, small droplets are 10-60 µm in diameter, and droplet nuclei are >10 µm in diameter. Individuals who are not coughing or sneezing will exhale an aerosol that consists almost entirely of droplet nuclei and small droplets. (A) The largest of the small droplets that are laden with SARS-CoV-2 will have a diameter of ~62 µm. (B) The smallest pore size of a low-cost mask is ~80 µm. (C) The largest of the droplet nuclei that are laden with SARS-CoV-2 will have a diameter of ~12 µm. (D) The largest pore size of a low-cost mask is ~500 µm.
= virus-laden droplet = pore in a low-cost mask

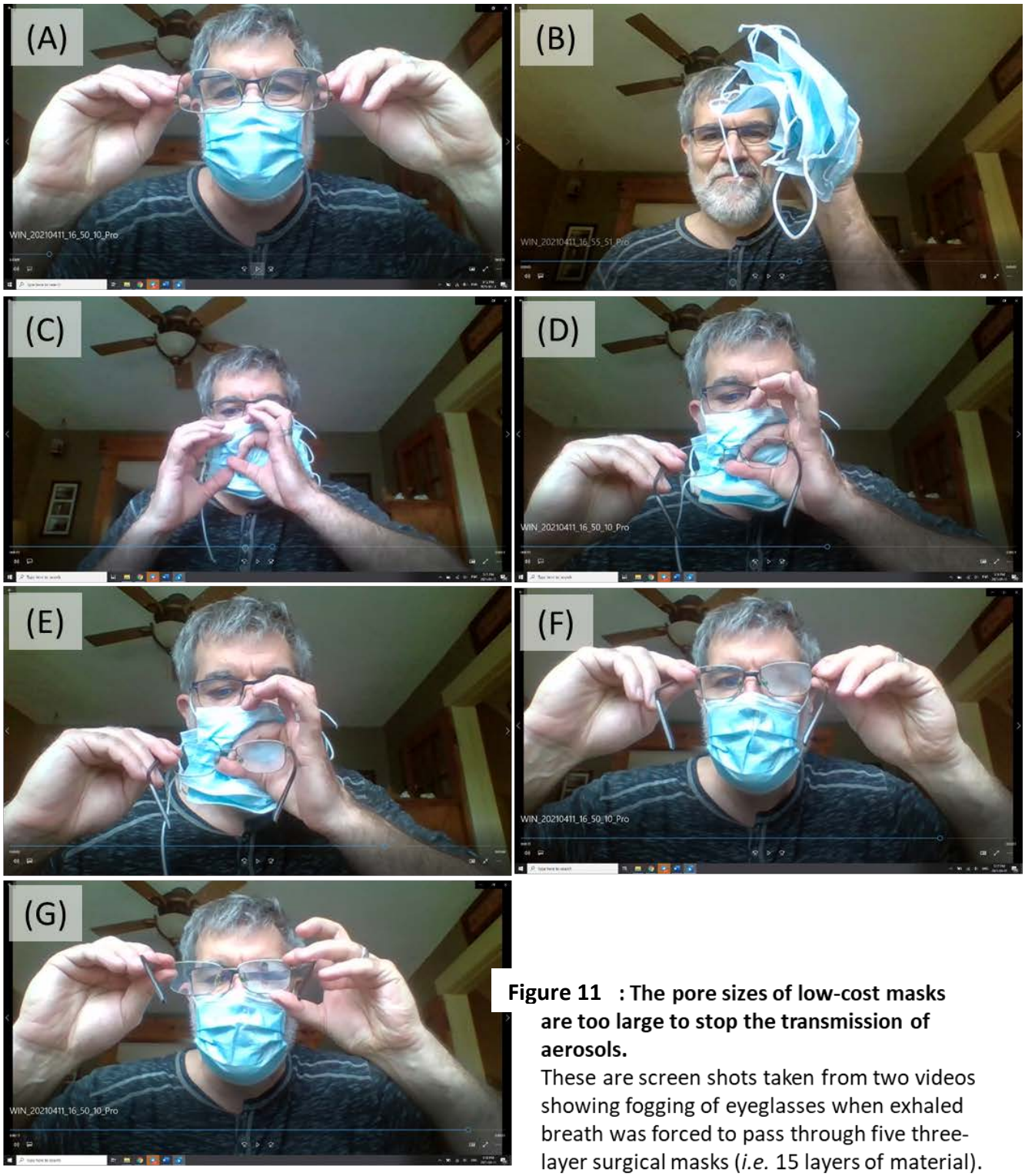


Figure 11 : The pore sizes of low-cost masks are too large to stop the transmission of aerosols.

These are screen shots taken from two videos showing fogging of eyeglasses when exhaled breath was forced to pass through five three-layer surgical masks (*i.e.* 15 layers of material). (A) This image shows the clarity of the eyeglasses when no fogging is present. (B) Five surgical masks were placed sequentially over the mouth. (C) A ring was made with the finger and thumb to apply pressure around the lips and seal the mask so the only place exhaled air could exhaust was through the five three-ply surgical masks. (D) Beginning to exhale through the five masks. (E) Near the end of exhalation. (F) Post-exhalation evidence of fogging is present on the lens of the eyeglasses to the right of the image. (G) So much aerosol had condensed on the lens of the eyeglasses that a cross pattern could be drawn in the liquid.

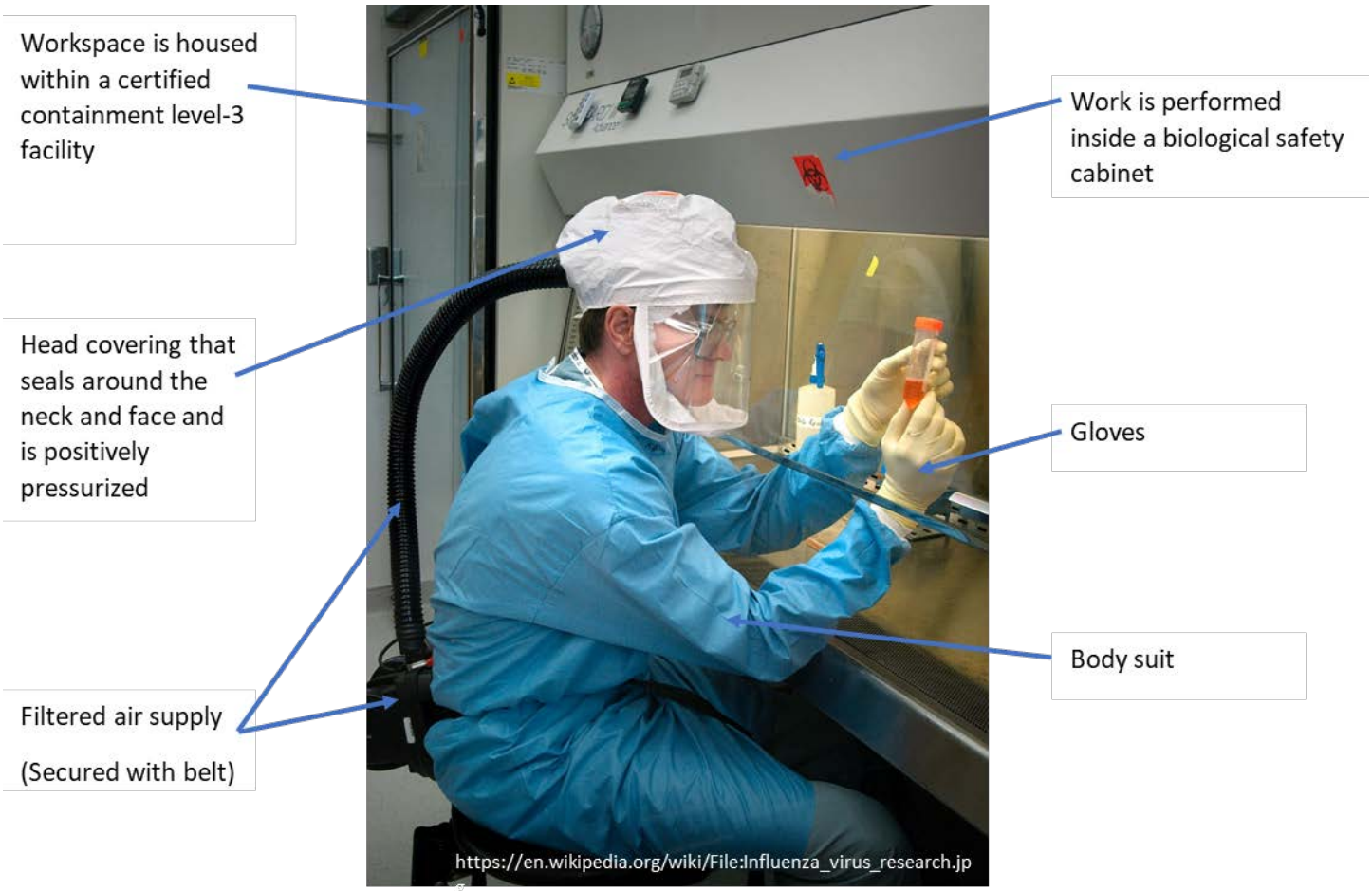


Figure 12 : Personal protective equipment required to safely work with containment level-3 pathogens such as SARS-CoV-2.

SARS-CoV-2 is defined as what is known as a 'containment level-3 pathogen' by the Public Health Agency of Canada. The personal protective equipment that they require scientists to use to ensure safe handling of SARS-CoV-2 typically includes the following: 1. Handling of SARS-CoV-2 can only be done inside a certified containment level-3 facility. 2. Anything containing SARS-CoV-2 can only be opened inside a biological safety cabinet, which is designed to provide a barrier between the virus and the scientist. 3. The scientist must wear a full body suit, including shoe covers and gloves. A head covering with a clear face shield and that seals around the neck and face must be worn. The head covering is connected by a tube that is attached to a pump that delivers filtered air into the head covering, thereby maintaining positive pressure (*i.e.* ambient air cannot flow into the head covering). Personal protective equipment that is known to prevent the wearer from being infected with a containment level-3 pathogen, such as SARS-CoV-2, is shown in figure 3.

A person wearing a low-cost mask would not be allowed to enter a containment level-3 facility due to a profound lack of protection. There is, therefore, a large discrepancy between what truly protects an individual from SARS-CoV-2 and the public health messaging surrounding cloth and surgical masks, which falsely implies a substantial amount of protection.

There are potential harms associated with long-term masking. Not only do masks fail to efficiently stop the spread of COVID-19-laden aerosols, in some cases they may cause harm. Although the pores sizes of low-cost masks are too large to prevent the passage of viruses, bacteria are much larger, as are dust and other environmental particles. Long-term prevention of exposure to the microbial world and natural environment in children has been associated with an increased incidence of allergies, asthma and autoimmune diseases based on an immunological principle known as the 'hygiene hypothesis' (see section 10 for the details). Another potential harm of wearing masks is the psychological effect it has on adherence to public health protocols. The false sense of security that a mask confers causes many people to become less aware of or less concerned with the practice physical distancing. Additional problems include things like blunting social cues by preventing reading of facial body language, muffling speech (a particular concern for individuals with pre-existing speech disorders) and preventing lip-reading.

To assist with understanding the virological principles underlying low-cost masking, I prepared a short, informative video[144].

Overall conclusion: Once one realizes that SARS-CoV-2 can pass through low-cost masks and travel >2 meters and sometimes much further on 'droplet nuclei' in pulmonary aerosols, it becomes readily apparent that the policies of mask-wearing and two-meter physical distancing are not adequately protective against the spread of SARS-CoV-2. If low-cost masking combined with only two-meter physical distancing does little to prevent the spread of SARS-CoV-2, it would be expected that a relatively high proportion of Canadians would have naturally acquired immunity to the virus over the past year. Indeed, this is precisely what was found in a recently published study that showed that the majority of apparently healthy adults in British Columbia have evidence of naturally acquired immunity[25].

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