Board File Nos. 1228-20-HS, 1236-20-HS, 1239-20-HS, 1240-20-HS

ONTARIO LABOUR RELATIONS BOARD

B E T W E E N :

ONTARIO SECONTARY SCHOOLS TEACHERS' FEDERATION, ONTARIO ENGLISH CATHOLIC TEACHERS' ASSOCIATION, ELEMENTARY TEACHERS FEDERATION OF ONTARIO and L'ASSOCIATION DES ENSEIGNANTES ET DES ENSEIGNANTS FRANCO-ONTARIENS

Applicants

- and -

THE CROWN IN RIGHT OF ONTARIO AS REPRESENTED BY THE MINISTRY OF EDUCATION, THE CROWN IN RIGHT OF ONTARIO AS REPRESENTED BY THE MINISTRY OF LABOUR and A DIRECTOR UNDER THE *OCCUPATIONAL HEALTH AND SAFETY ACT*

Responding Parties

- and -

THE CANADIAN UNION OF PUBLIC EMPLOYEES and THE COUNCIL OF TRUSTEES' ASSOCIATIONS

Intervenors

AFFIDAVIT OF DAVID FISMAN

I, **DAVID FISMAN**, of the City of Toronto, in the Province of Ontario, makes oath and say as follows:

1. I am a Professor at the Dalla Lana School of Public Health (DLSPH) at the University of Toronto, the former Head of the Division of Epidemiology at DLSPH, and the incoming head of the Pandemic Readiness stream at the new University of Toronto Institute for Pandemics. I am also a physician, with specialty certification in Internal Medicine from the Royal College of Physicians and Surgeons of Canada.

2. I graduated from the University of Western Ontario's Faculty of Medicine in 1994 and subsequently trained in Internal Medicine at McGill University in Montreal, and at Brown University in Providence, Rhode Island. In 1997 I moved to the Beth Israel Deaconess Medical Center in Boston, Massachusetts, where I completed a 3-year clinical and research fellowship in Infectious Diseases, which included clinical training in HIV management. I also completed a Master's degree in Public Health at Harvard School of Public Health, and was an Agency for Healthcare Research and Quality fellow under the supervision of Dr. Sue Goldie at the Harvard Centre for Risk Analysis.

3. From 2001 to 2003 I was an Associate Medical Officer of Health with the City of Hamilton, Ontario, Department of Public Health and have held faculty appointments at McMaster, Drexel, and Princeton Universities. I returned to Toronto in 2006, and now hold a tenured Professorship at DLSPH.

4. I am a practicing physician (part time, according to the terms of my University of Toronto appointment) and hold hospital privileges at Michael Garron Hospital in Toronto, and at London Health Sciences Centre and St. Josephs Healthcare in London, Ontario. In this context I have taken part in the clinical care of patients with COVID-19, both on medical wards and in the intensive care unit setting.

5. I have specialized knowledge in the field of epidemiology, with particular research interest in infectious diseases. I teach a variety of courses in infectious disease epidemiology and modeling at the University of Toronto, including infectious disease epidemiology (CHL5412), infectious disease epidemiology methods (CHL5432) and mathematical epidemiology (CHL5425). My field includes knowledge of statistics, which allows me to be able to analyze the statistics of infectious disease transmission risk.

6. I have a longstanding research interest in the epidemiology of respiratory infections and influenza; a current PubMed search on my name reveals over 200 publications; 41 of these relate to influenza or pneumococcal disease. Since February 2020 I have published 15 papers related to the epidemiology of COVID-19, and additional analyses are available as preprints. I hold peer reviewed funds from the Canadian Institutes for Health Research (CIHR) for the study of COVID-19, and also have served as Chair of the CIHR Public Health-1 study section for peer review of operating grants. I have recently chaired an international symposium on COVID-19 transmission for the GLOPID-R consortium and have been an invited speaker at a recent (August 4, 2020) World Health Organization symposium on COVID-19 transmission.

7. I am a member of Ontario's Modelling Table and Science Table, both of which advise the Ontario Provincial Government on COVID-19.

8. Attached as **Exhibit A** is a current copy of my C.V.

9. I have been retained by the Elementary Teachers' Federation of Ontario (ETFO) to provide an opinion on COVID-19 and Ontario's approach to re-opening schools. In particular, I have been asked to provide general background information about what we know about COVID-19 and how it is spread, how different public health interventions are able to reduce transmission, and to provide my opinion on measures set out in the Ministry of Education's *Guide to Reopening Ontario's Schools*.

10. I understand that my duty as an expert in a proceeding before the Board is to provide evidence that is fair, objective and non-partisan, to limit the evidence I give to matters that are within my area of expertise, and to provide such additional assistance as the Board may require

in order to determine any matter in issue before it. I believe that these duties prevail over any obligation that I may owe to ETFO, or to any other party.

How COVID-19 is Spread

11. COVID-19 is a viral respiratory disease caused by the SARS-2 coronavirus, also known as SARS-CoV-2. It is spread through multiple transmission routes, including through fomites, via contact, through large respiratory droplets and via aerosols.

12. Over time, our understanding of the relative importance of these different routes has evolved. For example, early in the pandemic, fomite transmissions (i.e. infection that results from physical contact with a contaminated object) was believed to be an important route. This resulted in public health recommendations such as regularly disinfecting high contact surfaces. However, evidence now shows that fomites are a far less significant driver of COVID-19 as originally thought.

13. On the other hand, aerosols are increasingly recognized as an important mode of transmission of COVID-19,[1] and likely explain the extraordinary variability in secondary attack rates. While individual COVID-19 cases can fail to infect others (around 30% of the time from contact tracing data), they can also be extraordinarily infectious, likely through respiratory aerosols. This is likely to explain the propensity of COVID-19 to cause large clusters in "closed,

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[1] Schjiven JL et al. Exposure assessment for airborne transmission of SARS-CoV-2 via breathing, speaking, coughing and sneezing. medRxiv 2020.07.02.20144832; doi: **https://doi.org/10.1101/2020.07.02.20144832**,, **Exhibit B;** Chen W, et al. Short-range airborne route dominates exposure of respiratory infection during close contact. Building and Environment 2020; 176: 106858. https://doi.org/10.1016/j.buildenv.2020.106859, **Exhibit C;** Jiminez, JL. COVID-19 Data Dives: Why Arguments Against SARS-CoV-2 Aerosol Transmission Don't Hold Water. Available via the Internet at https://www.medscape.com/viewarticle/934837?src=uc_mscpedt&faf=1#vp_1., **Exhibit D;**

close, crowded" settings including long term care facilities, food processing plants, and homeless shelters.

14. The SARS-CoV-2 epidemic has been characterized by a "Pareto-distributed" reproduction number, with a minority of primary cases causing a majority of secondary cases. This is strongly suggestive of (uncommon) aerosol transmission, including fine indoor long-distance aerosols, as a driver of superspreader events (i.e., transmission events where one person infects a large number of secondary cases).

15. It has been noted for several months that such events occur most commonly in **closed, close and crowded** spaces, and in the context of **continuous** (prolonged) exposure (i.e., the "4 C's"). Restaurants, bars and other indoor gathering places such as churches have featured prominently in the history of COVID-19 superspreader events.

16. The fact that large outdoor gatherings – such as the notorious large gatherings in Toronto's Trinity-Bellwoods Park – have not appeared to have driven the spread of COVID is further evidence of the important role aerosols play. Diseases spread by aerosols are not known to spread easily in outdoor settings due to the effectively unlimited space in which they can be dispersed to below concentrations capable of infecting an individual.

17. Aerosol transmission may be most likely during the pre-symptomatic phase of infection, as quantitative viral load is likely highest immediately before symptom onset,[2] and high viral

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[2] He X., et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nature Medicine *2020;* 26: 672–675. Available via the Internet at https://www.nature.com/articles/s41591-020-0869-5, **Exhibit E**; Casey M., et al. Pre-symptomatic transmission of SARS-CoV-2 infection: a secondary analysis using published data. medRxiv 2020.05.08.20094870; doi: https://doi.org/10.1101/2020.05.08.20094870, **Exhibit F;** Savvides C. and Siegel R. Asymptomatic and presymptomatic transmission of SARS-CoV-2: A systematic review. medRxiv. doi: 10.1101/2020.06.11.20129072, **Exhibit G;**

loads, in conjunction with coughing, sneezing, loud talking or singing, may create infectious aerosols that may infect at short (< 1.5 m) and longer ranges in indoor settings.

18. Asymptomatic infection appears common; as of July 26, 2020, in a dataset containing 38,405 Ontario confirmed cases 5358 (14% of cases) were listed as asymptomatic. Children aged < 10 were 3 times more likely to be asymptomatic than others.[3]

19. It is my opinion that children aged 10 and over are as likely as adults to be infected by COVID-19, and inasmuch as there is apparent decreased incidence in children under age 10, I believe this attributable to a combination of under-recognition of infection in young children due to absent or atypical symptoms, under-testing, and current reduced contact numbers due to school closures, rather than any differential biological susceptibility to infection.

20. This opinion is supported by a recent seroprevalence study performed in children and adults in Switzerland, after school opening. In a context where children had been able to interact normally for several months, seroprevalence (blood test evidence of past infection) in children and adults was the same.

21. There is some evidence that their infectivity per contact is reduced (perhaps because of weaker cough in small kids, making aerosol less voluminous) but children have larger contact numbers than older individuals, and these contact numbers are markedly increased in school settings. We know from recent studies that viral loads in children are similar to, and perhaps higher, than viral loads in adults.[4]

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[3] Juni Peter et al. for the Ontario COVID-19 Science Advisory Table. The Role of Children in SARS-CoV-2 Transmission. https://covid19-sciencetable.ca/sciencebrief/the-role-of-children-in-sars-cov-2-transmission/, **Exhibit H;**

[4] Heald-Sargent T. Age-Related Differences in Nasopharyngeal Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Levels in Patients With Mild to Moderate Coronavirus Disease 2019 (COVID-19). *JAMA Pediatr.* 2020;174(9):902-903. doi:10.1001/jamapediatrics.2020.3651, **Exhibit I;**

22. There was an initial presumption that children were not infectable by COVID-19 and did not transmit the virus, but these data were gathered in the context of under-testing of children, and during school closures which likely protected children from infection. There are limited data that suggest children may be less infectious than adults, per contact, in household settings; these data are principally derived from a modeling study performed in Israel.[5] However, it should be noted that decreased infectivity per contact in children would nonetheless be counterbalanced by increased contact density in children, especially in the school context.

23. The POLYMOD study performed in the European Union demonstrated highest contact rates in children under non-pandemic conditions, and also documented that children serve as the strongest between-age-group bridges, in that they have contacts with other children as well as adults, whereas most adults' contacts are derived chiefly from within their own age groups.[6] This means that children are potentially potent amplifiers of epidemics, which is consistent with existing literature on seasonal and pandemic influenza resurgence and school opening and also the limited existing literature on the impact of school closures on COVID-19 dynamics.

24. It is my opinion that many of the misconceptions about children and COVID-19 have been driven by the increased likelihood of asymptomatic infection in children (3-fold increased likelihood in Ontario data), which in turn has resulted in children being missed as index cases in clusters, with viral load assessments performed later in the course of infection leading to the assertion that children have lower viral loads. In my work, after adjustment for differential testing, children in Ontario aged 10-19 are approximately as likely as the population as a whole

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[5] Dattner I, et al. The role of children in the spread of COVID-19: Using household data from Bnei Brak, Israel, to estimate the relative susceptibility and infectivity of children.
medRxiv 2020.06.03.20121145; doi: https://doi.org/10.1101/2020.06.03.20121145, **Exhibit J;**

[6] Mossong J., et al. Social Contacts and Mixing Patterns Relevant to the Spread of Infectious Diseases. PLoS Medicine 2008; https://doi.org/10.1371/journal.pmed.0050074, **Exhibit K;**

to be in infected with COVID-19. While younger children appear less likely to be infected, these data have been obtained during school closures with profoundly diminished contact between children. Nonetheless, adjustment for decreased testing results in a two-fold increase in the observed relative frequency of COVID-19 in younger children in Ontario (test-adjusted SMR is 0.24, as compared to an unadjusted SMR of 0.14).[7]

25. My opinions on the infectious nature of COVID-19 is based on my research work and modeling of this infectious disease. I have numerous peer-reviewed publications on the dynamics of COVID-19 in Canada and globally,[8] and am currently working on the age-specific dynamics of this disease in Ontario, using Ontario's iPHIS dataset (for cases) and OLIS dataset (for testing). This data shows that both standardized testing ratios and standardized morbidity ratios for children in Ontario are < 1. This indicates that they are identified as cases at a rate lower than the population as a whole, but also tested at a rate lower than the population as a whole.

26. My conclusions on under-testing as a key driver of the perception that children are less likely to be infected with COVID-19 in Ontario stem from my direct work with Ontario's line list data (the Integrated Public Health Information System, iPHIS) and test count data (Ontario Laboratory Information System, OLIS). As incidence has changed markedly in Ontario during the period between March and August 2020, I have analyzed trends in both disease and testing using "standardized morbidity ratios" (SMR) and "standardized testing ratios" (STR). That is, I have divided reported disease rates, and reported testing rates, by rates of disease and testing in the population as a whole. Thus an SMR (or STR) of 1 would signify that a given age group has

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[7] Fisman D, Greer A, Hillmer M, O'Brien S, Drews SJ, Tuite AR. COVID-19 case-age distribution: correction for differential testing by age. medRxiv 2020.09.15.20193862; doi:https//doi.org/10.1101/2020.09.15.20193862, **Exhibit L;**

[8] PubMed Bibliography for David Fisman. Available at https://www.ncbi.nlm.nih.gov/myncbi/1T91aFEU3YHEwv/bibliography/public/, **Exhibit M;**

a rate of reported disease (or of testing) is the same as that in the population as a whole. We are able to "test-adjust" SMR by using age-specific regression models, with log(STR) used as an independent variable. As log(STR) is equal to zero when STR is equal to 1, (in other words, when testing in a given age group is happening at the same rate as the population as a whole), the intercepts from such models are equivalent to expected SMR when testing occurs at the same rate in a given age group as occurs in the population as a whole.

27. This work in progress leads me to believe that the apparent differences in disease incidence for COVID-19 in children vs. adults can largely be explained by several factors: decreased likelihood of symptomatic disease in children, which in turn leads to less testing, as well as markedly decreased contact densities in children, particularly younger children with less independence, as a result of school closures. It has also informed my understanding of disease severity in children, which I believe to be far lower than in adults.

28. My opinions in this regard have been further reinforced by the recent publication of the Swiss seroprevalence study which demonstrates that symptoms from COVID-19 in children is nonspecific. In this study, there was no difference in symptom history (e.g., having a history of respiratory symptoms or loss of smell) between children with and without antibody against SARS-CoV-2.[9] In this context, symptoms do not serve to increase the likelihood that an individual undergoing testing will, in fact, prove to have SARS-CoV-2 infection, such that testing is effectively at random. By contrast, testing adults with a history of cough, fever, and/or loss of smell is more likely to yield a positive SARS-CoV-2 test than testing adults at random.[10]

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[9] Ulyte A, Radtke T, Abela IA, et al.Variation in SARS-CoV-2 seroprevalence in school-children across districts, schools and classes. medRxiv 2020.09.18.20191254; doi: https://doi.org/10.1101/2020.09.18.20191254, **Exhibit N;**
[10] Ebinger J, Botwin GJ, Albert CM, et al. SARS-CoV-2 seroprevalence in relation to timing of symptoms. medRxiv 2020.08.02.20166876; doi: https://doi.org/10.1101/2020.08.02.20166876, **Exhibit O;**

Direct Effects of COVID-19

29. Severe illness from COVID-19 increases in likelihood with age in Ontario data, and internationally; overall infection fatality ratio is around 0.7% in Ontario; case fatality ranges from 0.07% in those aged < 20 years to 32% in those aged 70 and over. Hospitalization is also uncommon in younger individuals; among 1531 cases in Ontario aged < 20, 29 (2%) were hospitalized and 3 (0.2%) were admitted to intensive care.

30. Multisystem inflammatory syndrome (MIS) is a post-infectious complication of COVID-19 in children and often necessitates intensive care; while it is treatable with immune modulating medications deaths from MIS do occur. At the time of writing over 100 pediatric deaths from COVID-19 have occurred in the United States, in an epidemic with nearly 6 million counted cases of all ages.

Overview of Public Health Measures to Control the Spread of COVID-19

31. The COVID-19 epidemic causes substantial health and economic damage; while lockdowns may be necessary for control in order to prevent mass-death events, lockdowns themselves may cause secondary health consequences (via disruption of other health services, and due to increased deaths from overdose in lockdowns), as well as tertiary health consequences (as a result of economic damage-related health consequences). Thus prevention of health consequences depends on optimizing disease control while minimizing lockdowns.

32. While challenging, best practices globally show that it is possible to reduce COVID-19 transmission to low levels using a combination of distancing, masking, reduced gathering sizes, ventilation and other non-pharmaceutical measures.

33. My rationale for my belief that masking, distancing, and reduced contact numbers are all important in reducing COVID-19 transmission is rooted in the elementary mathematical epidemiology of communicable diseases. The reproduction number for a communicable disease (the number of new cases created by an old case), denoted *R*, can be expressed as p x c x D x S, where p is the probability of transmission per contact, c is the effective contact rate (that is, the number of contacts an individual has per unit time that are of sufficient intensity to transmit infection), D is the duration of infectivity, and S is the fraction of the population that's susceptible to infection.

34. Due to the novelty of COVID-19, the population in Ontario has not developed widespread immunity. Until an effective vaccine becomes available to the general public, in Ontario S will be close to 100%. As a result, we can say that *R* = p x c x D. Reducing the reproduction rate therefore requires public health interventions that lower p (probability of transmission per contact), c (the effective contact rate) and/or D (duration of infectivity).

35. Three important interventions are masking, ventilation and distancing. Masking would reduce p (by reducing infectivity and perhaps by reducing acquisition of infection). Ventilation would also reduce p (by removing infectious aerosol created by a case from an enclosed indoor space before it can infect). Distancing should reduce c. As such the three measures act in a multiplicative way to decrease spread, and none is a substitute for the others. Rather, in my opinion, an effective public health response to COVID-19 requires the simultaneous use of multiple complementary measures.

A. Masking

36. Masking is likely most effective as a means of source control: by reducing the amount of infectious aerosol created by infectious individuals, masks reduce the risk of both short and

longer-distance airborne COVID-19 transmission. They do so by reducing infective aerosol production by infected individuals. Because it appears that individuals are most infective prior to the onset of symptoms, and many infective people are completely asymptomatic, it is important that masking be done on a universal basis in all indoor locations.

37. Masks may also prevent infection in the wearer, but this is less clear at this time. It may be that the type of mask is significant in terms of infection prevention. For example, an N95 respirator would likely provide greater protection to the wearer than an improvised cloth face covering or surgical mask, particularly against very fine aerosols. However, randomized controlled trials of surgical masks vs. N95 masks in the healthcare setting have shown no advantage for N95 masks over surgical masks for prevention of influenza virus infection, and there is not yet a documented clear advantage for N95 masks over surgical masks for prevention of COVID-19 in high-risk healthcare settings.[11]

38. My views on aerosols have been shaped by the work of Schjiven et al., from the Netherlands,[12] by talks given by Drs. Charles Haas and Yougo Li at the GLOPID-R symposium (July 20, 2020) and WHO symposium (August 4, 2020) on COVID-19 transmission, and by the work of Dr. Jose Luis Jiminez at University of Colorado.[13] I have come to understand that aerosol transmission that creates superspreader events depends on high viral load in mucus in a

11 Loeb M., et al. Surgical mask vs N95 respirator for preventing influenza among health care workers: a randomized trial. JAMA. 2009 Nov 4;302(17):1865-71. doi: 10.1001/jama.2009.1466, **Exhibit P;** Chou R., et al. Masks for Prevention of Respiratory Virus Infections, Including SARS-CoV-2, in Health Care and Community Settings. Ann Intern Med. Available via the Internet at https://www.acpjournals.org/doi/10.7326/M20-3213?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed, **Exhibit Q;**

12 Schjiven JL et al. Exposure assessment for airborne transmission of SARS-CoV-2 via breathing, speaking, coughing and sneezing. medRxiv 2020.07.02.20144832; doi: https://doi.org/10.1101/2020.07.02.20144832**, Exhibit B;**

13 Jiminez, JL. COVID-19 Data Dives: Why Arguments Against SARS-CoV-2 Aerosol Transmission Don't Hold Water. Available via the Internet at https://www.medscape.com/viewarticle/934837?src=uc_mscpedt&faf=1#vp_1., **Exhibit D;**

source patient (commonly pre-symptomatic), with respiratory aerosols created by talking, singing, coughing and sneezing (in the absence of masks).

39. My opinions related to the importance of masking in reducing transmission of COVID-19 also drives from my own modeling work on this subject, as well as review of published and unpublished studies from other countries noting the temporal relationship between masking orders and declines in disease incidence.

40. I have also for the purposes of this report performed a cross-sectional time series analysis of the impact of masking orders by health unit in Ontario. The variable timing of mask mandates by health units has created a de facto natural experiment so that masking can be analyzed as a "shock" with respect to disease time trends. My model is based on publicly available case count data from the COVID-19 Canada dashboard (https://art-bd.shinyapps.io/covid19canada/). I have adjusted for time trends using cubic splines with monthly knots. I have incorporated phase 1, 2 and 3 opening, by health unit, into the model as binary exposures. Health units are treated as fixed effects. In this model, I find substantial effects of masks.

41. It is challenging to rigorously assign causality to the effects of masks on COVID-19 transmission because of many interventions and behavior changes occurring simultaneously. Nonetheless, it has been notable in July and August 2020 that British Columbia has had a rising effective reproduction number (R(t), the average number of new cases created by an old case) while Ontario and Quebec have gone through a period of low R(t) following mask mandates, notwithstanding substantial economic opening in those provinces. We have performed an analysis using variable timing of masking mandates in Ontario health units, which suggests that the relative risk reduction associated with masking orders in Ontario has likely been on the order of 38% (95% CI 28% to 47%) in the province as a whole, higher in the Greater Toronto Area

(53%, 95% CI 27% to 65%) and lower outside the GTA (19% reduction (3% to 33%). This is consistent with published modeling work by my group, which suggests that masks are likely to be sufficient to cause R(t) to fall below 1 when R(t) is near 1 in the absence of masks.

42. In my opinion there is no reason to anticipate harms, physical or psychological, from mask wearing in children. Public or indoor mask wearing, including by children, is mandated in many jurisdictions in North America, Europe and Asia, and I am unaware of credible reports of harms.

B. Ventilation

43. As I noted above, poorly ventilated indoor spaces, crowded places, and close contact increase the likelihood that these aerosols infect secondary cases. As such, the use of masks is one intervention that helps to reduce the likelihood of aerosol transmission events. Another mechanism is increased ventilation While poorly ventilated indoor spaces are an important driver of infection, outdoor gatherings have not resulted in superspreader events. This is likely a result of aerosols dispersing into an effectively limitless volume of air, which reduces the probability of infection.

44. Ventilating indoor spaces – that is to say removing air inside of an enclosed space and replacing it with air from outdoors – has a similar protective effect. It removes aerosolized virus-laden particles, reducing the probability of infection for any given contact.

C. Physical Distancing

45. Distancing reduces the likelihood of transmission via short distance aerosols and by contact. Current evidence from the COVID-19 pandemic shows that distancing is most effective at distances greater than 1.5 metres.[14]

D. Multiple Measures Should be Used Simultaneously

46. I should add that, while contact and fomite transmission appears to be a less significant route for COVID-19, measures such as hand hygiene can also play an important role alongside masking in all indoor locations, ensuring good ventilation of indoor locations, and distancing (>1.5m) in both indoor and outdoor situations. However, none of these measures are substitutes for each other. Rather, they must all be used simultaneously and consistently in order to effectively reduce the reproduction rate of COVID-19.

47. For example, masks should always be worn in indoor public spaces, even when social distancing is feasible, because they reduce the likelihood of generation of fine aerosols through coughing, sneezing or talking or singing, and such aerosols (depending on air currents and environmental conditions in the space) do have the potential to remain airborne for long periods of time. As such, while distancing is helpful for reducing transmission by short-distance aerosols that fall rapidly to the ground, masking can help reduce both generation of these aerosols, and the generation of finer aerosols that can remain airborne and result in superspreader events.

[14] Chen W, et al. Short-range airborne route dominates exposure of respiratory infection during close contact. Building and Environment 2020; 176: 106858. https://doi.org/10.1016/j.buildenv.2020.106859, **Exhibit C;**

48. Similarly, ventilation of indoor locations should be a priority even where physical distancing can be maintained. Ventilation can help in disbursing finer aerosols that remain airborne, are capable of traveling longer distances, and which result in superspreader events.

Schools and COVID-19

49. Schools have emerged as one "large gathering" which it is very challenging to close. Education of children is desirable, and the ability to send children to school allows their adult carers to focus on work, mitigating the economic harms of the pandemic.

50. Given the novelty of COVID-19, we do not have clear knowledge of how school opening will affect pandemic waves. While school opening in Denmark in spring 2020 was a notable success, that effort included dramatic reductions in class sizes, strict cohorting and separation of student groups, and an emphasis on the use of outdoor spaces for teaching.[15] School openings in Chile, Israel, Scotland and South Korea have been notable for recent outbreaks.[16]

51. In my opinion, schools represent a form of "large gathering" that is particularly concerning with respect to the spread of COVID-19. There are a number of reasons why school reopening represents a significant risk factor in the pandemic spread of COVID-19.

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[15] Musset B. Switzerland and Denmark may offer tips for successful return to school in B.C. CBC News, August 15, 2020. https://www.cbc.ca/news/canada/british-columbia/switzerland-denmark-school-reopening-plan-covid-19-1.5683975, **Exhibit R;**

[16] Covid-19: South Korea closes Seoul schools amid rise in cases. BBC News, August 26, 2020. https://www.bbc.com/news/world-asia-53901707, **Exhibit S;** Bowie J. Coronavirus Scotland: Transmission in Glasgow schools confirmed for first time as two more hit by outbreaks. The Scottish Sun, September 3, 2020. https://www.thescottishsun.co.uk/news/5999814/coronavirus-scotland-glasgow-school-outbreak-transmission/, **Exhibit T;** Torres JP et al., SARS-CoV-2 antibody prevalence in blood in a large school community subject to a Covid-19 outbreak: a cross-sectional study. Clinical Infectious Diseases 2020, ciaa955, https://doi.org/10.1093/cid/ciaa955, **Exhibit U;**

52. As discussed above, superspreader events in the COVID-19 pandemic have most commonly taken place in closed, close and crowded spaces, in the context of continuous (prolonged) exposure (i.e., the "4 C's"). School classrooms represent a paradigmatic example of this type of setting.

53. Children have larger contact numbers than older individuals generally, and these contact numbers are markedly increased in school settings. Recalling that the reproduction rate *R* can be expressed as p x c x D, reopening classrooms increases "c" both because of higher numbers of contacts as well as more prolonged contacts.

54. The timing of school reopening in Ontario is also relevant. There is general acceptance that there is a real risk of a "second wave" of the pandemic in fall. The reason for this is that fall represents a confluence of several overlapping – and likely reinforcing – factors that increase the risk of spread of respiratory diseases like COVID-19. Changing environmental conditions that begin during the fall are both more favorable for transmission of diseases like COVID-19 (e.g. lower temperature, drop in absolute humidity) and also result in changes in human activity that increases the risk of transmission (e.g. more time spent indoors, increased close contact between individuals). Historically, other major pandemics, like the 1919 Spanish Flu and the H1N1 pandemic, had new waves emerge during the fall.

55. The start of the school year in Ontario coincides with these other risk factors. This is why school opening has historically been a driving dynamic in seasonal influenza. In my view, these dynamics also apply to COVID-19.

56. Much of the discussion around school opening in Canada has assumed reduced susceptibility to infection, and reduced infectivity by children. However, I do not believe this to be the case. There is some limited evidence that younger children are less infectious to adults

within households, but even this decreased per contact infectivity would be overcome by higher contact rates of children placed in large-sized classes.

57. My opinion that unsafe reopening of schools is likely to result in surges in disease that will cause illness and deaths to rise in the community is based on my knowledge of the existing literature on importance of school opening and closing in driving disease dynamics for both seasonal and pandemic influenza, and based on work on which I have collaborated, or which I have reviewed, suggesting that school closures during COVID-19 have resulted in decreased transmission relative to what would have happened if schools had been left open.[17]

58. It is my opinion that a strong focus on reduced class sizes, improved school ventilation, and mask use would help reduce school-related surges in COVID-19 activity in Canada this fall. The importance of reducing class sizes has been demonstrated in mathematical modeling work by the highly regarded Canadian mathematician Dr. Chris Bauch at the University of Waterloo.[18]

The *Guide to Reopening Ontario's Schools*

59. I have reviewed the *Guide to Reopening Ontario's Schools* (the *Guide*). In my opinion, the directions that it contains are inadequate to protect against the spread of COVID-19 within schools. The guide does not contain sufficient measures to adequately protect students, teachers and other adults working in schools, or the public more broadly. There are additional reasonable

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[17] Earn, DJD et al. Effects of school closure on incidence of pandemic influenza in Alberta, Canada. Ann Intern Med. 2012 Feb 7;156(3):173-81. doi: 10.7326/0003-4819-156-3-201202070-00005, **Exhibit V;** Cauchemez, S et al,. Estimating the impact of school closure on influenza transmission from Sentinel data. Nature. 2008 Apr 10;452(7188):750-4. doi: 10.1038/nature06732., **Exhibit W;** Auger, KA., et al. Association Between Statewide School Closure and COVID-19 Incidence and Mortality in the US. *JAMA.* 2020;324(9):859-870. doi:10.1001/jama.2020.14348, **Exhibit X;** Juni, P., et al. Impact of climate and public health interventions on the COVID-19 pandemic: a prospective cohort study. CMAJ May 25, 2020 192 (21) E566-E573; DOI: https://doi.org/10.1503/cmaj.200920, **Exhibit Y;**

[18] Phillips B et al., Model-based projections for COVID-19 outbreak size and student-days lost to closure in Ontario childcare centres and primary schools.
medRxiv 2020.08.07.20170407; doi: https://doi.org/10.1101/2020.08.07.20170407, **Exhibit Z;**

steps that should be included in the guide in order to reduce the risk of Ontario's schools being a driver of the COVID-19 pandemic.

60. In my opinion, there are at least five major failings in the *Guide*: The failure to require universal indoor masking at all age levels; the failure to require enhanced ventilation of indoor locations; failing to set out minimum standards for physical distancing; not requiring reduction in class sizes outside of designated secondary school boards; and serious flaws in its approach to cohorting. In my opinion, other measures that are contained in the *Guide* are not sufficient to make up for the inadequacies I have identified above.

A. Masking

61. The *Guide* requires students in grades 4 to 12 to wear non-medical or cloth masks indoors in school, including in hallways and during classes. Outdoor times like recess can be used as opportunities to provide students with breaks from wearing masks. In my view, these are reasonable rules. As discussed above, mask wearing is an important method of source control of expelled respiratory particles of various sizes, which is particularly critical within indoor locations, regardless of distancing. The universal masking requirement for grades 4-12 are therefore one important protective measure (amongst others) that can reduce the reproductive rate of COVID-19 within schools. Given the evidence on outdoor transmission, it is reasonable to permit students to not wear masks while outdoors (though other measures, like distancing and sneeze/cough etiquette should still be followed).

62. Where the *Guide* is problematic is in its treatment of Kindergarten to Grade 3 students. These students are encouraged but not required to wear masks in indoor locations. For the reasons I have already discussed in this affidavit, in my opinion this is not appropriate. These students should also be required to wear masks at all times when indoors. Evidence shows that

children in this age group are able to wear masks, and that there is no credible evidence that masking causes them any harm. Indeed, if the *Guide* were drafted on the premise that masking was harmful to students in this age range, it would not make sense for it to encourage masking.

63. As I have discussed above, the belief that younger children do not become infected or do not infect others is misguided. Concerns about contamination by touching masks fails to recognize that masks main purpose are as source control. It also fails to recognize that, given greater understanding of COVID-19, aerosol transmission is a much more significant concern than fomite transmission. To the extent that maintaining physical distancing for younger students can be difficult, there is even more reason to require universal indoor masking.

B. Ventilation

64. Ventilation of indoor spaces is not addressed by the *Guide,* notwithstanding the important role good ventilation plays in reducing the spread of COVID-19. The only place in the guide that makes express reference to ventilation is in the context of bussing, where it indicates that windows should be opened when feasible to increase ventilation. The section of the guide on adapted school environments does make reference to indoor ventilation.

65. For the reasons I have discussed earlier, ventilation appears to play an important role in reducing the risk of infection from finer aerosols that do not fall to the floor, but rather remain suspended in air currents for extended periods of time. This is why transmission rates in large outdoor gatherings has appeared to be surprisingly low.

66. Due to the fact that classrooms are closed, close and crowded spaces in which there is continuous contact between individuals, requiring adequate ventilation is key to reducing the risk of infection.

67. I am not an expert in ventilation, and so I do not have a what specific standard would represent a reasonable minimum for a safe re-opening of schools. My point is that the absence of any rules at all in the *Guide*, coupled with the well-known variability in schools in Ontario (including some that lack any mechanical ventilation at all), constitutes a significant shortcoming in my opinion.

C. Physical Distancing

68. The *Guide* calls for the promotion of "as much distancing as possible between students, between students and staff and between staff members". I agree with this approach. Distancing is an important factor in reducing the risk of transmission of COVID-19 and is therefore a key component of any reasonable approach to school re-opening.

69. However, the *Guide* does not set out any minimum rules for distancing. For example, the guide states that "Gymnasiums should only be used where physical distancing measures can be followed." It does not identify what constitutes a "physical distancing measure". Similarly, the *Guide* recognizes the wide variability in classroom sizes, and encourages removing furniture so that there is "as much distancing as possible" between individuals. However, the guide does not indicate what is the minimum distancing that is acceptable.

70. As I have discussed above, studies have demonstrated that physical distancing of 1.5 metres or more provides meaningful protection against the transmission of COVID-19. Distancing of less than this provides significantly less protection against transmission. I am aware that in some jurisdictions, guidelines have called for minimum distancing of 1 metre. In my view, 1 metre distancing is not supported by the scientific evidence that currently exists, and that distancing of 1.5 or 2 metres should be required in order to meaningfully reduce the risk of transmission.

D. Class Size

71. For the most part, the *Guide* does not require schools to reduce class sizes below what would normally be the case in the province. The notable exception to this is that in the 24 Designated school boards, secondary schools are required to operate with reduced class cohorts of approximately 15 students. I am informed by counsel that class sizes vary in Ontario, but that in most cases they are larger than 20 students.

72. Reducing class sizes is one of the most effective tools in lowering the risk that classrooms will be drivers of the COVID-19 pandemic. I am aware that the SickKids *Updated Guidance for School Reopening* states that "smaller class sizes should be a priority strategy" in reopening schools (p. 10). Reducing class sizes produces four distinct forms of protection simultaneously.

73. First, reduced class sizes reduce the probability that any member of a class is infected with COVID-19. The logic here is obvious. All other factors being equal, the risk that any group of individuals includes at least one person who is infected increased based on the size of the group. Reducing class sizes reduces the probability that any given classroom could be a potential source of transmission in the first place.

74. Secondly, reducing class sizes also reduces the number of secondary cases that could result from a primary case. If there is an infectious individual in a given group, the size of the group will impact the expected number of secondary infections that will occur. The larger the group, the larger the average number of secondary infections we would expect to see. The size of the group also constitutes the maximum number of secondary infections that could occur within a classroom.

75. Third, given that classrooms are essentially fixed spaces, reducing class sizes allows for greater distancing between individuals. As discussed above, this provides an increased protection against transmission via the droplet route.

76. Fourth, reducing class sizes reduces the overall production of finer aerosols within a fixed indoor space. Every individual in an indoor location produces aerosols as they breath, speak, cough, etc. The more individuals in a room, the more aerosols are produced. Conversely, the fewer individuals in a room, the lower the level of aerosol production. Reducing class sizes reduces the risk that infectious aerosols will be produced at a sufficiently high quantity to become infectious.

77. This last protective effect is even more important in poorly ventilated spaces. As enclosed spaces become occupied by larger numbers of individuals, the requirement for increased airflow to produce adequate ventilation also increases. Conversely, in circumstances where ventilation cannot be provided at adequate rates with fully occupied classrooms, reducing class sizes may be able to ameliorate this problem somewhat by reducing the rate at which aerosolized particles are produced and need to be ventilated out.

78. In my opinion, the total absence of class size limits in most classrooms is an unreasonable approach to school re-opening from a public health perspective. As I discussed above, current mathematical modeling indicates that class sizes in the 20s produce significantly higher predicted infection rates than classes half that size.

79. I should also note that, when speaking of class size, it is not only students who matter. A kindergarten class size, for example, needs to also take into account the presence of a teacher and designated early childhood educator, as well as any other adults that may be present, such as educational assistants.

80. Highschool classes of 15 in designated board are more reasonable in terms of class size. While even greater reductions in infection rates would likely occur in classes of 8 to 10, or fewer, in my opinion a class size of 15 is still a safer approach to re-opening than classes with 22, 23 or 24 students.

E. Cohorting

81. The *Guide* sets out rules respecting "cohorting". As used in the *Guide* cohorting referred to grouping students together throughout their time at school and attempting to keep each group separate from one another. Cohorting does not necessarily reduce the total number of contacts a student has during the course of the day, but rather seeks to limit the number of unique individuals who are in contact with a given student. Cohorting, combined with other measures, is an important way to reduce the risk of COVID-19.

82. The guide sets out different expectations for cohorting of students depending on the grade level. At the elementary level, the guide indicates that students should remain in a single cohort the whole day, where possible. In effect, the cohort and the class are the same. In my view, this is a sound strategy, although as I have discussed above, the size of each class cohort is too large. Cohorting students to a single class, combined with lower class sizes, universal masking, distancing of at least 1.5 metres and adequate ventilation rates constitutes an effective means to ensure that schools do not become drivers of pandemic spread of COVID-19.

83. However, side from the size of the class-based cohort, there are two additional flaws in how cohorting is implemented at the elementary level. First, while students are ideally cohorted in single classes, the *Guide* makes clear that students who participate in before and after school

programs will in fact be parts of two cohorts. This increases not only the total number of contacts that students have, but also the total number of unique individual students will have contact with. The latter increases the probability that someone that a student has contact with is infectious. It also increases the total number of persons that an infected student could spread the disease to. Depending on the size of a cohort in a before or after school program, this could significantly undermine the effectiveness of the *Guide*'s class-based cohorting system for elementary students.

84. The second problem at the elementary level is the issue of "itinerant" teachers. The guide states that specialized teachers, such as French language teachers, will still move from classroom to classroom to provide instruction. This increases the risk of infection to both the teacher, and to the students. This is because teachers (or other adults) moving from class to class can act as a bridge that links cohorts together. A teacher may become infected by students in one cohort, and subsequently pass on the infection to a student in a previously uninfected cohort. In other words, by having itinerant teachers, elementary students are not fully cohorted into single class groups at all.

85. We have already experienced a clear example of how this type of movement between cohorts can drive the pandemic in Ontario: the case of long-term care homes. Early in the pandemic, evidence clearly demonstrated that the pattern of workers who held part-time hours of multiple long-term care homes were a major factor in the rapid and devastating spread of COVID-19 in long-term care homes. Itinerant teachers present the same risk factors.

86. At the high school level, schools are directed to use timetabling strategies to keep student to approximately 100 direct and indirect contacts per day and limiting them to two class cohorts.

87. In my opinion, cohorts of this size are dramatically too large. Public health guidance directs individuals to maintain social circles of 10, yet the *Guide* uses contacts ten times that size as a goal. While the requirement to universally mask at school means that one cannot directly compare school cohorts to social circles, it does provide some sense of the significance of the scale of cohorting that the *Guide* permits. Masking reduces transmission, but I am not aware of any suggestion that masking is perfectly effective. As such, the benefits of masks are likely to be overcome by the extremely large contact numbers permitted by the *Guide*.

F. Other Measures in the *Guide* are not Adequate Substitutes

88. Consistent with the opinion I have provided above, the *Guide* expressly recognizes that no one strategy provides adequate protection against schools becoming drivers of the COVID-19 pandemic. Rather, it requires schools to "employ **multiple strategies**" (emphasis in original). However, in my opinion, the other strategies that the guide calls for are not adequate substitutes for requiring universal masking, implementing physical distancing of 1.5 or more metres, reducing class sizes, requiring adequate ventilation and addressing the shortcomings of the *Guide*'s cohort rules.

89. The *Guide* requires students to be trained on hand hygiene and to be given the opportunity to practice proper hand hygiene throughout the day. I agree that this is a positive measure. However, given the minor role contact and fomite transmission plays in driving the pandemic, compared to droplet and aerosol transmission, hand hygiene measures are not substitutes for the measures I have identified above.

90. The *Guide* requires that all staff and students must self-screen for symptoms before attending school and must stay home when feeling sick. While staying home while feeling sick is a generally good public health practice, in the context of COVID-19, these measures have little value in preventing the spread of the disease.

91. As discussed earlier in this affidavit, individuals who are infected with the SARS-CoV-2 virus are most infectious *before* they become symptomatic. While it has been challenging to study infectivity in pre-symptomatic individuals, who, by definition, feel well, there is now a literature based on testing of contacts of infectious individuals that demonstrates higher viral loads in pre-symptomatic than symptomatic individuals, and which demonstrates a progressive decrease in infectivity over time (with no evidence of culturable virus in individuals after 9 days of symptoms).[19] Screening measures therefore identify infected persons far too late. By the time a student or adult will be screened out from coming to school, they will already have been in the school setting at their peak infectiousness.

92. The fact that peak infectiousness occurs well before symptom onset is a problem with symptom screening in all settings. However, it is a particularly ineffective measure in the school setting due to the fact that children, as compared to adults, are far more likely to be asymptomatic carriers of the disease. Compared to adults, infected students are more likely to never develop symptoms at all. This is why, as discussed above, children have been under-tested

[19]He X., et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature Medicine 2020;* 26: 672–675. Available via the Internet at https://www.nature.com/articles/s41591-020-0869-5, **Exhibit E;** Casey M., et al. Pre-symptomatic transmission of SARS-CoV-2 infection: a secondary analysis using published data. medRxiv 2020.05.08.20094870; doi: https://doi.org/10.1101/2020.05.08.20094870, **Exhibit F;** Savvides C. and Siegel R. Asymptomatic and presymptomatic transmission of SARS-CoV-2: A systematic review. medRxiv. doi: 10.1101/2020.06.11.20129072; **Exhibit G;** Roman Wölfel,Virological assessment of hospitalized patients with COVID-2019. *Nature* 2020; 581, 465–469. Available via the Internet at https://www.nature.com/articles/s41586-020-2196-x, **Exhibit AA;**

compared to adults. However, the fact that a person is asymptomatic does not means that they are not infectious.

93. As noted in a classic paper entitled "Factors that make an infectious disease outbreak controllable",[20] Christophe Fraser and colleagues, in reference to the importance of asymptomatic or pre-symptomatic spread in determining the ability to control an infectious disease outbreak or epidemic, stated that "the success of…control measures is determined as much by the proportion of transmission occurring prior to the onset of overt clinical symptoms (or via asymptomatic infection) as the inherent transmissibility of the etiological agent (measured by the reproductive number R_0)."

94. As the SARS-CoV-2 pandemic has evolved, it has become increasingly clear that asymptomatic and pre-symptomatic transmission of infection are common and as predicted by Fraser and colleagues, are likely to be important factors determining the lack of elimination of SARS-CoV-2 in many jurisdictions, including Canada. Two independent analyses (one by Prof. Gabriel Leung at University of Hong Kong; the other by Prof. Allison Galvani at Yale) have estimated that 40-50% of transmissions of SARS-CoV-2 are from individuals with no symptoms.[21]

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[20] Fraser C. et al., Factors that make an infectious disease outbreak controllable. Proceedings of the National Academy of Sciences April 20, 2004 101 (16) 6146 -6151; https://doi.org/10.1073/pnas.0307506101, **Exhibit BB;**

[21] Moghadas SM, Fitzpatrick MC,Sah P, Pandey P, Shoukat A, Singer BH, Galvani AP. The implications of silent transmission for the control of COVID-19 outbreaks. Proceedings of the National Academy of Sciences USA. July 28, 2020 117 (30) 17513-17515; first published July 6, 2020 https://doi.org/10.1073/pnas.2008373117, **Exhibit CC**; He X., et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nature Medicine *2020;* 26: 672–675. Available via the Internet at https://www.nature.com/articles/s41591-020-0869-5, **Exhibit E;**

95. The *Guide* indicates that teachers will also be provided with goggles or face shields in addition to “medical masks”. Goggles and face shields forms of eye protection, which protect against ballistic droplets. However, they are not considered to be a form of protection against aerosols. Layering a face shield on top of a non-medical mask does not make up for the absence of mandatory masking in Kindergarten to Grade 3, as masks in this instance serve as “source control” to prevent the generation of infective aerosols.

SWORN before me, by video link, in the City of Toronto, in the Province of Ontario, this ___ day of September, 2020 ______________________________ A Commissioner, &c. *Pursuant to O.Reg. 431/20*	______________________________ David Fisman Sworn at Toronto