Learning from the Pandemic: An Indoor Air Crisis

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EDITORIAL

WILEY

The COVID-19 pandemic is a global indoor air crisis that should lead to change: A message commemorating 30 years of Indoor Air

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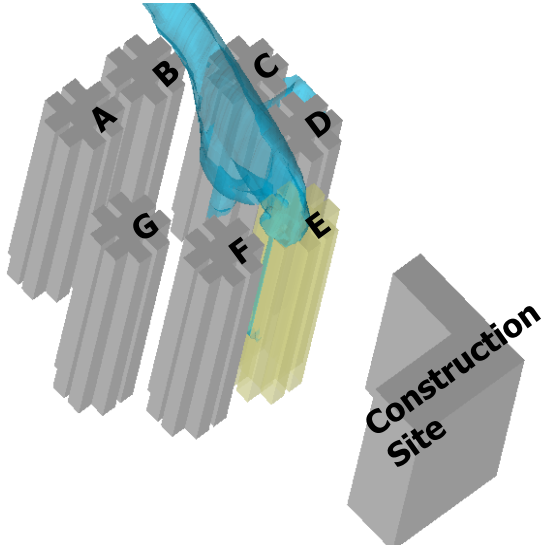
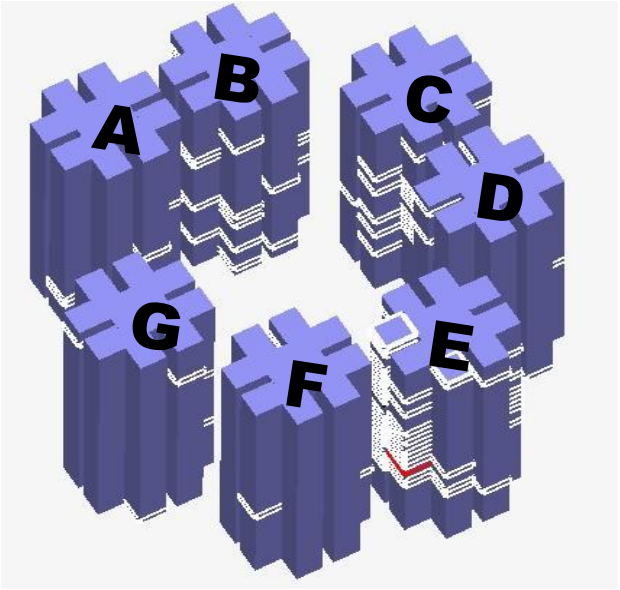
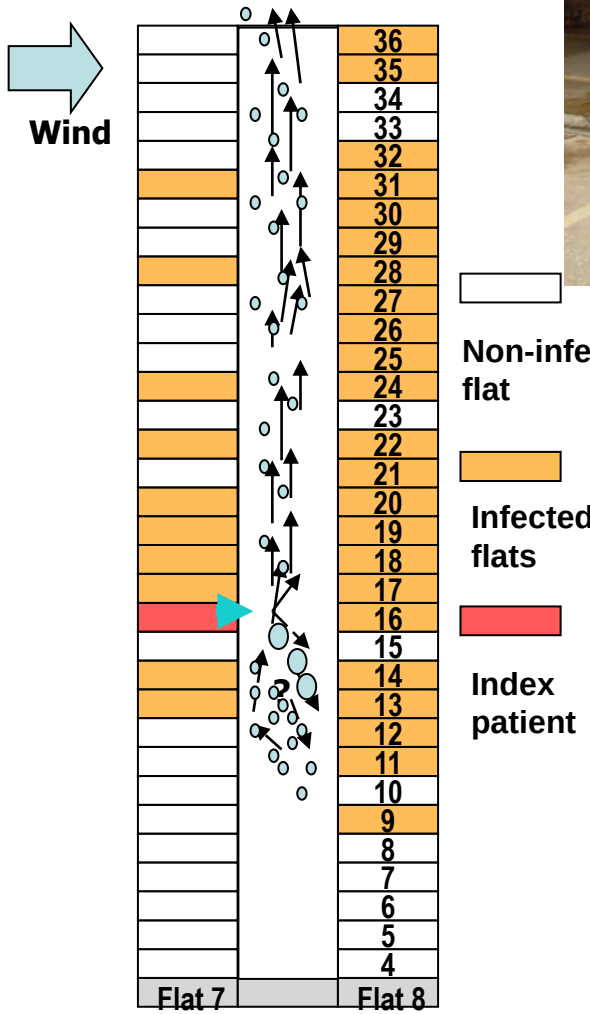
This reasoning supports an important conclusion: that SARS-CoV-2 transmission does not occur everywhere, but mostly indoors in poorly ventilated spaces.

Is this the right time for an indoor air revolution?…, The indoor air revolution of the 21st century will not come if we do not act.

2003 Amoy Gardens SARS Outbreak



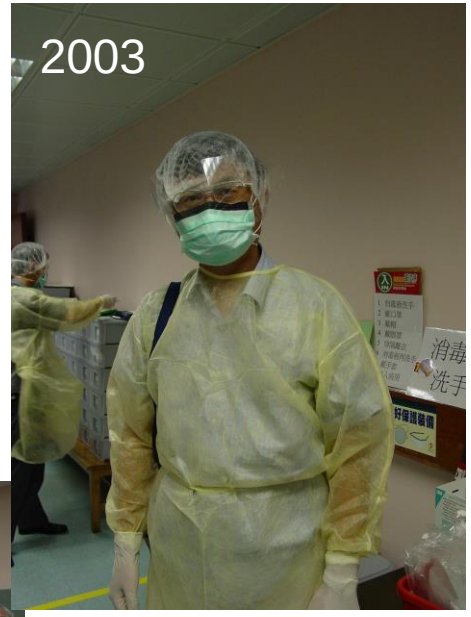




Non-infected flat

Infected flats

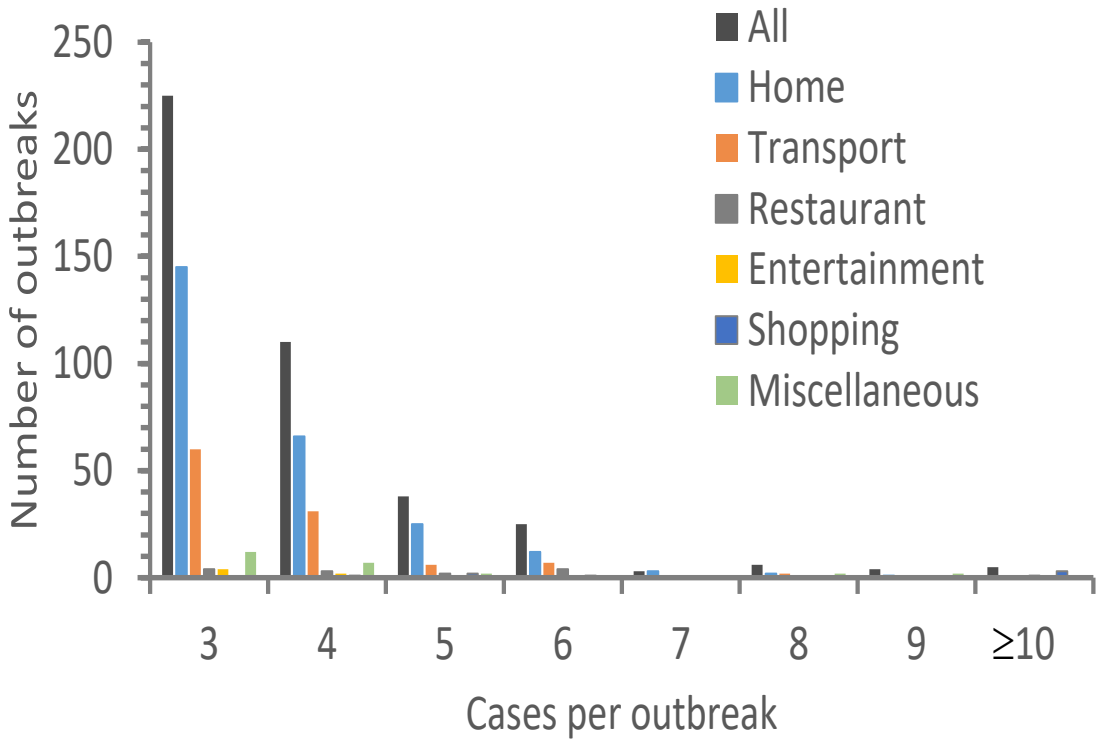
Index patient



Li et al. Pop Dyn and Infect Dis in Asia 2006:305-327
Yu ITS, et al (2004) New England Journal of Medicine, 350, 1731-1739.

April 4 2020: nearly all SARS-CoV-2transmission occurred indoors

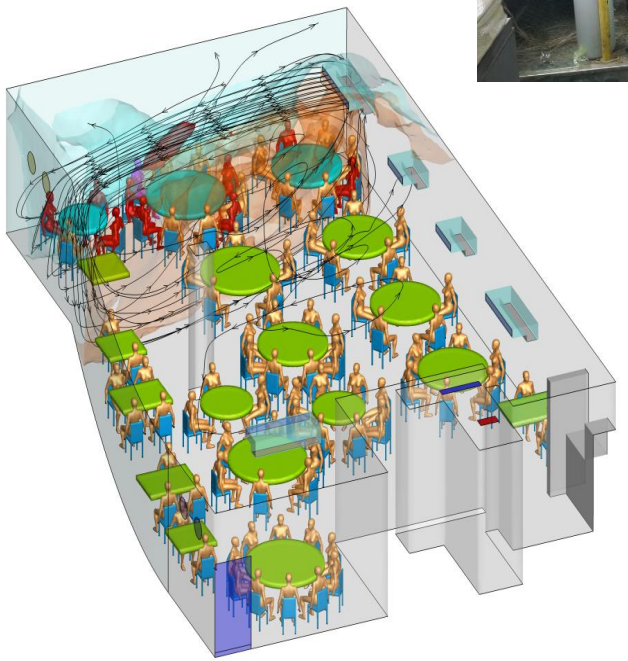
- extended research teams – former students' students
- identified 7324 cases in Mainland (non-Hubei) (66.7% of 10,980 by Feb 11 2020)
- 318 outbreaks with ≥ 3 cases
- only one outdoor outbreak with 2 cases

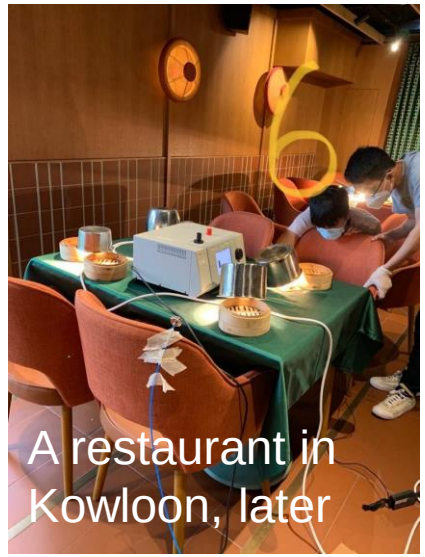


Qian, H., 2021. Indoor transmission of SARS-CoV-2. Indoor Air, 31(3), pp.639-645.

Feb 2020: SARS-CoV-2 indoor transmission and airborne route

- first airborne outbreak study: a restaurant in Guangzhou and two buses in Hunan
- no spread by AHU in Diamond Princess
- ventilation rate <5 L/s high risk



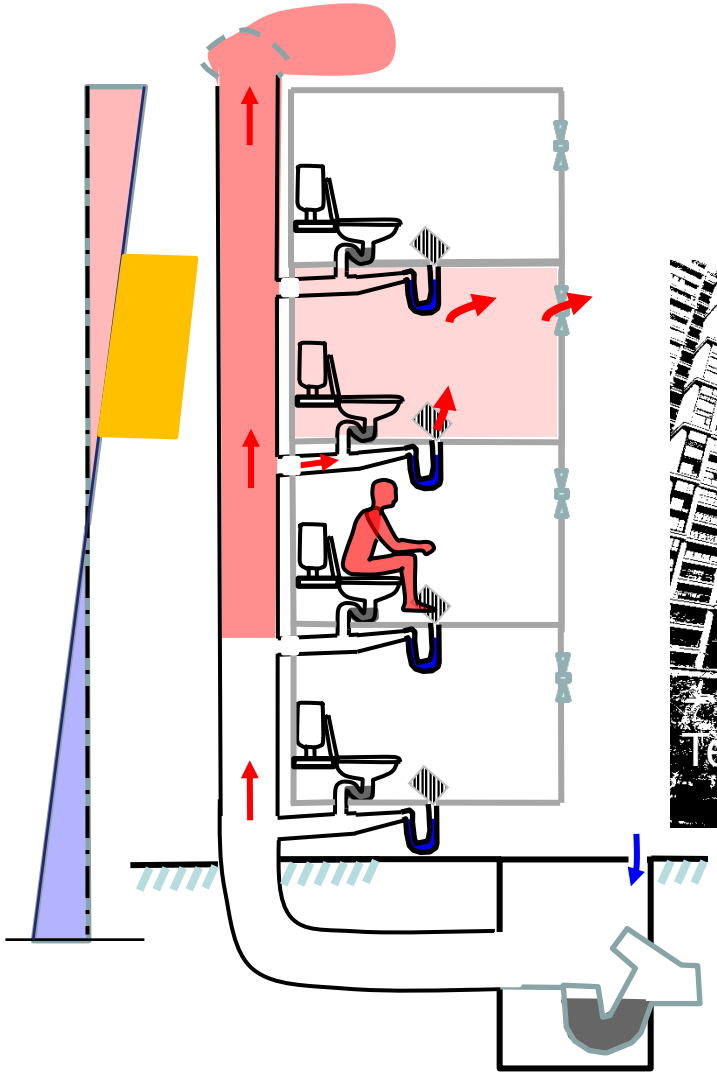


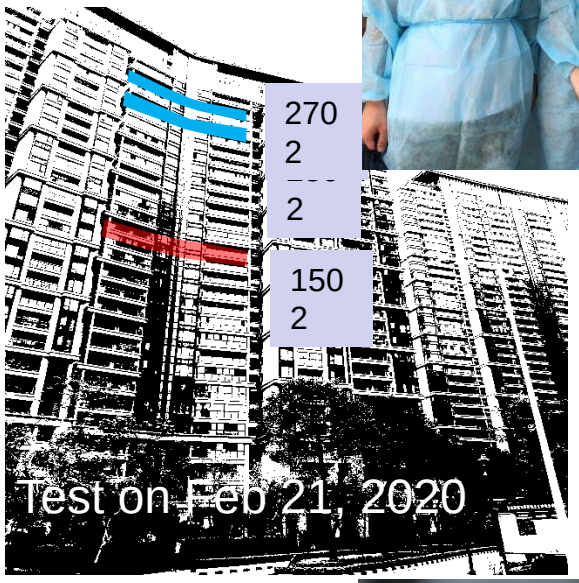
Li, Y., et al., 2021. Building and environment, 196, p.107788.

Feb 2020

- Chimney effect in drainage stacks in Block X, Guangzhou
- Kang et al (2020) first refused by a preprint publisher.

- >20 vertical outbreaks in HK before Omicron

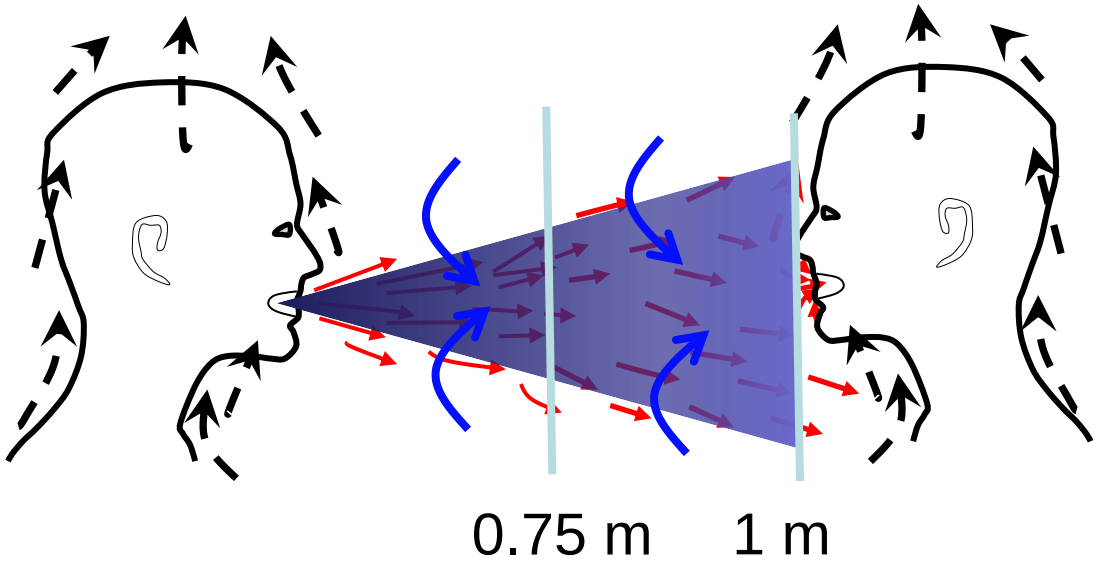




Kang, M., et al. Annals of internal medicine, 173(12), pp.974-980.
Wang Q, et al. 2022. *Journal of Aazardous Materials*, *421*, 126799.
Wang Q, et al. 2022 Interface Focus. https://doi.org/10.1098/rsfs.

Feb 24 2021: explaining probably the most revealing phenomenon

- **Outdoor transmission was rare**?
- ventilation affect short-range inhalation
- 10 L/s ventilation
- adopted by Lancet Commission, and US CDC new guide



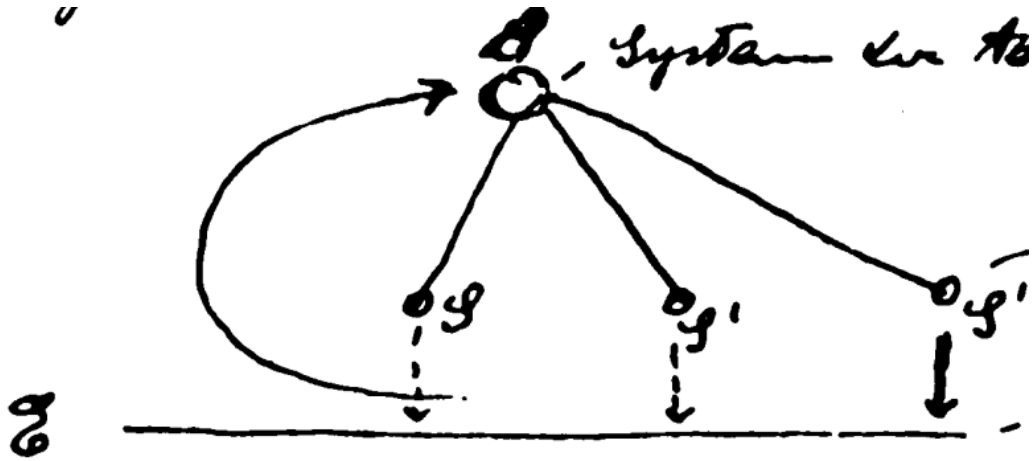
Li, Y et al.., 2022. Indoor Air, 32(1), p.e12946.
Jia, W et al., 2022. Building and environment, 219, p.109166.

By early 2021, I saw four basic phenomena of the transmission plus at least two others

P1 Close range transmission
Dominates (change to high risk later)

P2 Most infection occurs indoors

P3 Outdoor infection is less



Albert Einstein's abduction drawing

P4 Long range **occurred occasionally (change to frequently later)**

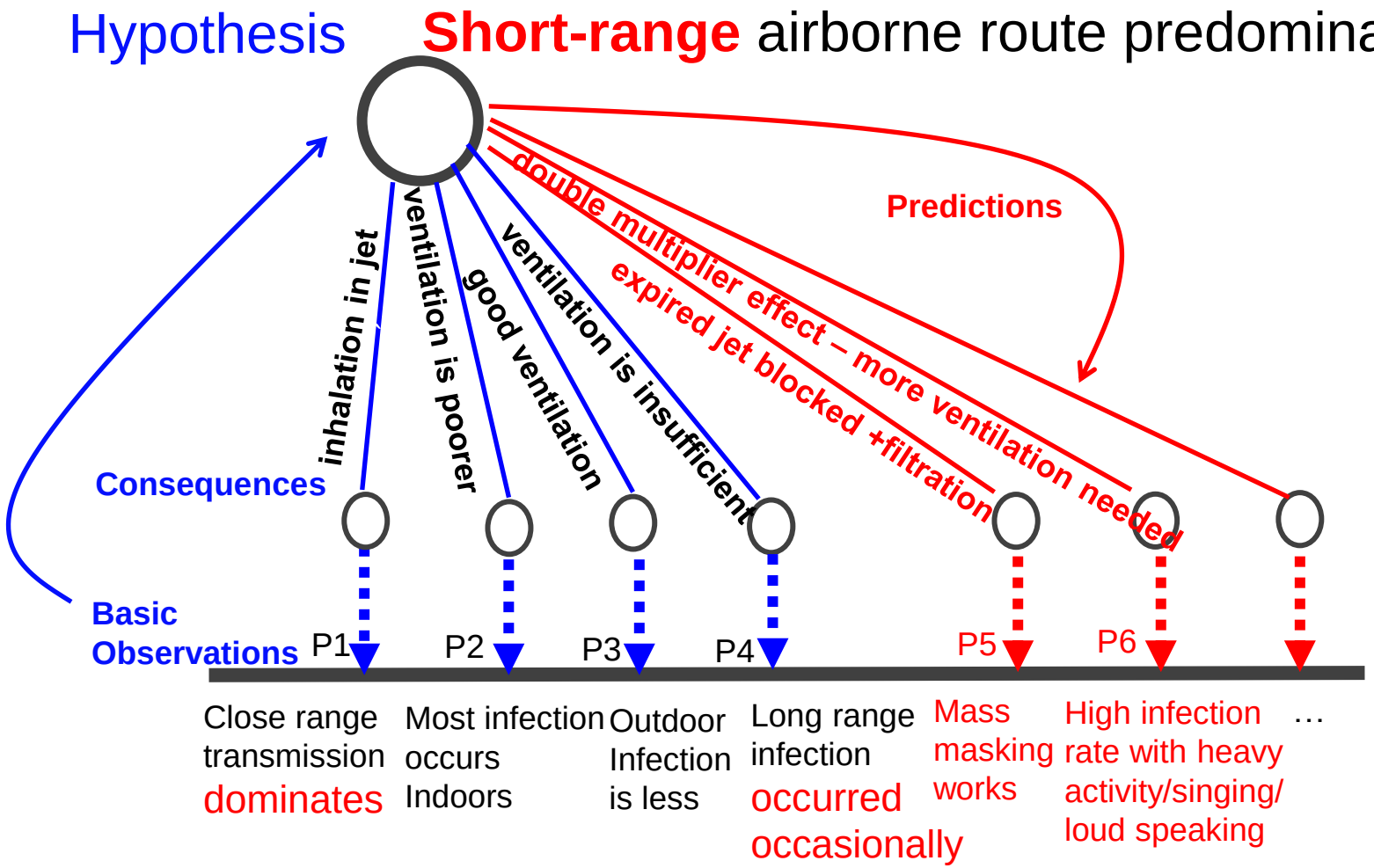
Mass masking works

…

High infection rate with heavy activity/singing/ loud speaking

Li Y. Hypothesis: SARS-CoV-2 transmission is predominated by the short-range airborne route and exacerbated by poor ventilation. *Indoor Air*. 2021
Li Y et al. (2021). Dominant transmission route of SARS-CoV-2 and its implication to indoor environment. *Chinese Science Bulletin*, *66*(4-5). https://doi.org/10.1360/TB-2020-1532

24 Feb 2021: a historical WHO multi-disciplinary workshop "Inhalation route dominates"



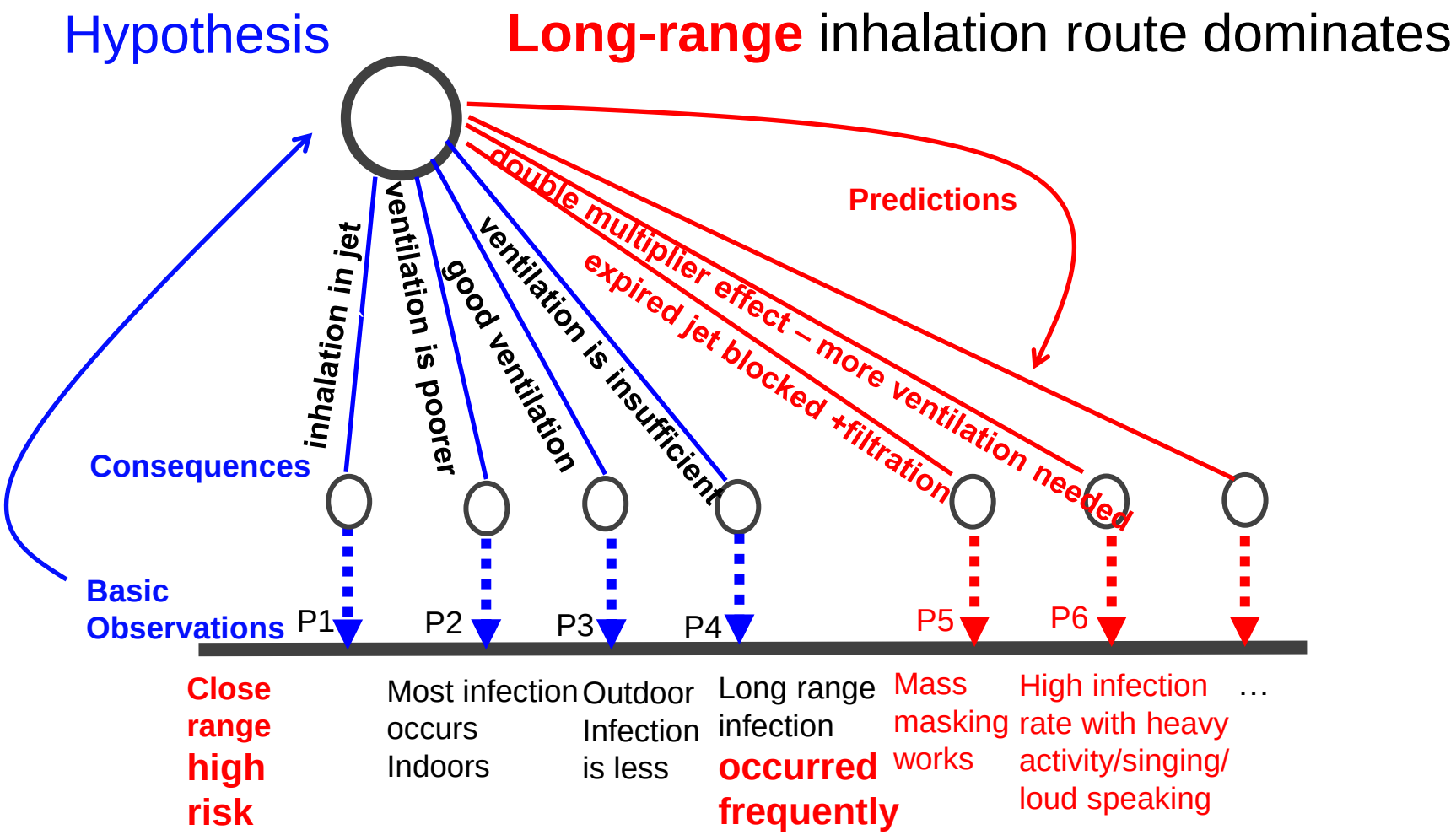
"You are invited to predict new trends from the airborne hypothesis and collect the data in your community, verify or reject the hypothesis."

WHO multidisciplinary workshop, Feb 24, 2021

Li Y. Hypothesis: SARS-CoV-2 transmission is predominated by the short-range airborne route and exacerbated by poor ventilation. *Indoor Air*. 2021

Li Y et al. (2021). Dominant transmission route of SARS-CoV-2 and its implication to indoor environment. *Chinese Science Bulletin*, *66*(4-5). https://doi.org/10.1360/TB-2020-1532

2021-2022: Long-range inhalation route dominates



BUILD SIMUL (2023) 16: 663–666
https://doi.org/10.1007/s12273-023-1019-z

Predicting building ventilation performance in the era of an indoor air crisis

Yuguo Li[1,2] (✉), Pan Cheng[1], Li Liu[3], Ao Li[1], Wei Jia[1], Nan Zhang[4]

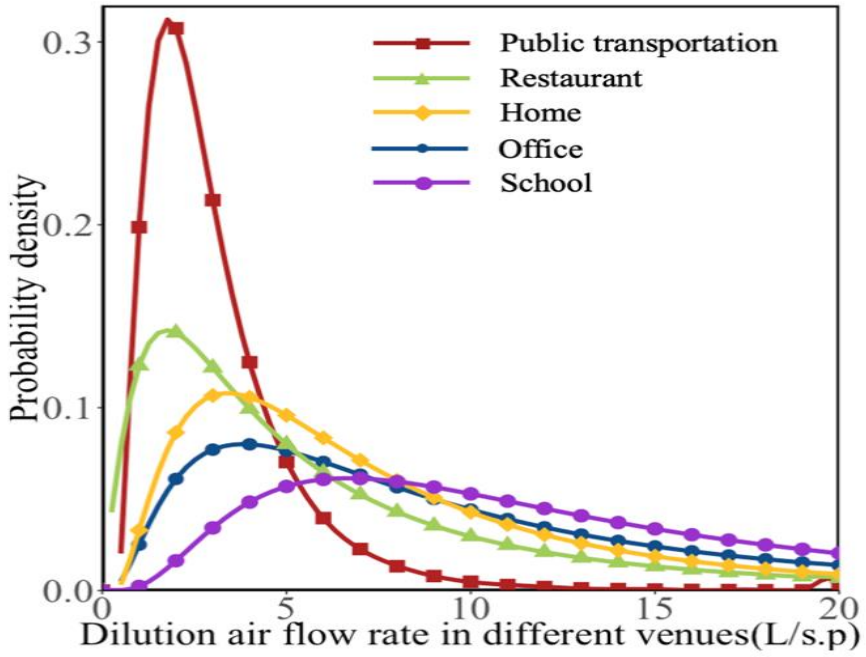
History tells us about the future

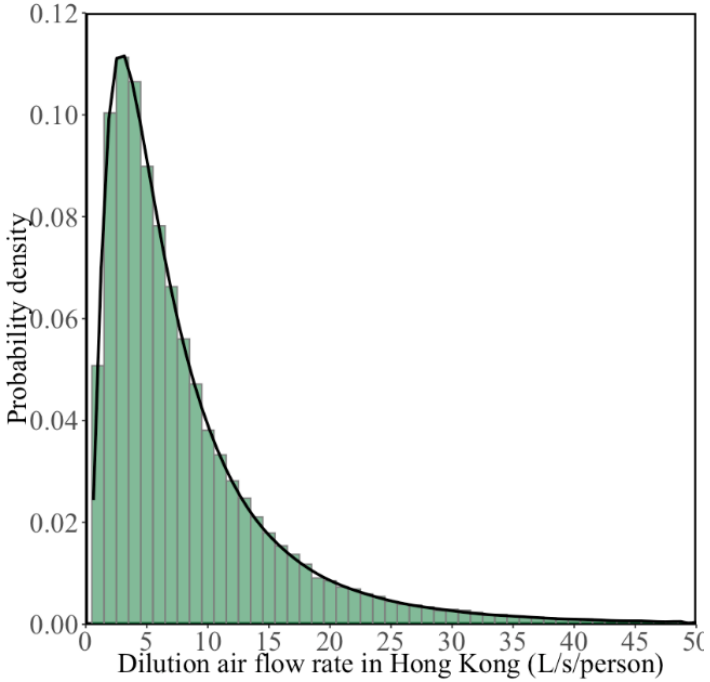
In the absence of a worldwide effort to improve building ventilation, ... another pandemic is likely to occur.

The COVID-19 pandemic clearly illustrated that there are enough poorly ventilated spaces in almost all countries and cities to sustain chains of infection.

[W]e call for national governments to consider mandating real-time indoor air quality monitoring in at least all public buildings, as people have a right to healthy air in the buildings they must use.

Using outbreak data in 2020 Hong Kong as "tracers for dilution (ventilation, filtration and deactivation)…



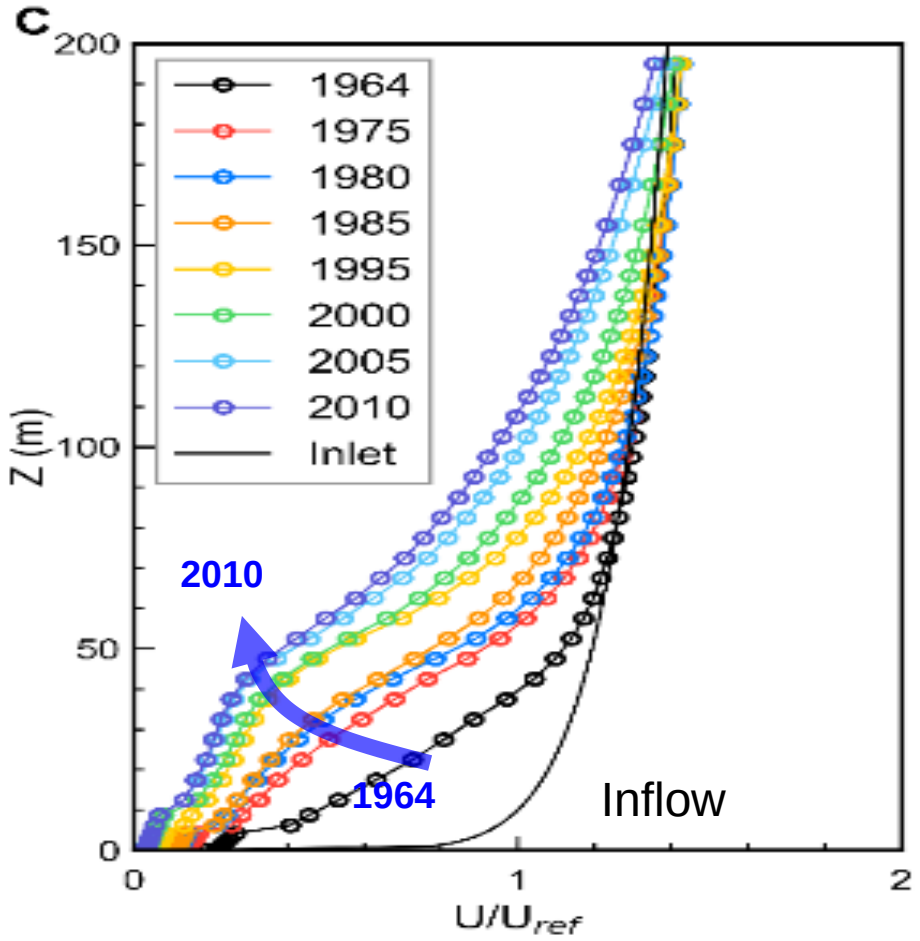


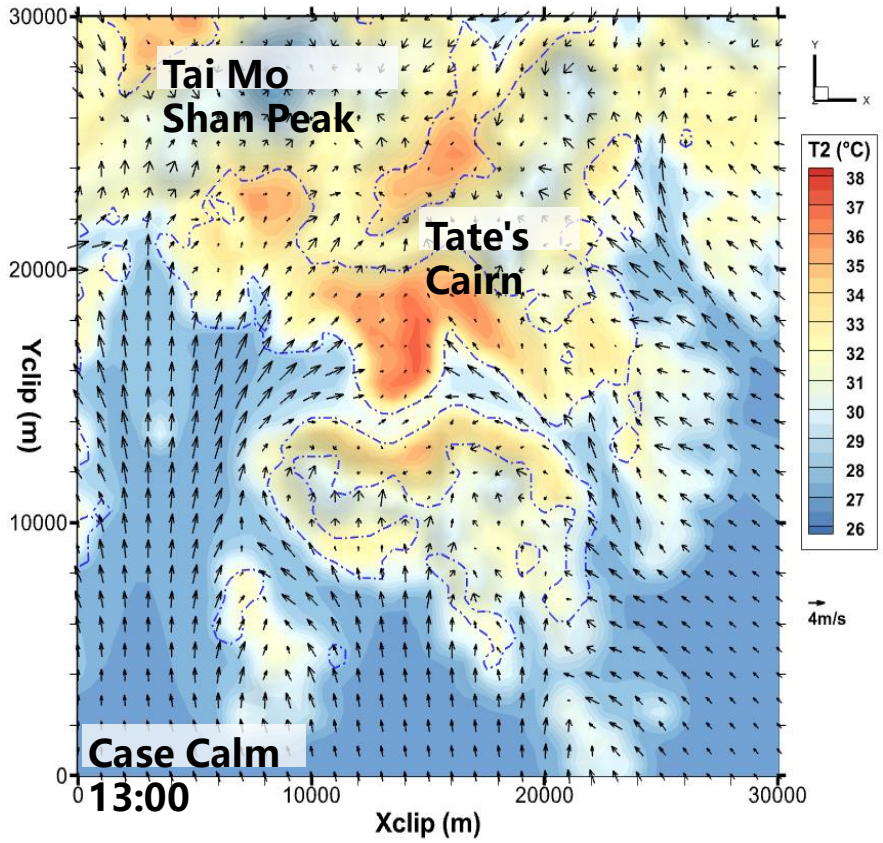
CO_2 monitoring in public spaces in Hong Kong?

Requires regulations?

Li Ao – not published

Wind weakening reduces natural ventilation, and our city is also over dense. Not just indoors, but also...





Peng, L., et al., 2018. Building and Environment, 138, pp.207-220.
Zhang, C., et al., 2023. Urban Climate, 49, p.101517.

We learned in the pandemic

- COVID infection mostly occurs indoors with poor ventilation/dilution
- This is an indoor air crisis.

- Need to develop low-cost methods for identifying the poor dilution buildings.

- CO_2 display in public spaces is necessary in Hong Kong.
- In Hong Kong, estate sewer and high-rise building drainage requires immediate attention.

Thank you