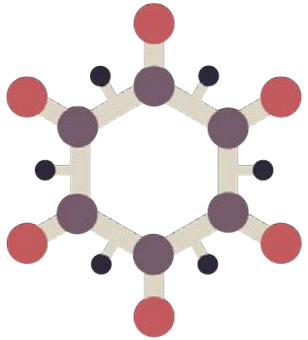
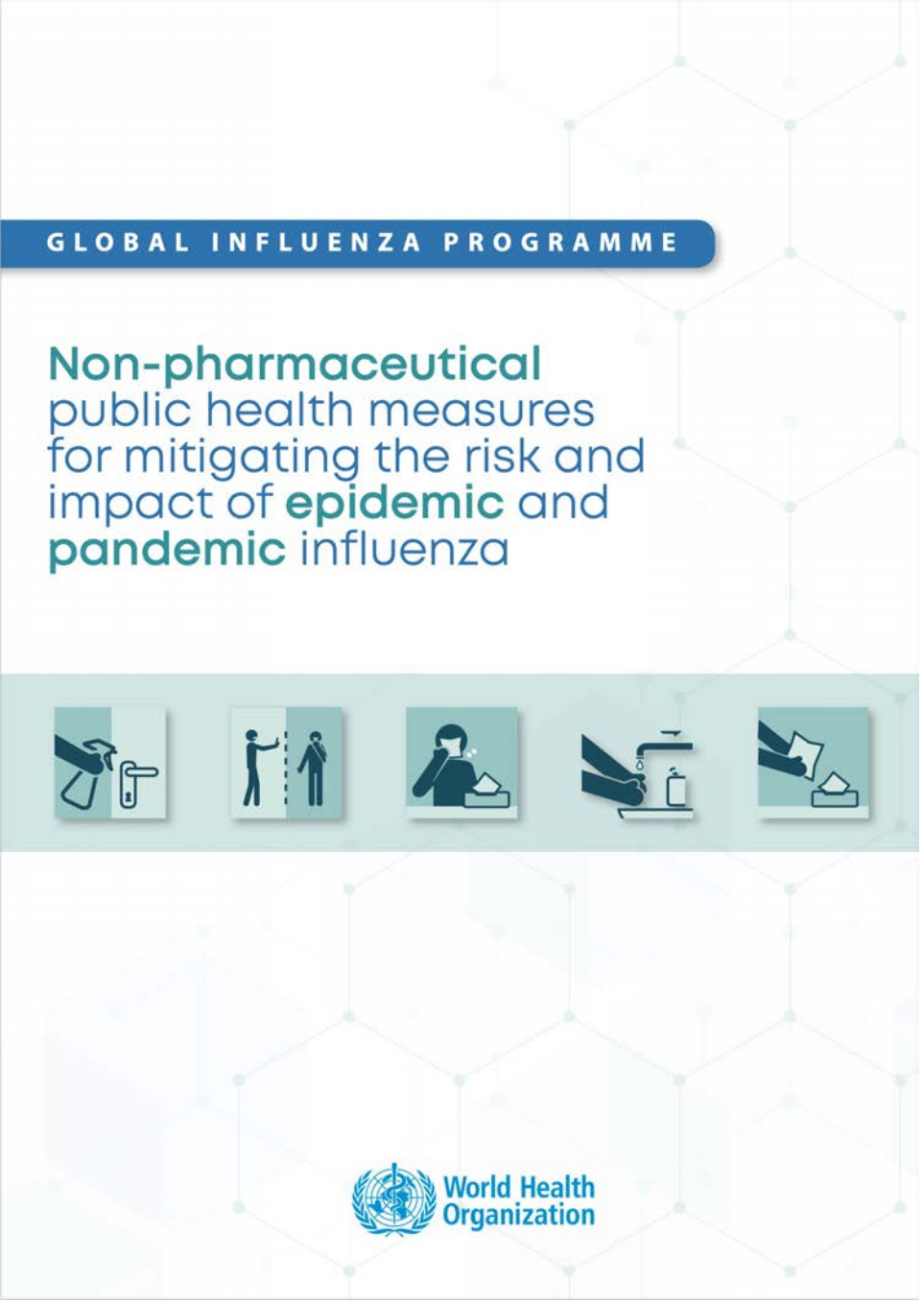
Pandemic epidemiology, public health and modeling

Ben Cowling
WHO Collaborating Centre for Infectious Disease Epidemiology and Control,
School of Public Health, The University of Hong Kong, Hong Kong



IMMUNISATION
COALITION

6 February 2022



Updated WHO guidelines on NPIs (October 2019)

"This document provides recommendations for the use of non-pharmaceutical public health measures for mitigating the risk and impact of epidemic and pandemic influenza. The recommendations are based on review of existing guidance documents and the latest scientific evidences that were gathered through a series of systematic literature reviews on the effectiveness of non-pharmaceutical public health measures. The findings of the systematic reviews are summarized in the *Annex: report of systematic literature reviews*."

https://apps.who.int/iris/handle/10665/329438

Non-pharmaceutical public health measures included

Personal protective measures

- Hand hygiene
- Respiratory etiquette
- Facemasks

Environmental measures

- Surface and object cleaning
- UV light
- Ventilation
- Humidity

Social distancing measures

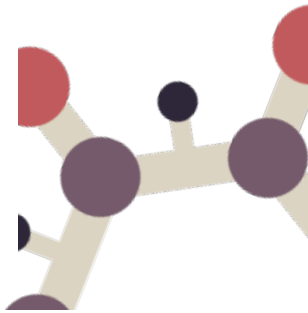
- Contact tracing
- Isolation of sick individuals
- Quarantine of exposed individuals
- School measures and closures
- Workplace measures and closures
- Avoiding crowding

Travel related measures

- Travel advice
- Entry and exit screening
- Internal travel restrictions
- Border closures

Quality of evidence

- Moderate
- Low
- Very low
- None



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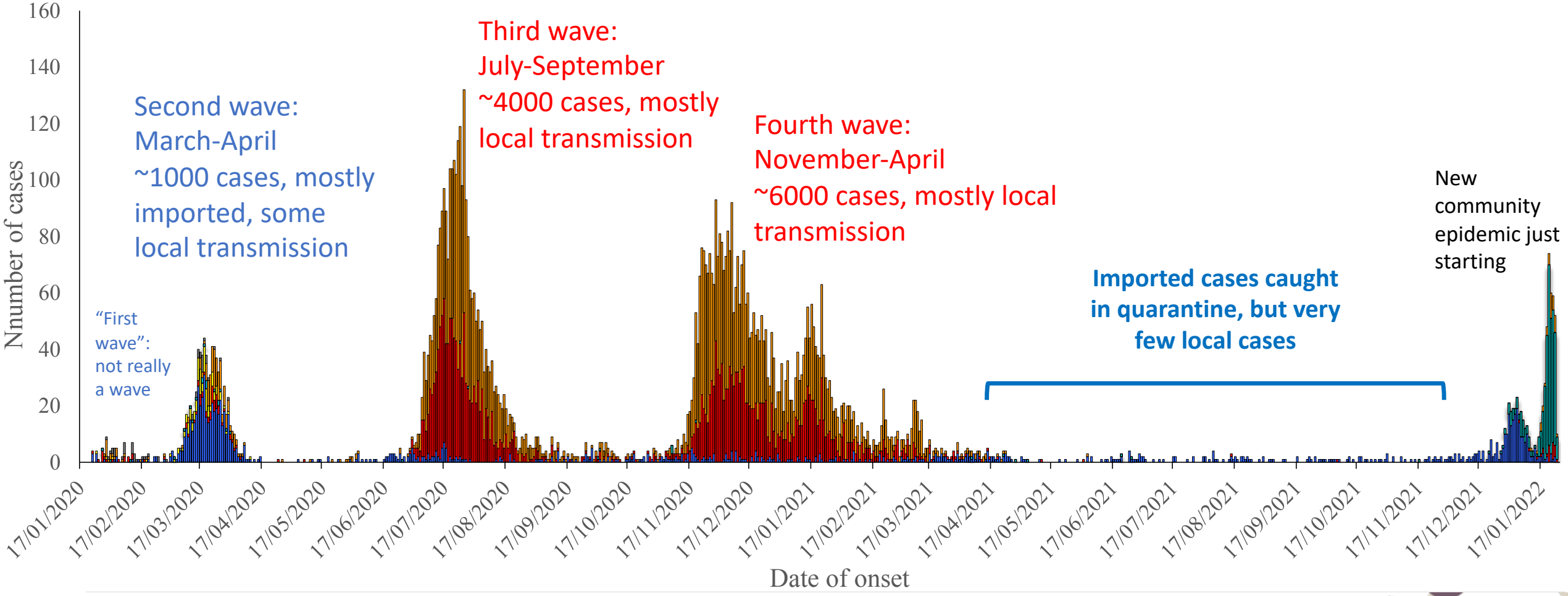
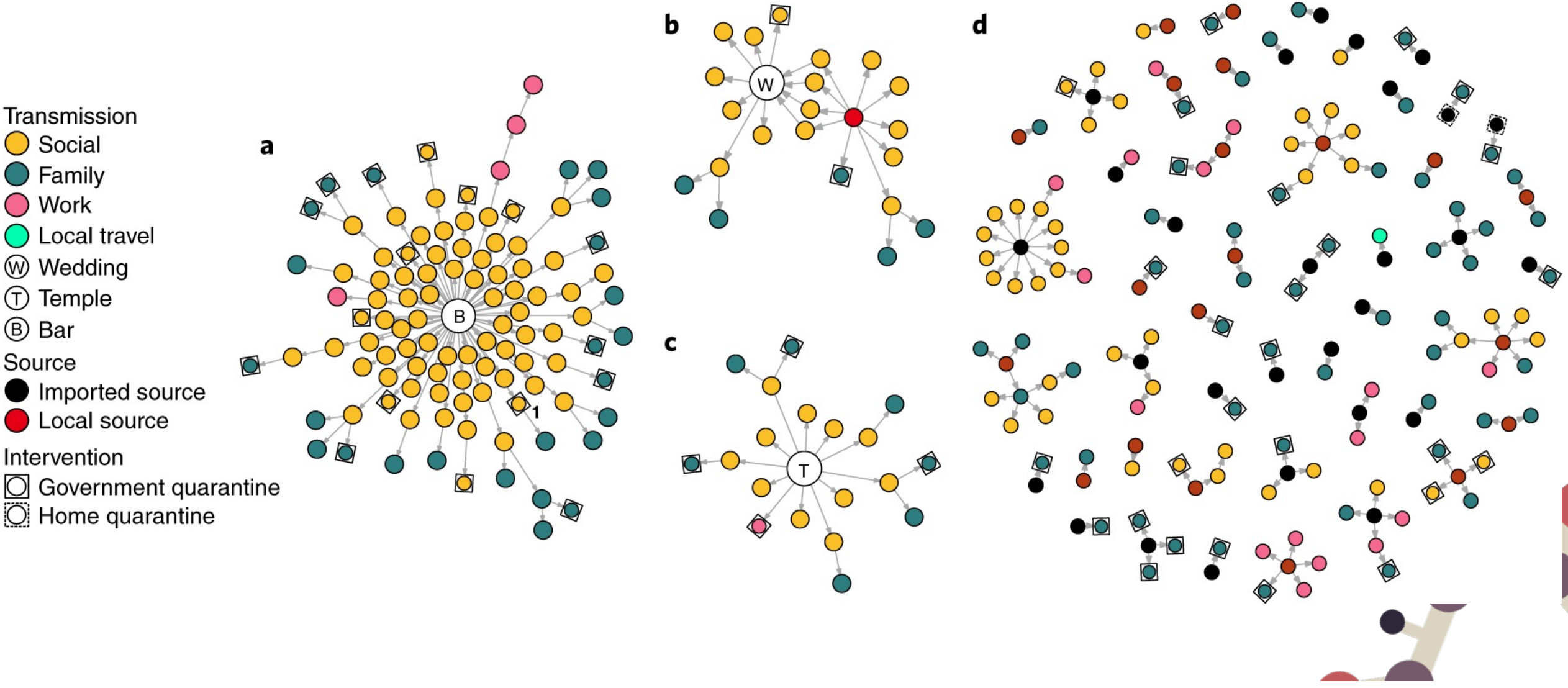
COVID-19 in Hong Kong

13,626 confirmed cases to date (1.5 per 1000 persons)



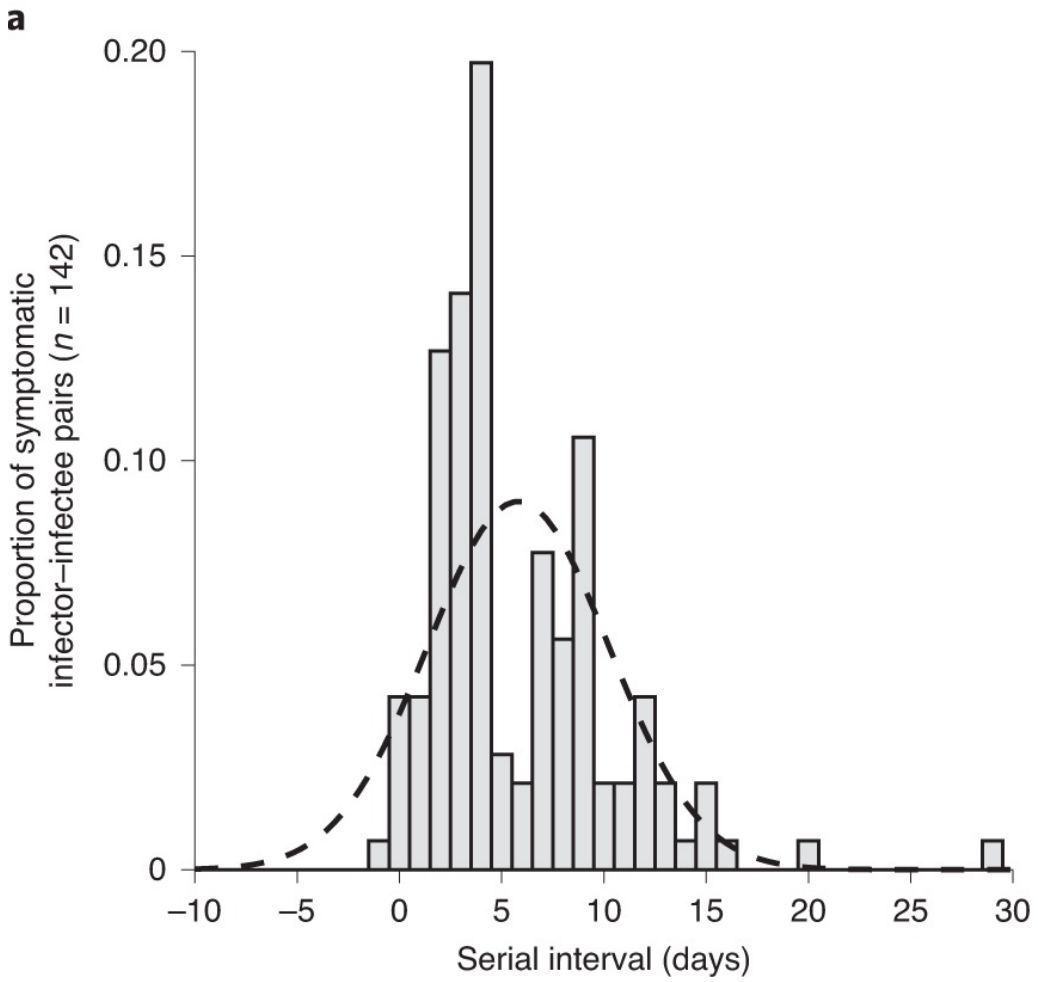
https://www.chp.gov.hk/files/pdf/local_situation_covid19_en.pdf

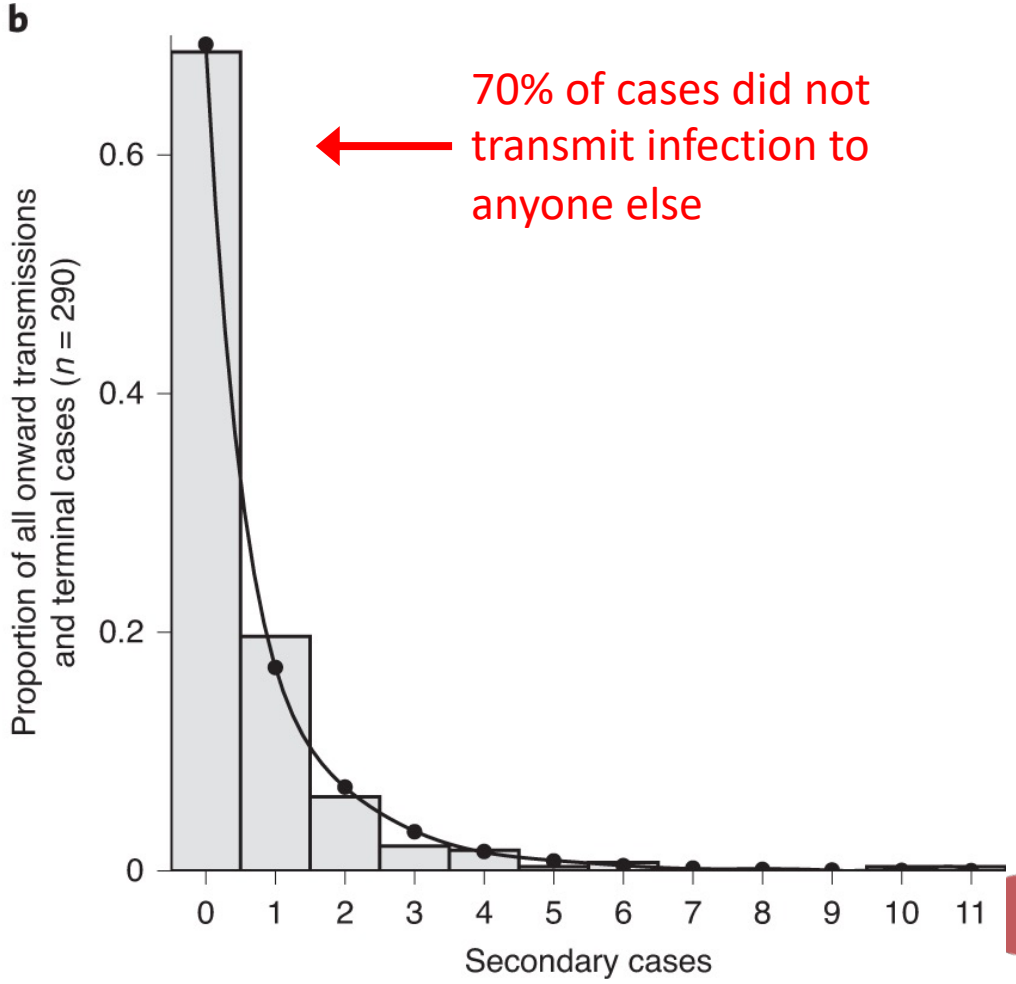
Clustering of COVID-19 infections (Jan-Apr)



Adam DC, et al. *Nat Med* 2020;26:1714–9.

Serial interval and offspring distribution (Jan-Apr)





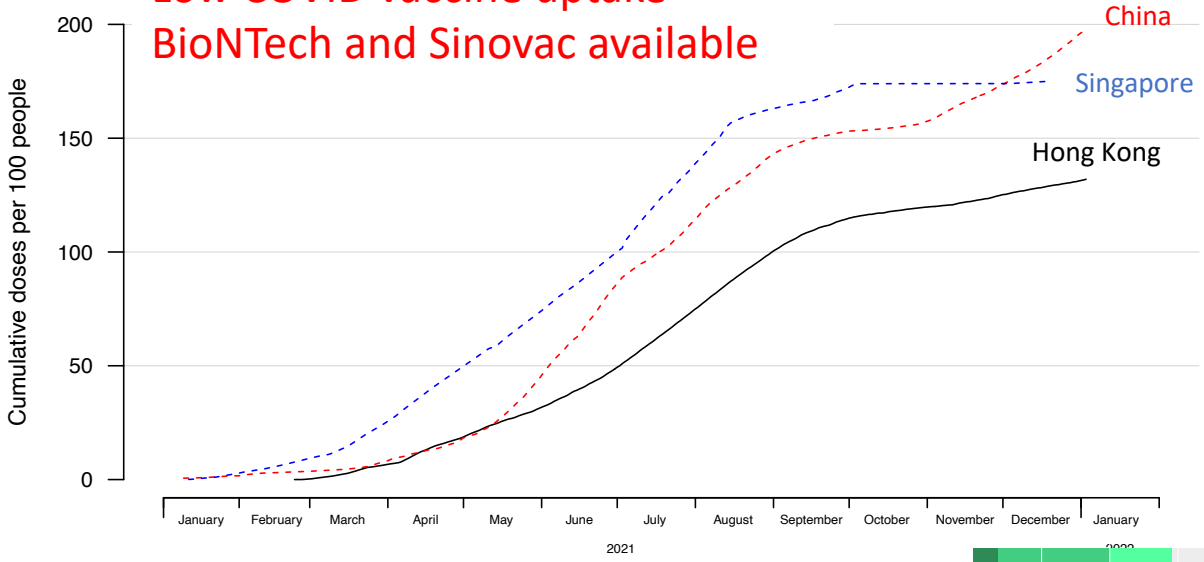
70% of cases did not transmit infection to anyone else

19% of cases responsible for 80% of transmission events
(overdispersion parameter k=0.33)

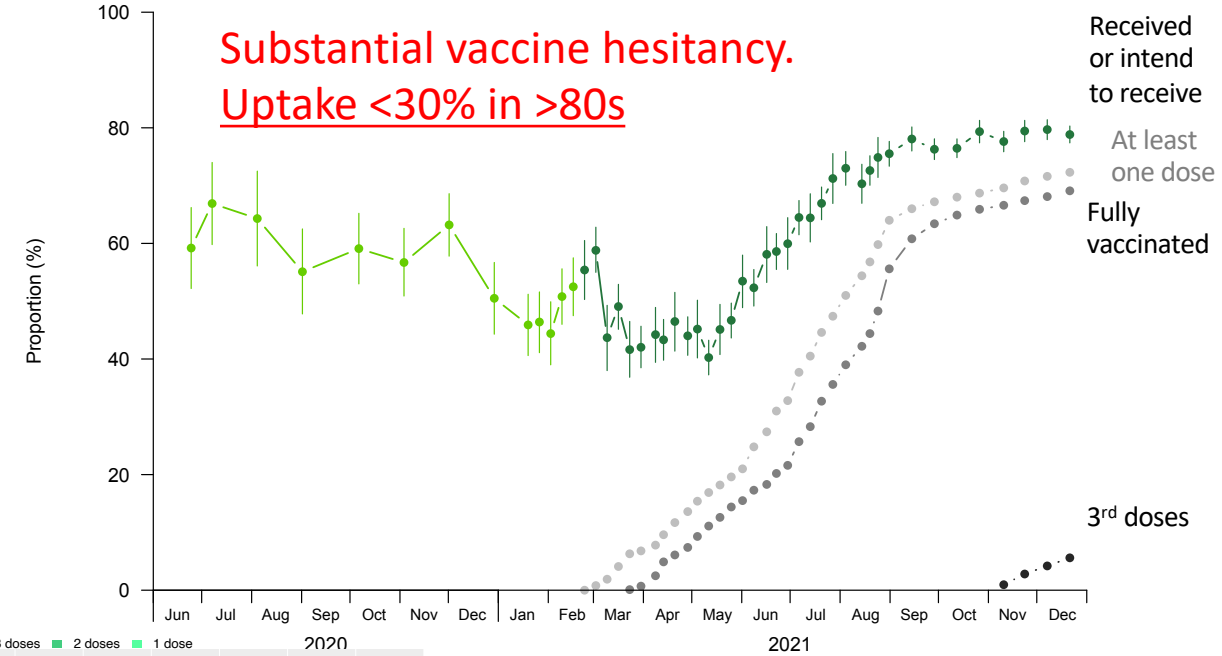
Adam DC, et al. *Nat Med* 2020;26:1714–9.

COVID vaccination in Hong Kong

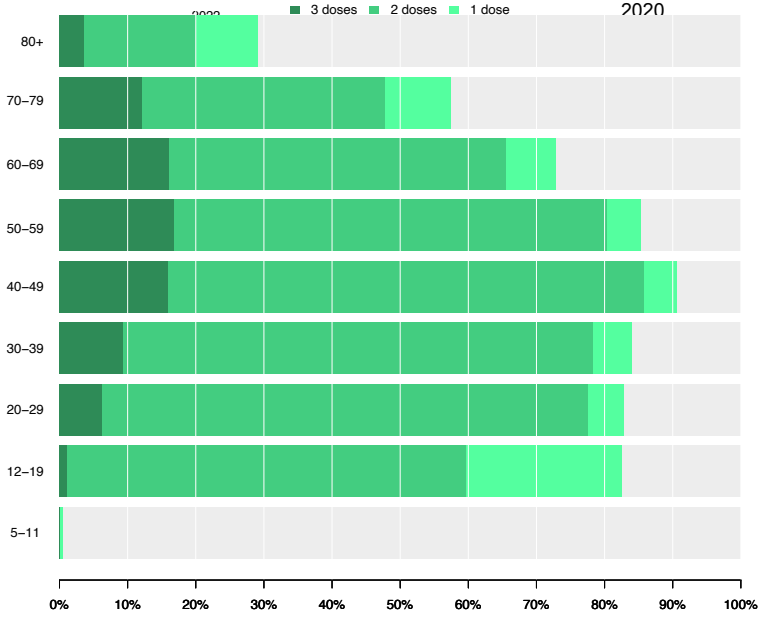
Low COVID vaccine uptake
BioNTech and Sinovac available



Substantial vaccine hesitancy.
Uptake <30% in >80s

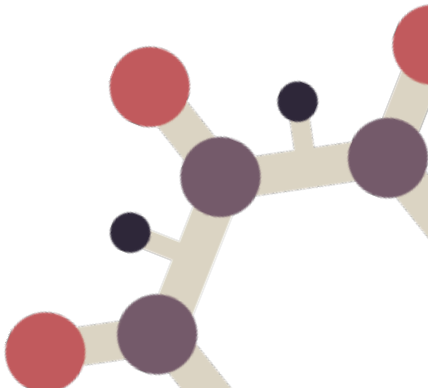


Vaccine uptake by age



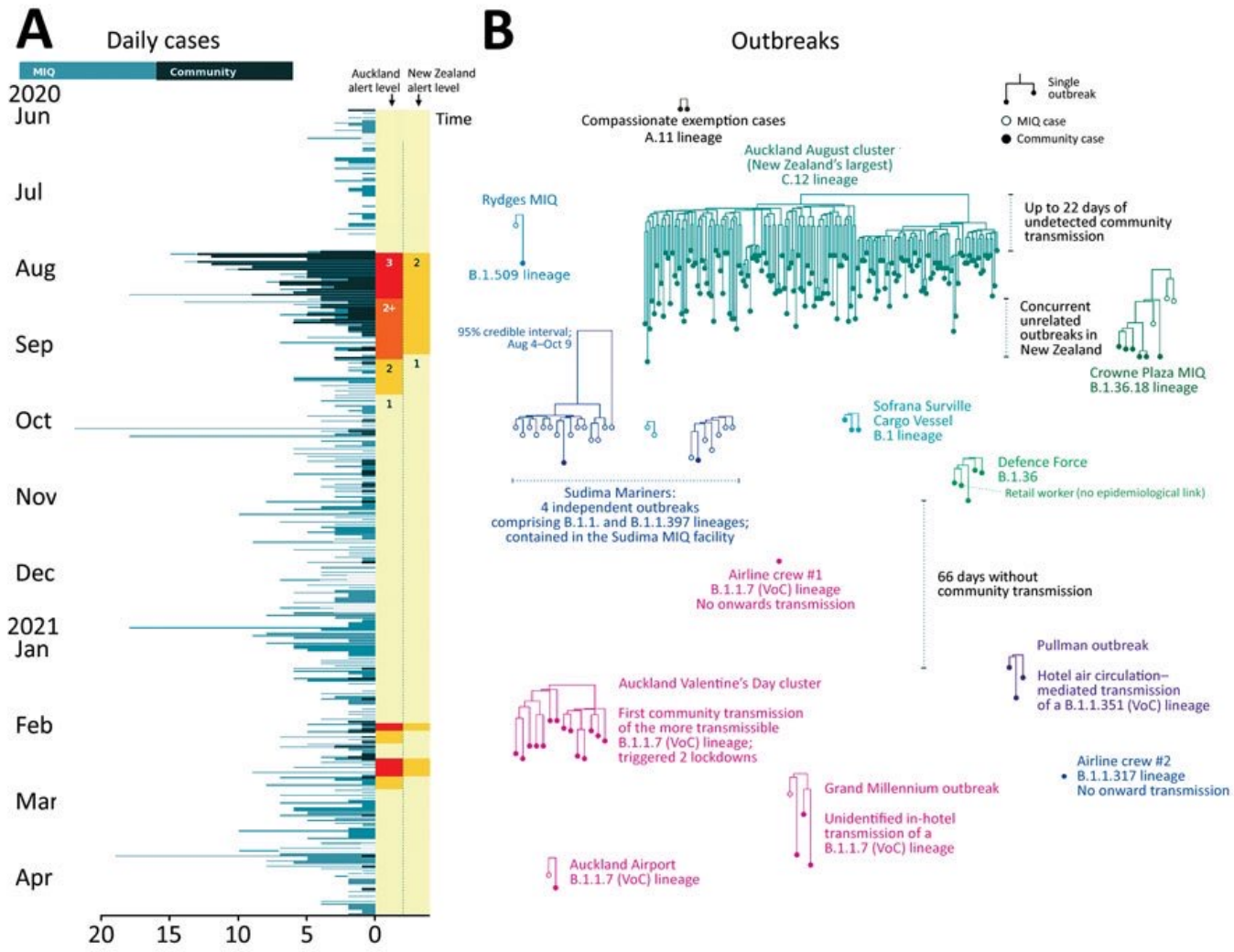
COVID-19 control strategy in Hong Kong

- “Dynamic Zero Covid”
- While daily cases at zero – ban on visitors, returning residents need to quarantine (mostly 21 days, had been 14 and briefly 7) – but loopholes exist
- While daily cases >0 (community spread) – isolate, trace+quarantine, moderate social distancing



How could it be done perfectly?

- Stay-at-zero phase:
  needs large purpose-built on-arrival quarantine facility with resident staff, could also be used for aircrew and airport/port workers



Douglas et al. 2021 Emerg Infect Dis

How could it be done perfectly?

- Get-back-to-zero phase: need infrastructure + lab capacity for repeated mass testing, isolation and quarantine outside the home, and preferably also for a lockdown ("pause button")

- Aided in mainland China by "HealthCode"

Chinese city of Tianjin to test 14 million people after Covid outbreak

The port near Beijing began mass testing after 20 children and adults tested positive, including at least two with Omicron

People line up for Covid testing in the Chinese port city of Tianjin, which is testing its population of 14 million. Photograph: Reuters

Tianjin, a major Chinese port city near the capital Beijing, has begun mass-testing its 14 million residents after a cluster of 20 children and adults tested positive for Covid-19, including at least two with the Omicron variant.

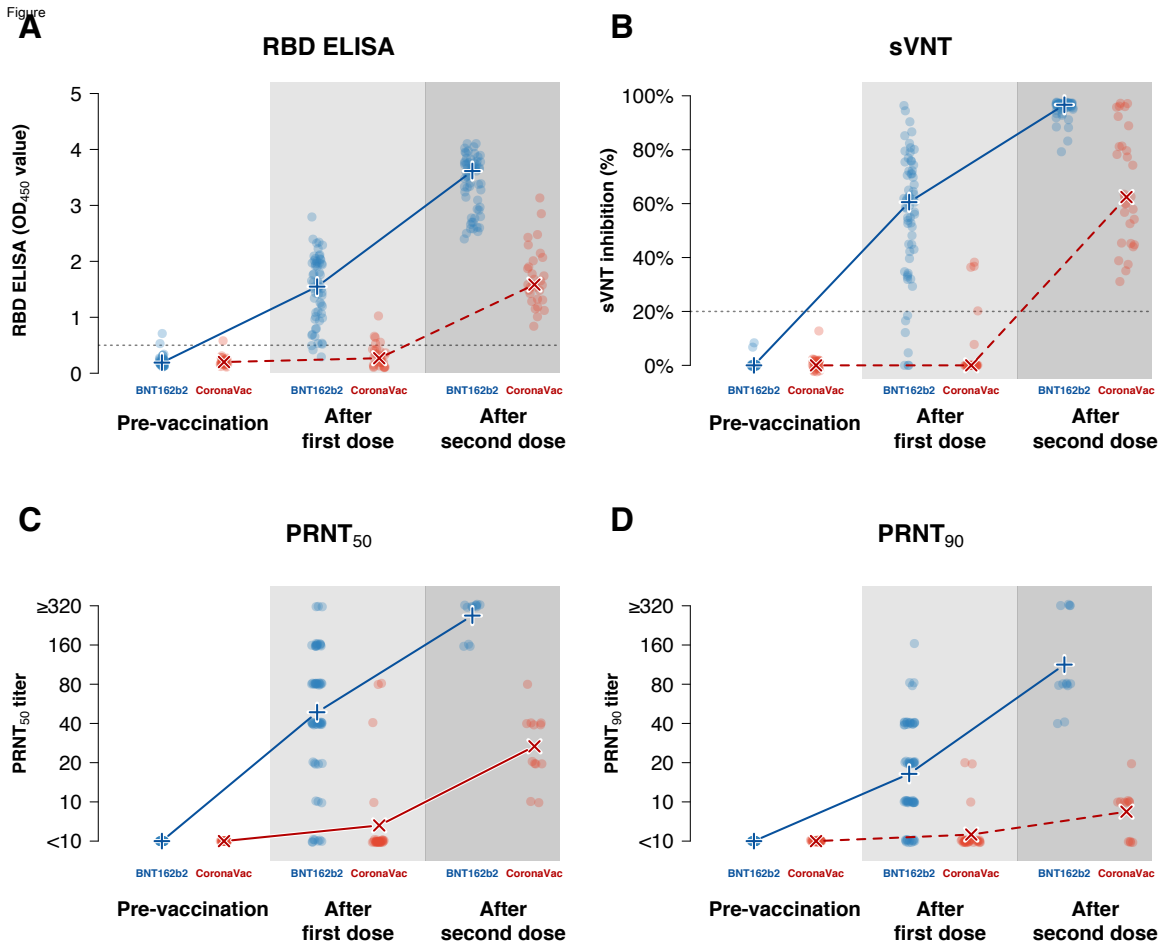
The Guardian, 9 Jan 2022

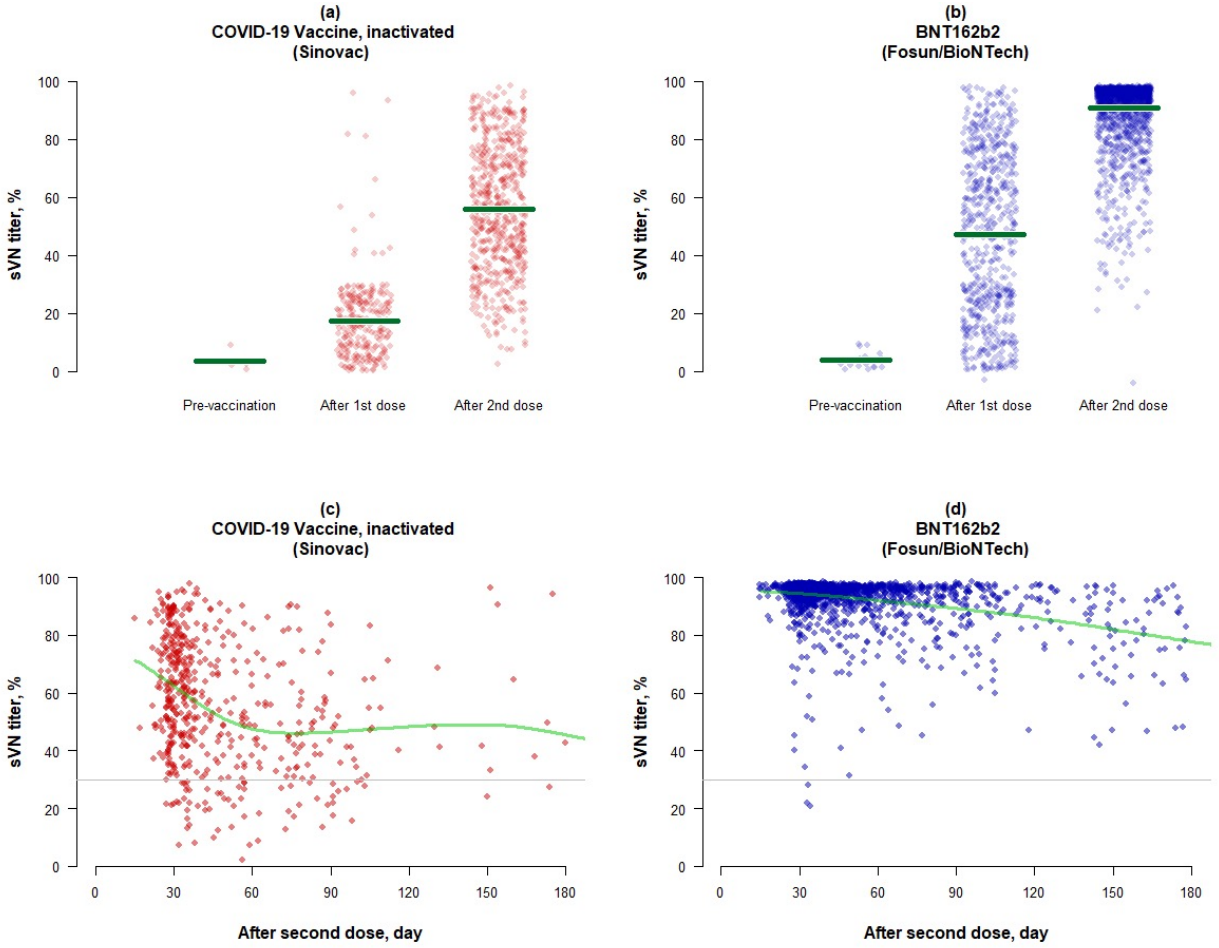
Strategies pros / cons (not complete list)

	Advantages?	Disadvantages?
"ZeroCovid" (e.g. Hong Kong)	Minimise health impact of COVID-19 including serious cases, deaths, and cases of long COVID Hope for quarantine-free travel to/from mainland China (travel bubble)	Economic and social costs of public health measures and travel restrictions
"Return to normal" (e.g. Singapore)	Can gradually relax the COVID measures such as on-arrival quarantines, social distancing, face masks etc	COVID will have health impact even in a highly vaccinated population Would not be able to open boundary with mainland China until they also return to normal

SARS-CoV-2 antibody levels after vaccination

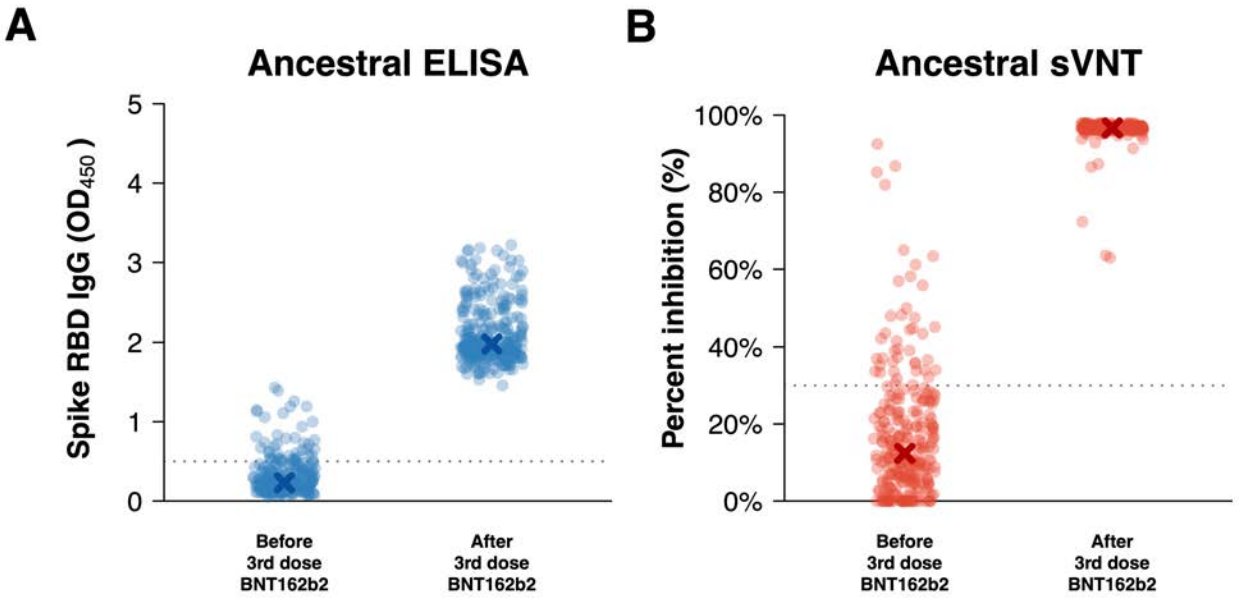
Figure

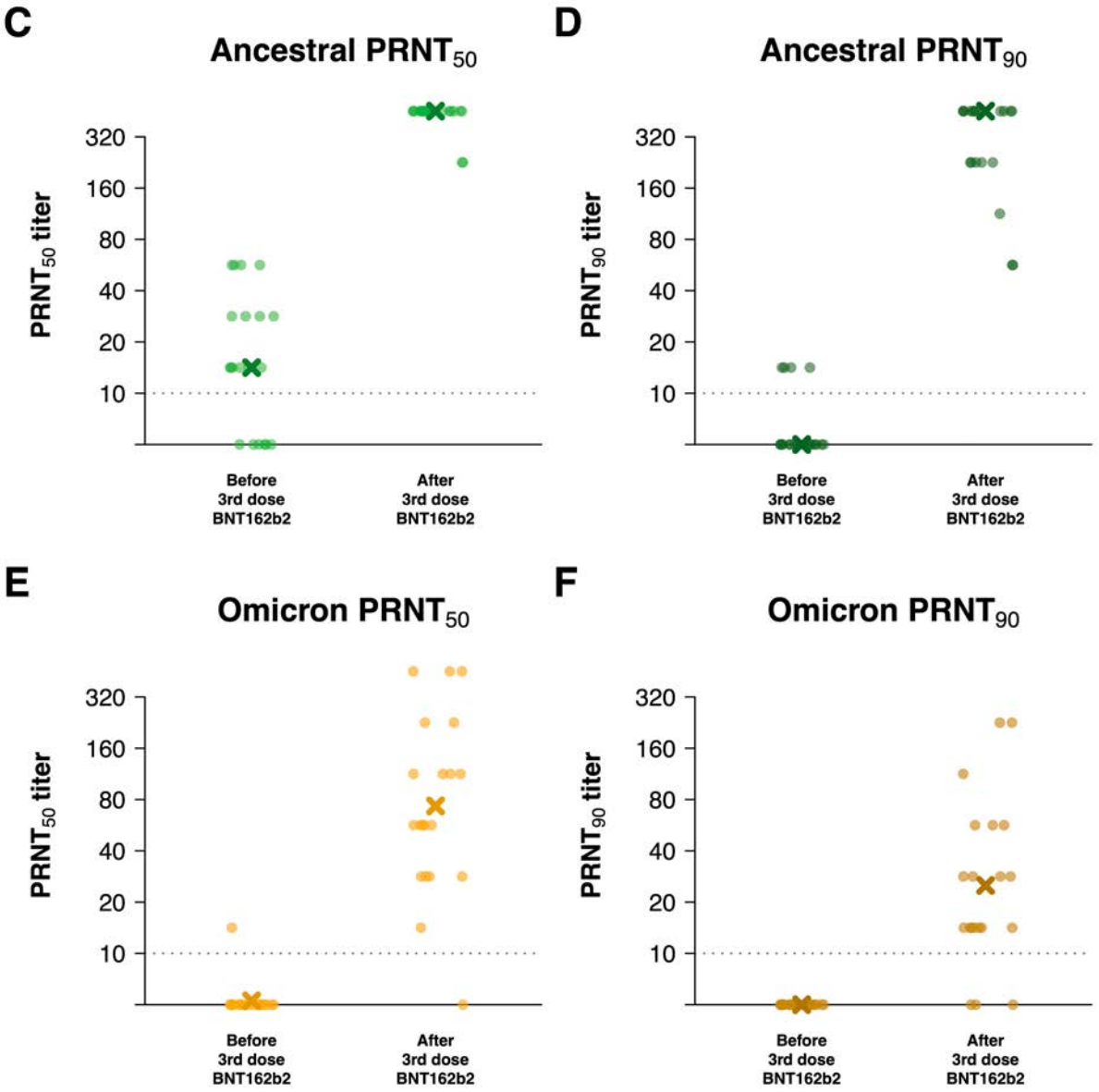




- Results from cohort studies in HK

BNT162b2 as third dose in S+S recipients

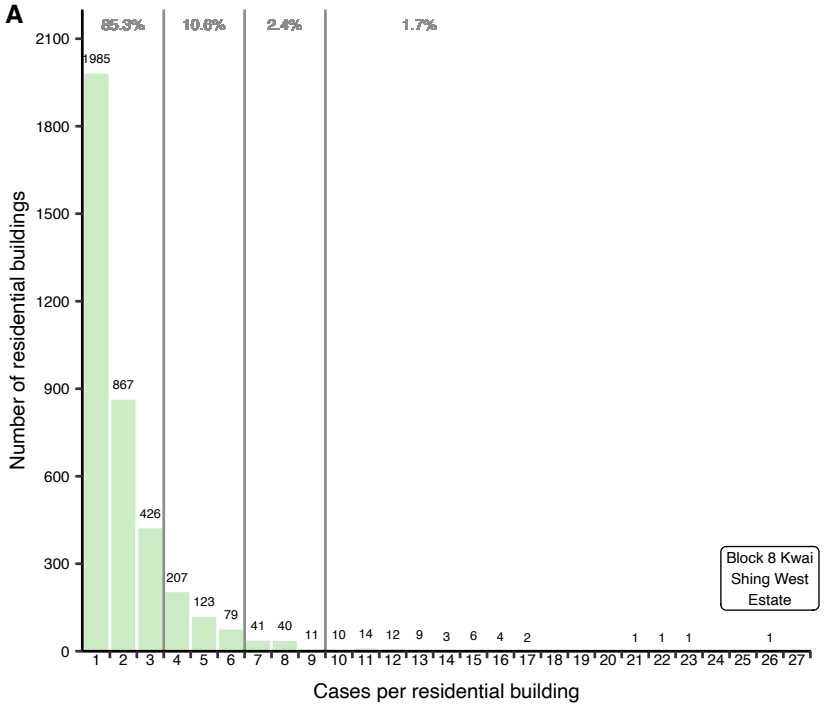




- Substantial improvements in antibody titers after third dose of mRNA vaccine (average 6 months after second dose of Sinovac)

Omicron transmission dynamics different?

- 2020-21, very few clusters in apartment buildings, with intense surveillance (more than 1000 compulsory testing notices)



Published: 19:33, January 22, 2022 | Updated: 21:02, January 22, 2022

2nd Kwai Chung block in 5-day lockdown as Omicron spreads

By Shadow Li & Chen Shuman

Police officers in protective gear guard at the lockdown area in Kwai Chung Estate, in Hong Kong, Jan 22, 2022. (KIN CHEUNG/AP)

Kwai Chung Estate update as of 2pm:
334 confirmed and preliminary positive (+58)

Yat Kwai: 229 (+45 cases, +6 units)
Ying Kwai: 71 (+8/+2)
Nga Kwai: +2 new cases
Yuk Kwai: +1 unit (3 units total)

8:38 AM · Jan 26, 2022 · Twitter Web App

Value of continuously assessing transmission dynamics

Monitoring key epidemiological parameters of SARS-CoV-2 transmission

To the Editor — Control of the SARS-CoV-2 pandemic requires targeted interventions, which in turn require precise estimates of quantities that describe transmission. Per-capita transmission rates are influenced by four quantities: (1) the latent period (time from infection to becoming infectious); (2) individual variability in infectiousness (defined by variation in intrinsic transmissibility and contact rate); (3) the incubation period (time from infection to symptom onset); and (4) the serial interval (time between symptom onset of an infector and an infected) (Fig. 1).

Exact knowledge of these four quantities contributes to our ability to control an outbreak[1] but they can vary depending on disease-mitigating interventions[2] and population structure, as well as the inherent properties of the SARS-CoV-2 variant[3,4]. Inaccurate estimates of the four quantities can lead to incorrect estimation of the time-varying reproduction number (R_t) (ref. [5]) and the role or effectiveness of interventions such as testing, isolation and contact tracing on transmission.

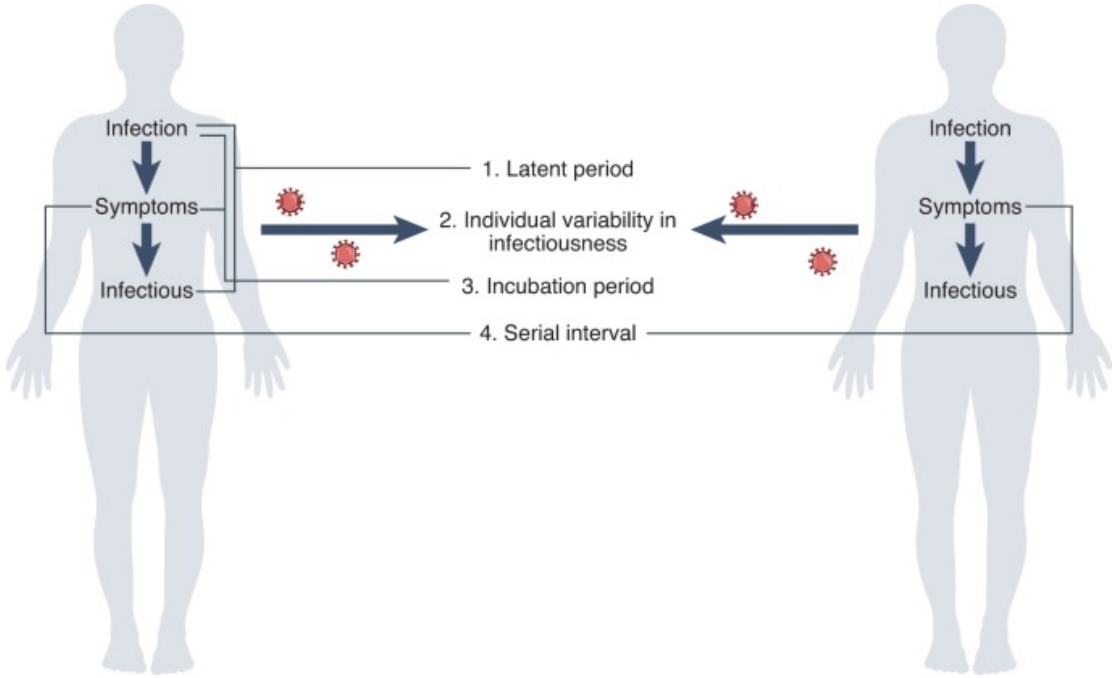
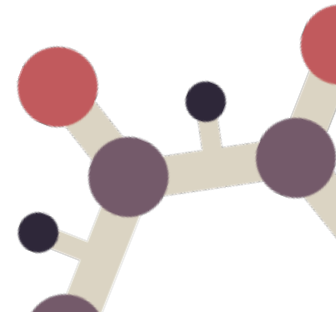


Fig. 1 | Epidemiological parameters of SARS-CoV-2 transmission. Four quantities that affect SARS-CoV-2 transmission are shown.

As we progress to an even more complicated landscape of SARS-CoV-2 transmission, affected by varying levels of immunity, vaccination and SARS-CoV-2 variants of concern (VOCs), we argue that coordinated studies are needed to continually monitor for changes in transmission behavior.

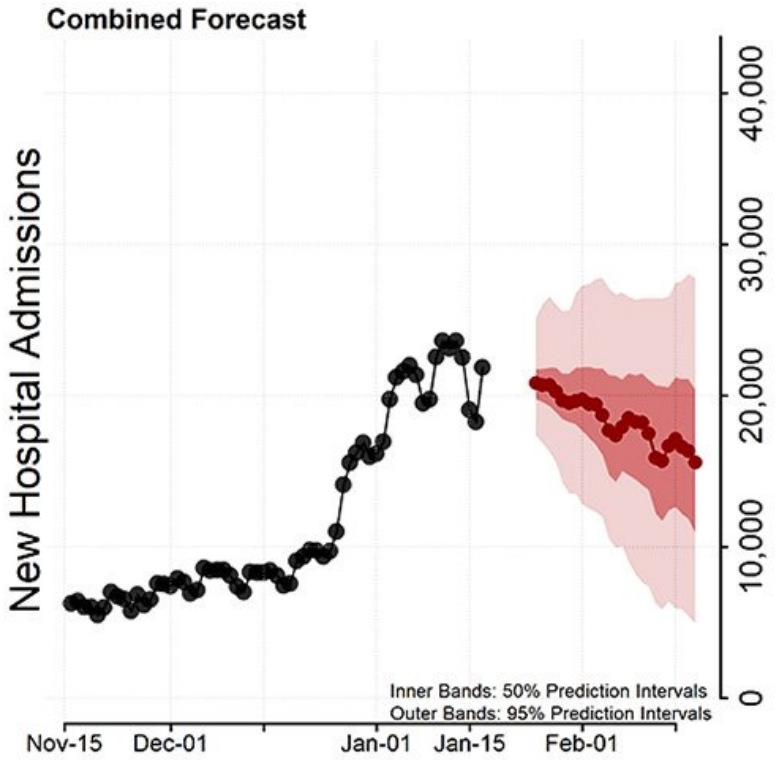


Kraemer et al. 2021 Nat Med

What’s next? Short term predictions

COVID DATA TRACKER

National Forecasts

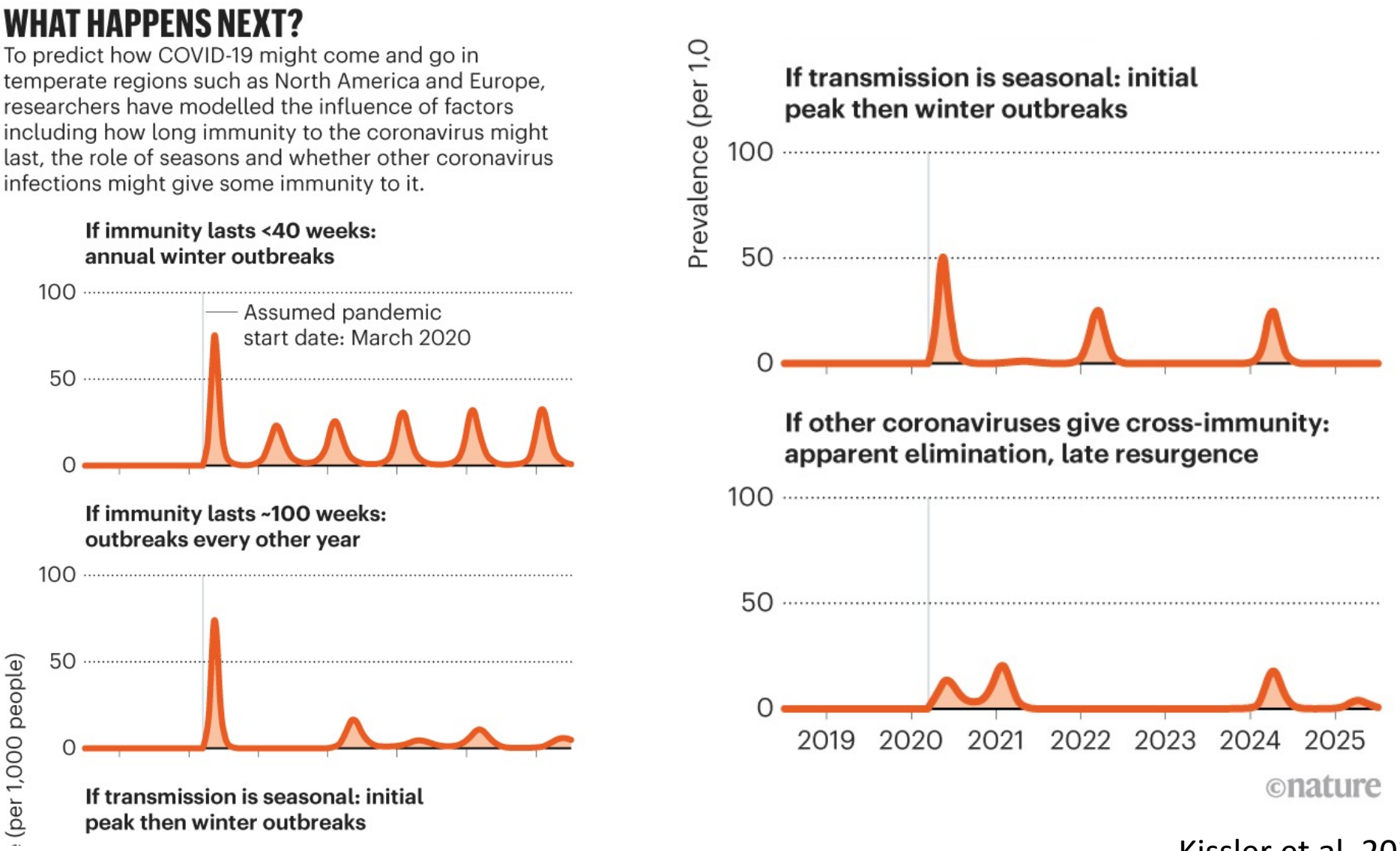


Data include new hospitalizations reported from November 16, 2021, through January 17, 2022, and daily projections from 13 forecasting models through February 18.

Find the latest data on
CDC’s COVID Data Tracker

Source: COVID Data Tracker – United States Forecasting

What's next? Longer term?



Kissler et al. 2020 Science

Lessons learned / questions

- COVID-19 probably at the highest level of influenza pandemic severity scale?
- Border closures not as infeasible as had been thought?
- Should now be a lot of valuable data on work-at-home policies?
- “Lockdowns” / “stay-at-home orders” not even considered as an NPI in our review
- Perhaps there will be more enthusiasm to use NPIs for severe seasonal influenza epidemics, given the experience with COVID-19?

Final comments

- Dynamic Zero Covid a valuable short-term strategy to buy time for development of vaccines and antivirals. Costs may exceed benefits in the longer term?
- How to measure population immunity? (vs infection, vs hospitalization)
- Optimal vaccination approaches – 3rd doses, 4th doses etc.
  - Timing, strain composition, any inference from influenza vaccination data?
- What's next after Omicron ??