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副院长：李玉國教授

To Legislative Council of the Hong Kong Special Administrative Region of the People's Republic of China

29 April 2021

Re: Six air change per hour in terms of equivalent fresh air intake in the seating area of dine-in restaurants under the Prevention and Control of Disease (Requirements and Directions) (Business and Premises) Regulation (Cap. 599F) on infection control grounds

Dear Chairman and Honourable Members,

I write to support the recommended six air change per hour in terms of equivalent fresh air intake for infection control in the seating area of dine-in restaurants in Hong Kong.

I am a member of the Working Group on Implementing the Requirement on Air Change or Air Purifiers in Dine-in Restaurants under Cap. 599F. I have been studying environmental transmission of respiratory infection such as influenza and SARS-CoV-1 since the 2003 SARS epidemic. Since the COVID-19 pandemic emerged in early 2020, I have been collaborating with various health authorities in Hong Kong and Mainland, and many researchers in Hong Kong and elsewhere to study the transmission routes of SARS-CoV-2 and the roles of building ventilation.

I wish to clarify two aspects of the recommended six air change per hour ventilation requirement.

First, the recommended six air change per hour is a moderate ventilation requirement for the purpose of infection control for COVID-19.

The scientific basis for sufficient ventilation for infection control of COVID-19 originates from the dilution effect of clean air for the expired infectious aerosols in both short-range (less than 1-2 m of an infected individual) and long-range (i.e. the rest of a room where an infected individual stays). A sufficient dilution of expired aerosols would reduce infection risk due to short- and long-range airborne transmission to a minimum.

The required minimum ventilation rate for infection control of COVID-19 is currently an active research topic. Having studied three outbreaks in a Guangdong restaurant and two Hunan buses, my research team found that a ventilation rate less than 3 L/s per person led to the long-range airborne transmission. These studies do not rule out that ventilation rates larger than 3 L/s per person do not lead to long-range airborne transmission in other venues. On the other hand, although there have been some reported outbreaks of COVID-19 in well-designed/operated offices and passenger air cabins, but their attack rates are also much lower than in spaces with relative high activity levels such as gyms, dancing floors and restaurants.

In explaining the observed phenomenon of low infection risk of COVID-19 outdoors, we have realized for the first time that at rest conditions, a ventilation rate of 8-10 L/s per person would produce effectively similar infection risk indoors and outdoors for the short-range airborne transmission. By using an equal exposure concept, the ventilation requirements in different indoor spaces for ventilation control can be determined. In dine-in restaurants, this concept produces a ventilation requirement of 17.8 L/s per person, considering the increased metabolic activity of the restaurant patrons during eating than at rest conditions.

The current requirement of ventilation in dine-in restaurants in Hong Kong is 17 m³/h (or 4.7 L/s per person), which does not account for infection control. For an occupancy of 2.2 m² floor area per person, 17 m³/h ventilation air corresponds to three air change per hour. Six air change per hour corresponds to 34 m³/h (or 9.4 L/s per person). This is much lower than the ventilation requirement of 17.8 L/s per person in restaurants that my research team has estimated. The 9.4 L/s per person corresponds well to the commonly designed (equivalent) ventilation rates of 8-10 L/s per person in offices and passenger air cabins.

Second, the recommended six air change per hour ventilation requirement will very likely minimize infection risk in dine-in restaurants and subsequently in the general community in Hong Kong.

The transmission route(s) for SARS-CoV-2 have been in debating since the very beginning of the pandemic. China CDC initially recognized the predominance of large droplet transmission and contact transmission, and then by 18 February 2020 the possibility of airborne (aerosol) transmission in enclosed spaces with long exposure, following an outbreak in a Guangzhou high-rise housing block where tracer gas studies revealed the possible roles played by the drainage stack. More than 15 similar outbreaks of COVID-19 occurred in Hong Kong. It was not until October 2020 when World Health Organization and US CDC recognized this possibility of airborne transmission.

I have personally joined many scientists around the world to campaign for the recognition of the airborne route by authoring or co-authoring several commentaries on airborne transmission and discussing our latest findings in COVID-19 outbreak studies. Very importantly, in their science brief, US CDC stated that “The principal mode by which people are infected with SARS-CoV-2 (the virus that causes COVID-19) is through exposure to respiratory droplets carrying infectious virus” and “It is possible for people to be infected through contact with contaminated surfaces or objects (fomites), but the risk is generally considered to be low.”

The reported and observed outbreaks of COVID-19 shows that the SARS-CoV-2 is occasionally transmitted by long-range airborne route, and research in my team shows that among various possible transmission routes (large droplets, surface touch and airborne), the short-range airborne route predominates in the close-contact transmission of SARS-CoV2. To me, the predominant short-range airborne route with long-range airborne route as its continuation can explain most observed transmission phenomena so far in Hong Kong and elsewhere. Most importantly, a good ventilation, e.g. 10 L/s per person at rest conditions, can also significantly reduce the infection risk due to the short-range airborne route to the outdoor level, and a poor ventilation would significantly increase the short-range airborne route risk.

Thus, six air change per hour ventilation requirement will minimize the infection risk in dine-in restaurants. The currently 4.7 L/s per person requirement seems too low for the infection control purposes.

I shall be pleased to provide scientific references for all the statements that I made in this support letter.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'Yuguo Li', with a stylized, cursive script.

Yuguo Li