

Health Research Symposium 2021

23 November 2021

*The 10th Anniversary of the Establishment
of the Health and Medical Research Fund*

Health and Medical
Research Fund (HMRF)



COVID190205

Molecular epidemiological study of COVID-19 cases in Hong Kong

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**HKU
Med**

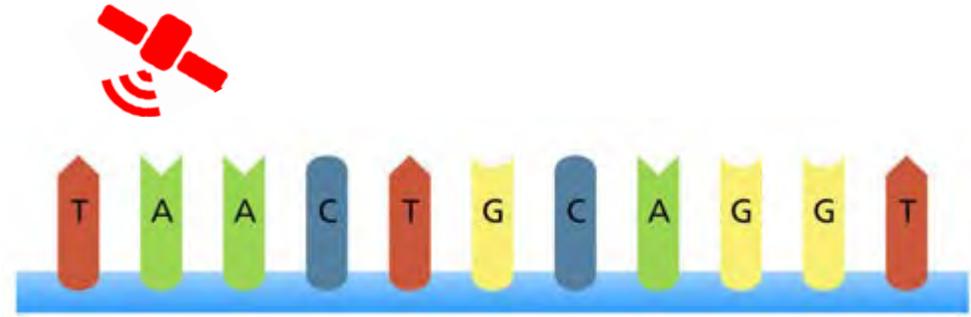
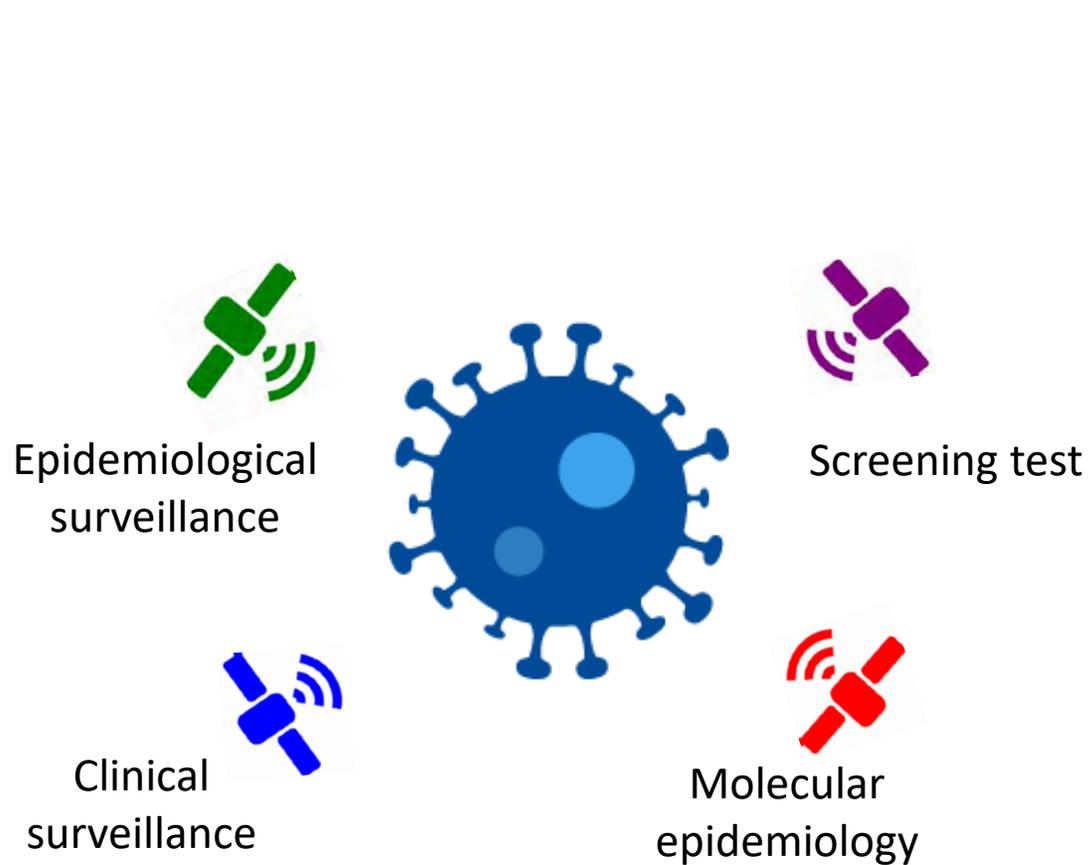
LKS Faculty of Medicine
School of Public Health
香港大學公共衛生學院



LKS Faculty of Medicine
HKU-Pasteur Research Pole
香港大學-巴斯德研究中心

C2i
Centre for
Immunology & Infection
免疫與感染研究中心

Use of multidisciplinary approach to study SARS-CoV-2 transmission



Objectives

- New virus variant introduction? How?
- Cases are related or not?
- Understand transmission dynamic.

Outcomes

- Science
- To provide scientific underpinnings for policy and decision making;

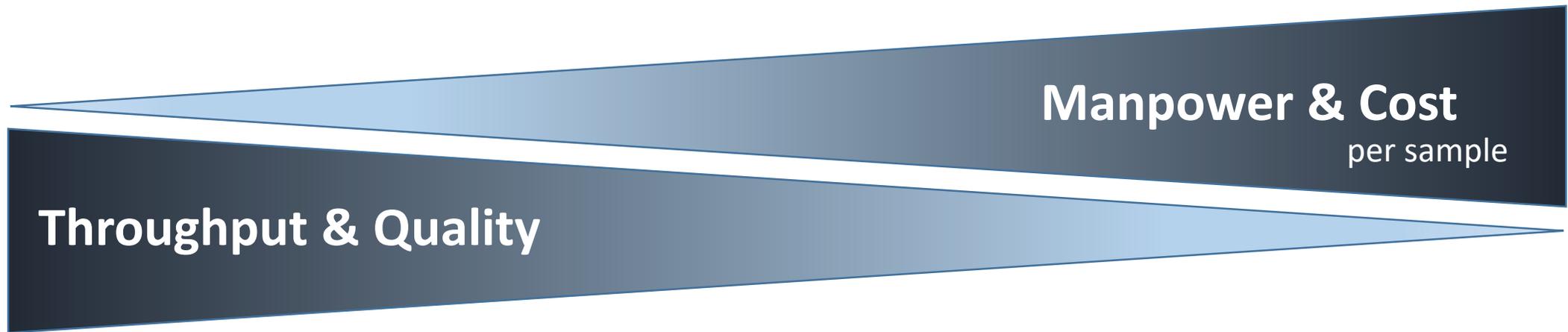
Current sequencing platforms @HKU

illumina®

NovaSeq

illumina®

ISeq



Urgent cases: < 48 hours

Weekly report to various stakeholders

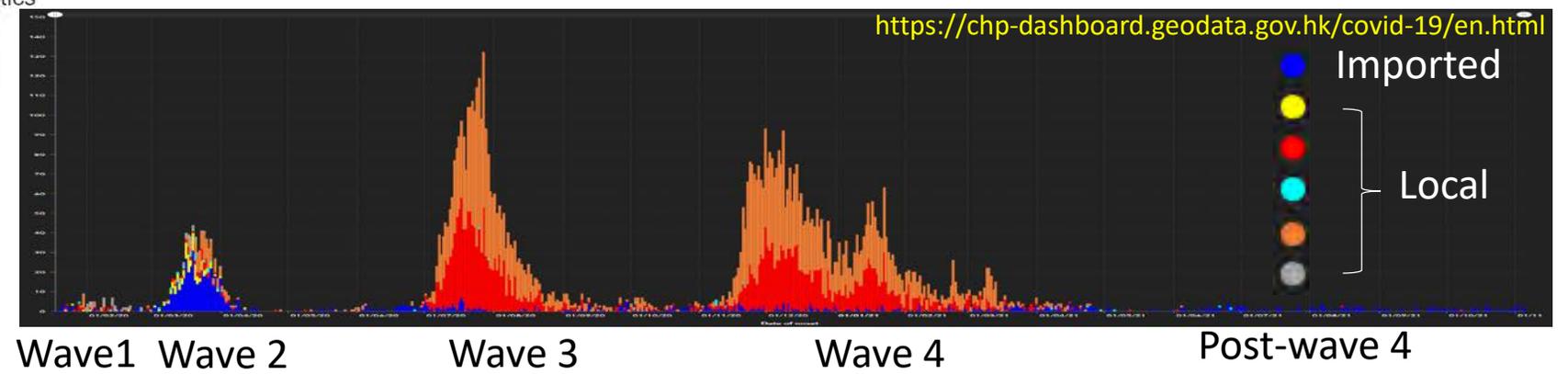
COVID-19 cases in HK

9 Nov 2021

Cumulative statistics

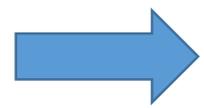
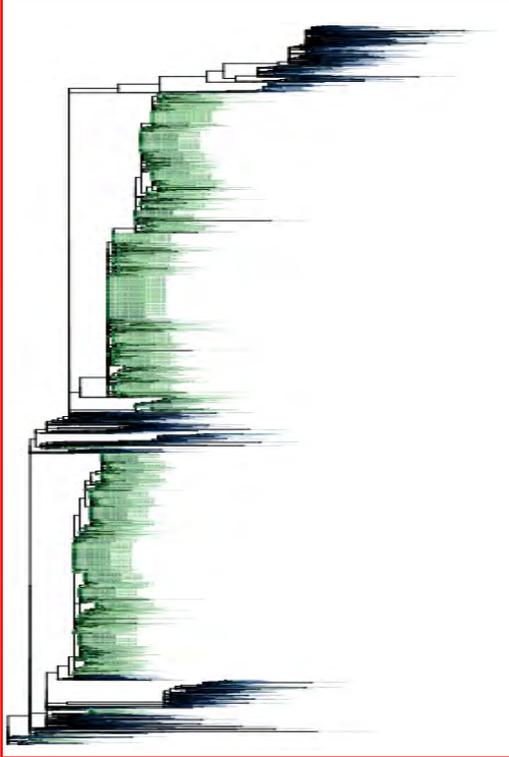
Cumulative no. of confirmed cases
12369

Cumulative no. of death
213



- Studied 25% of these cases (~3000 samples)

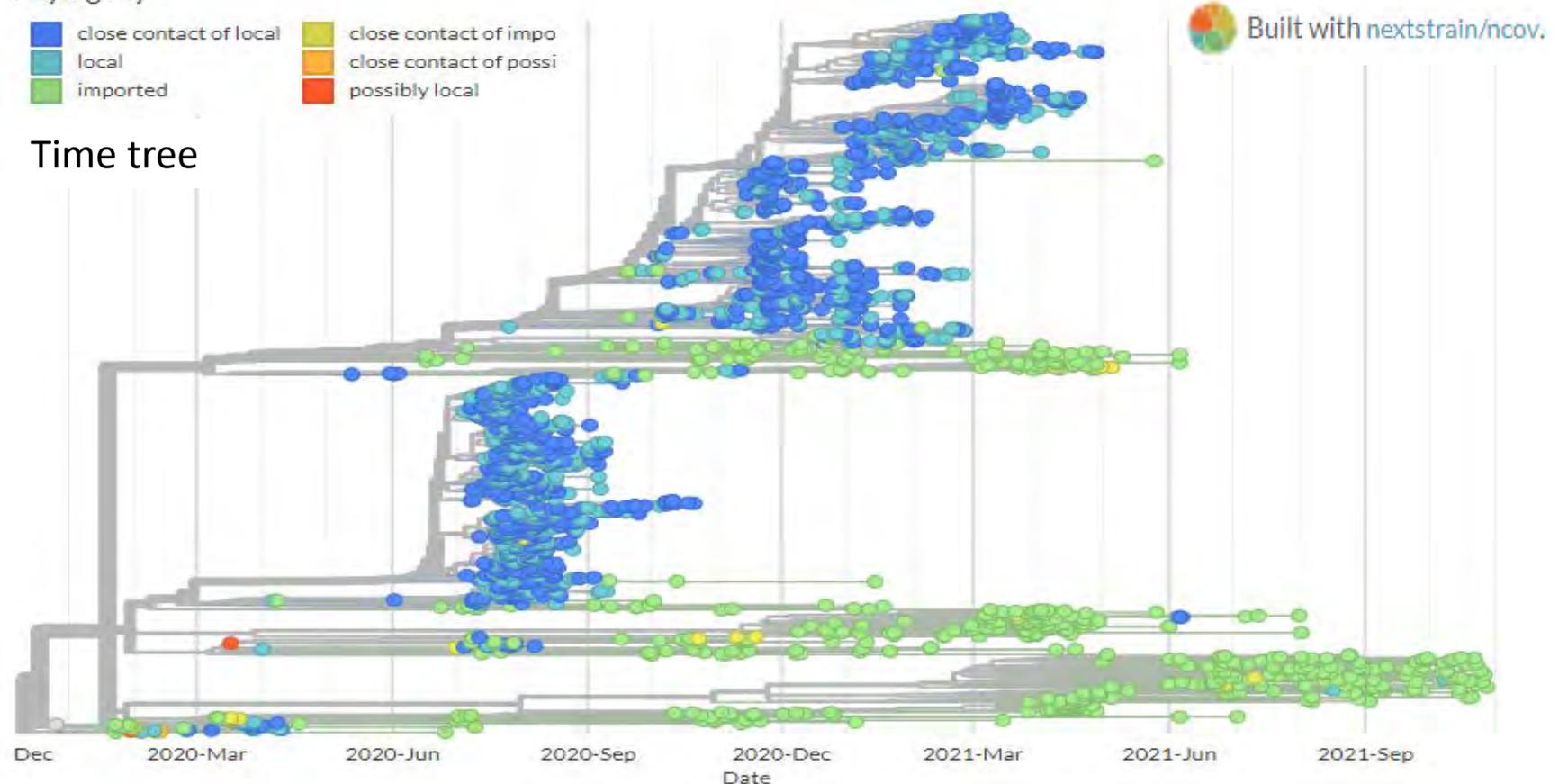
Genetic tree



Phylogeny

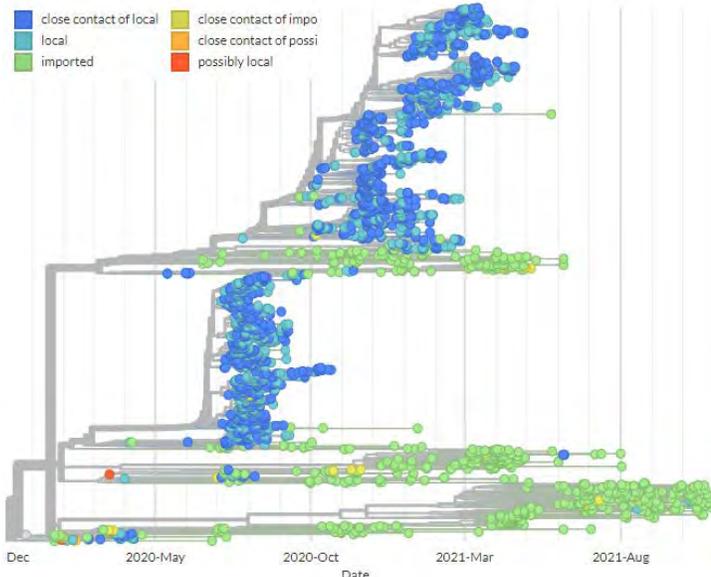
- close contact of local
- local
- imported
- close contact of impo
- close contact of possi
- possibly local

Time tree

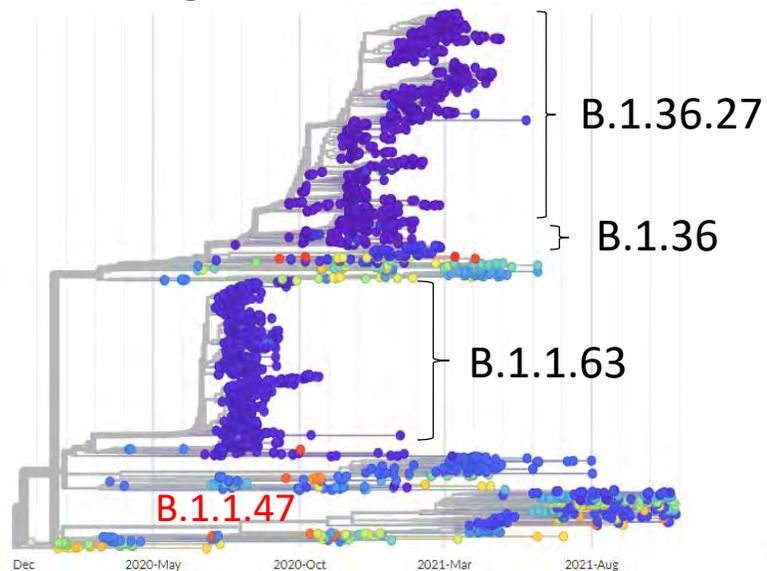


COVID-19 cases in HK

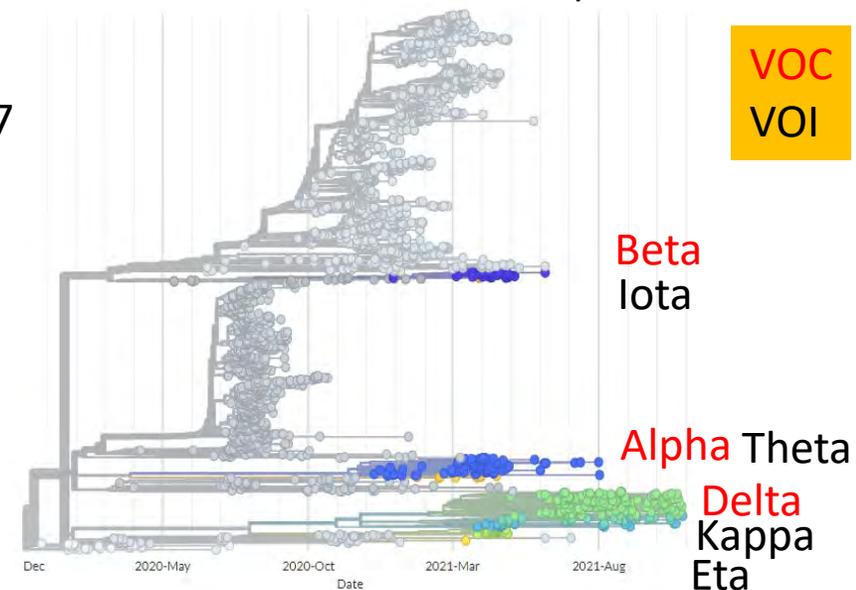
~75% are local cases



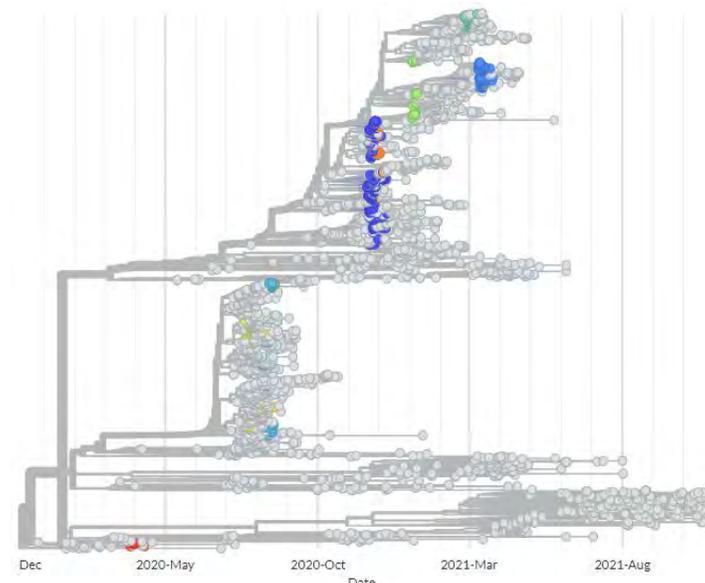
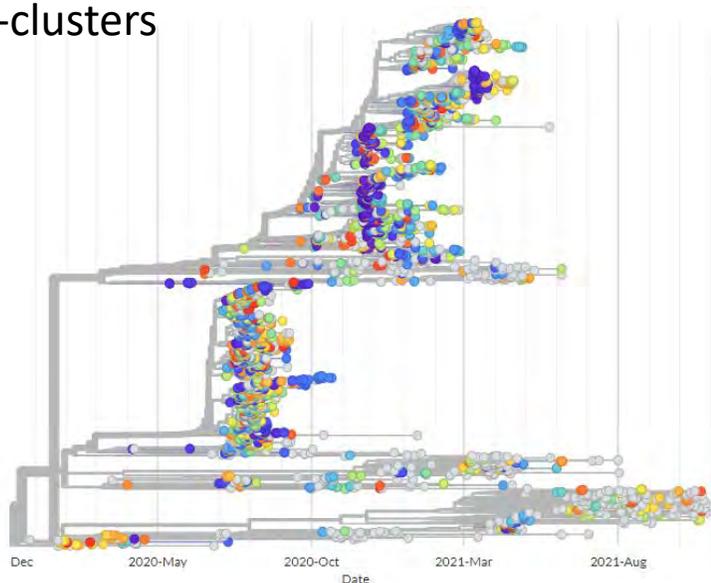
3 lineages → 90% of local cases



Variants of concern/interest



Epi-clusters



Top 10 clusters

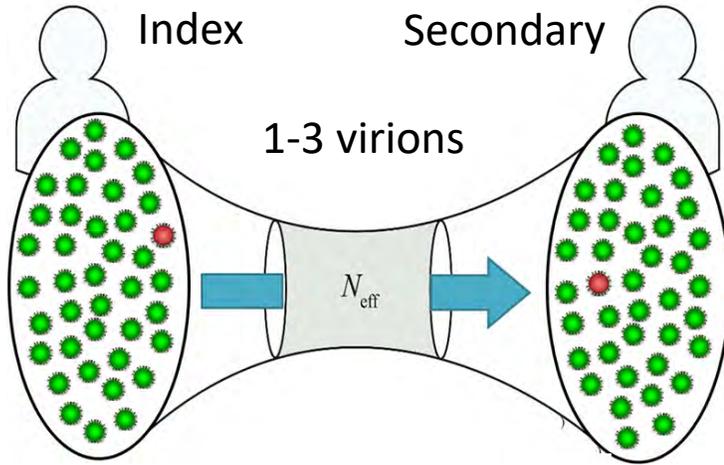
- Dancing/Singing (N=732)
- URSUS fitness club (N=155)
- Kwai Chung container terminal (N=77)
- K11 (N=57)
- Lam Tin tunnel construction site (N=50)
- Tuen Mun Fulum (N=52)
- Star Globla (N=88)
- Kai Tak construction site (N=74)
- Fong Shu Chuen Day Activity Centre (N=61)
- Bar and Band (N=103)

Use of genetic information to facilitate case clustering & declustering:



Genetic difference between cases in the same epi-cluster is very small

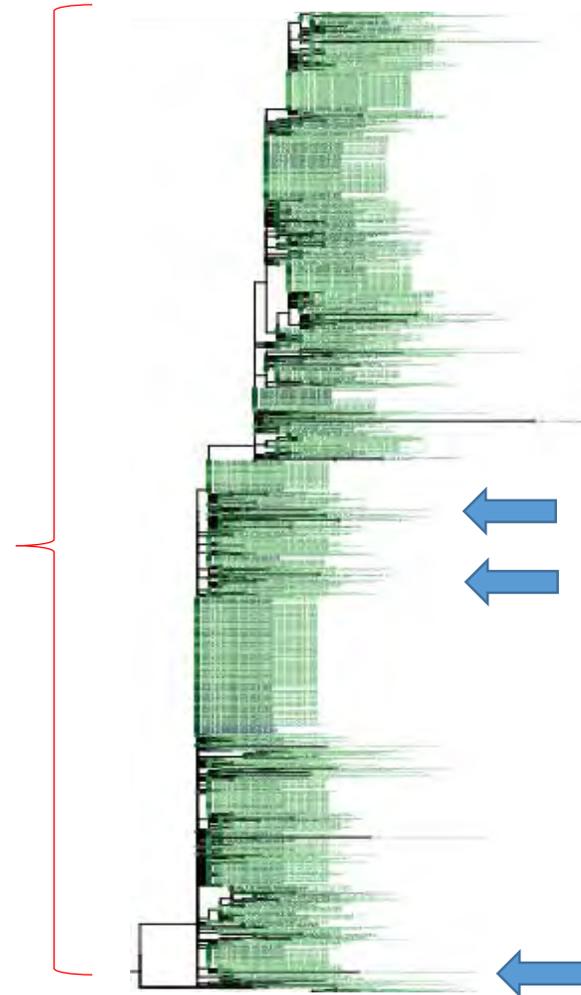
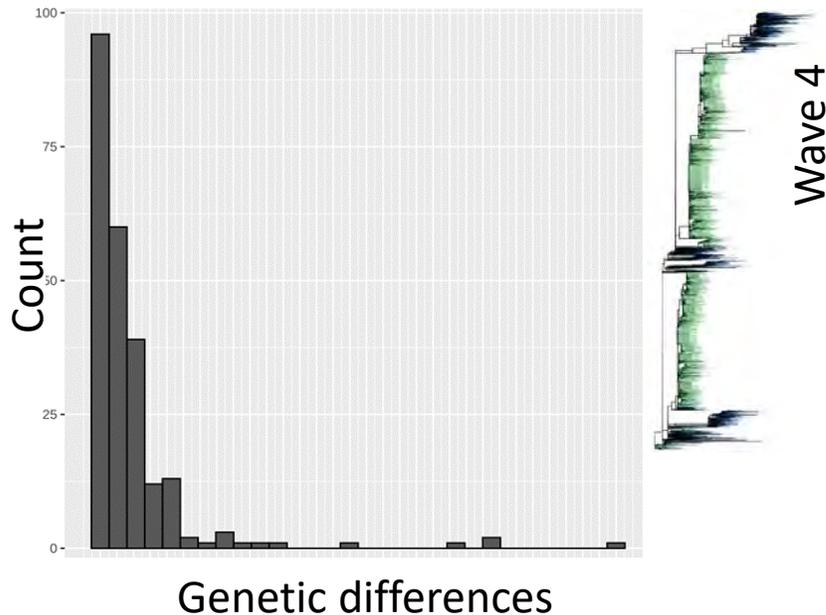
Transmission bottleneck analysis



Declustering

- Clusters with multiple transmission chain
- False positive cases
- Local cases due to imported cases

Genetic difference within the same cluster

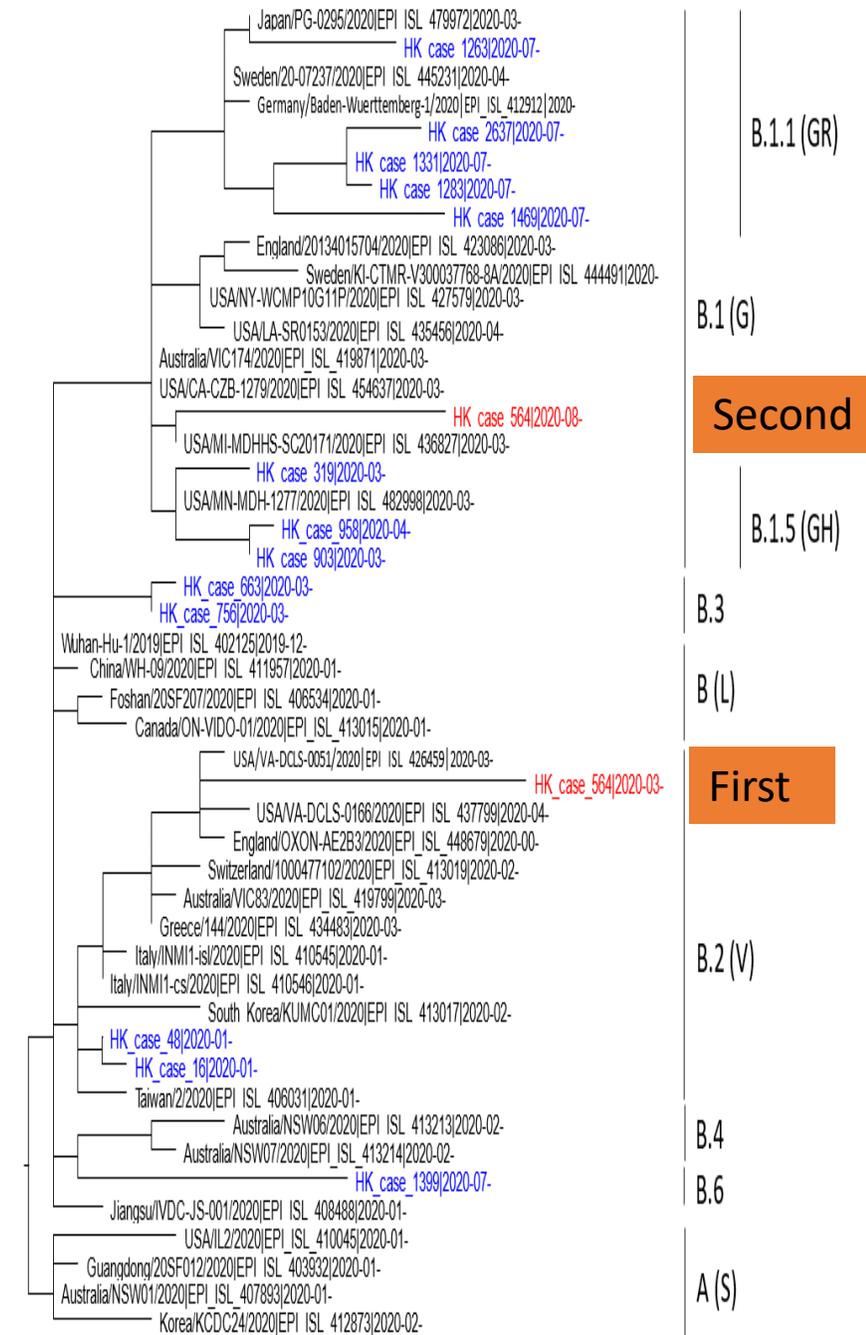
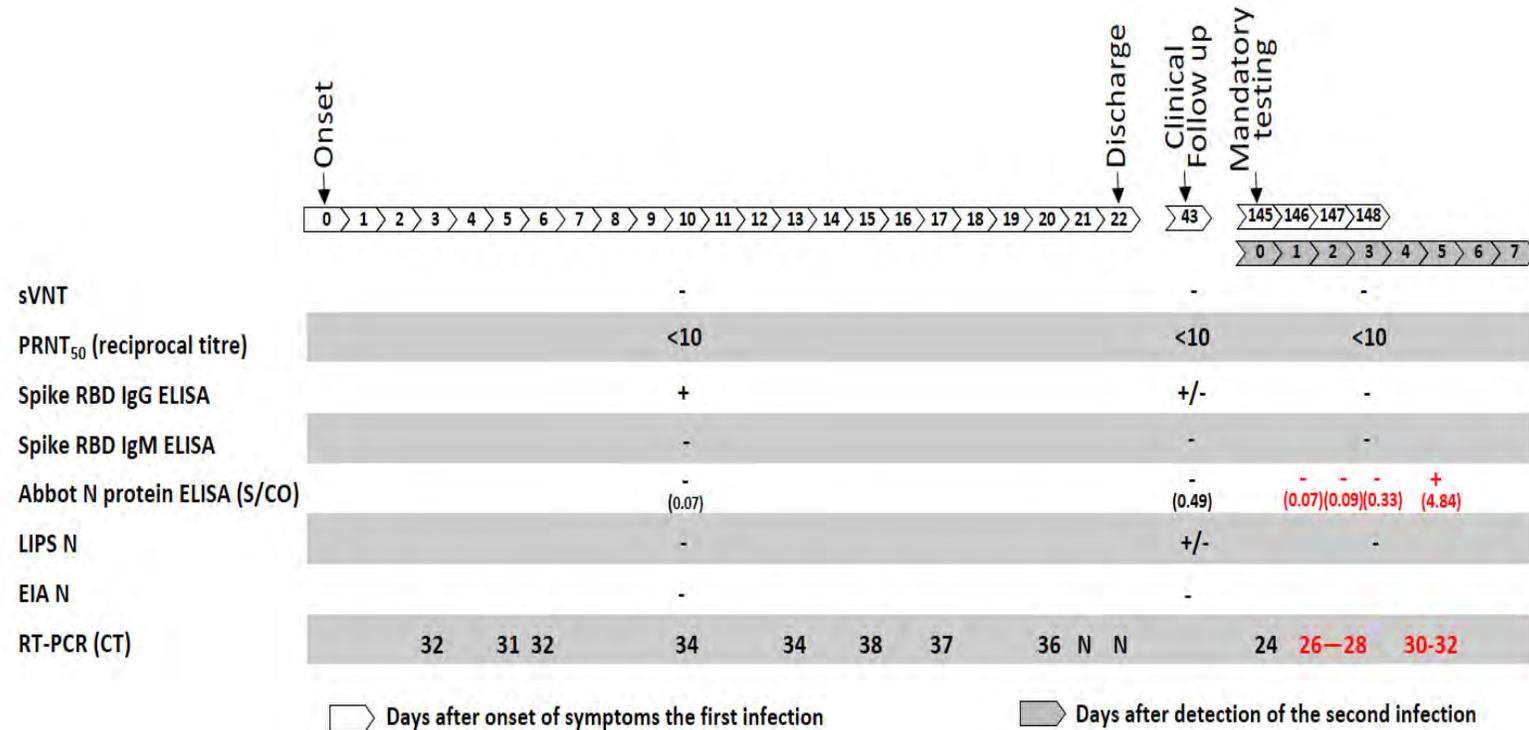


Clustering

- Identify links between cases or clusters

First case of COVID-19 reinfection

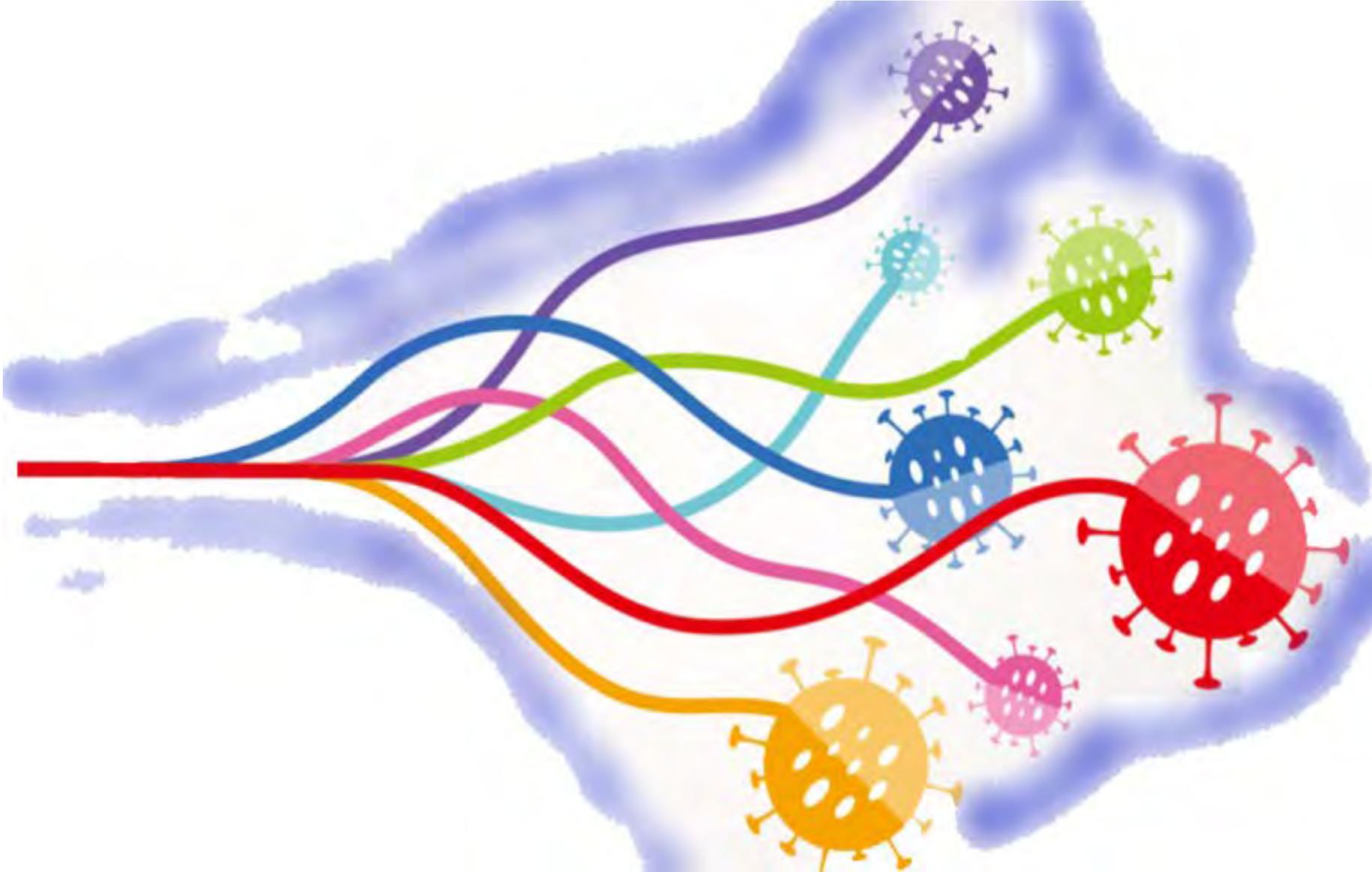
- Infected in HK in March 2020
- Recovered and tested negative in April
- No detectable neutralizing antibody after the first infection
- Returned to HK and tested positive in the HK airport (Day 145)



Research findings



Inform policy making

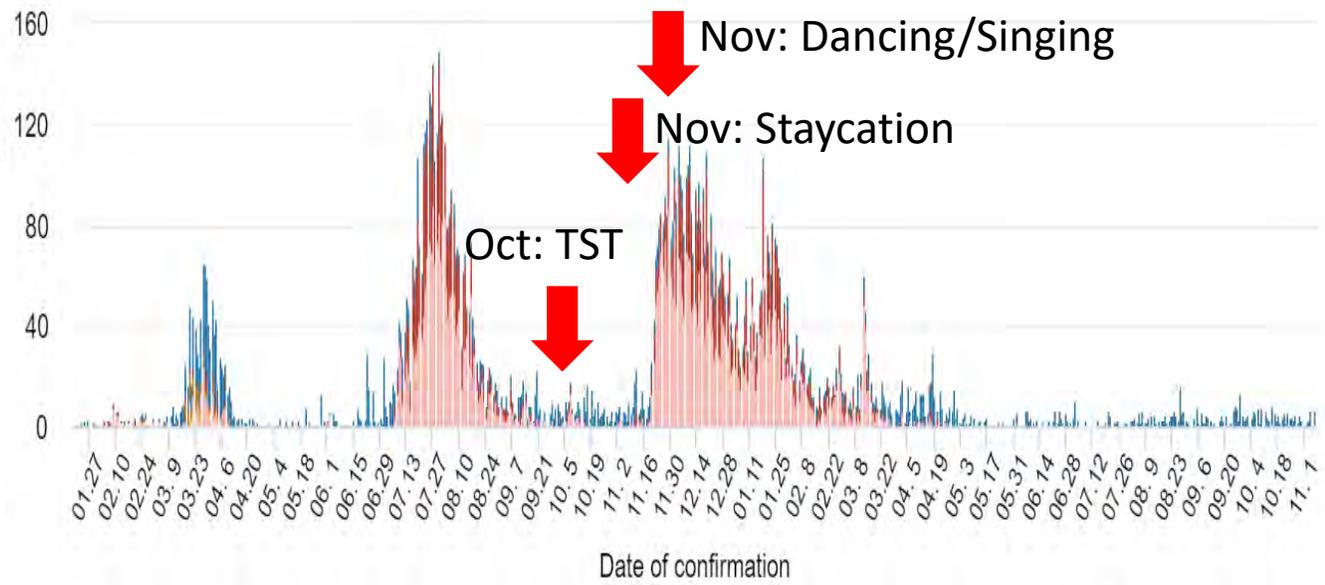
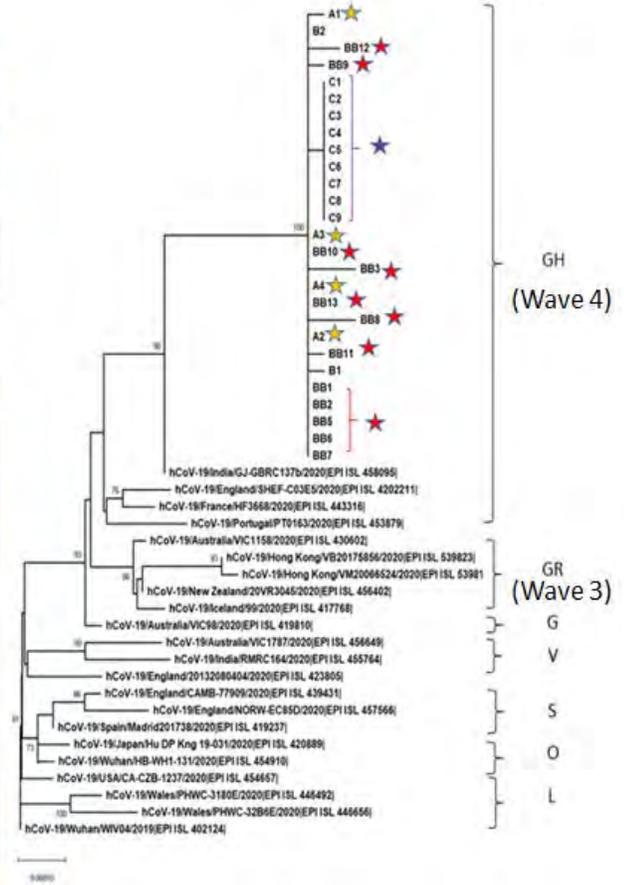
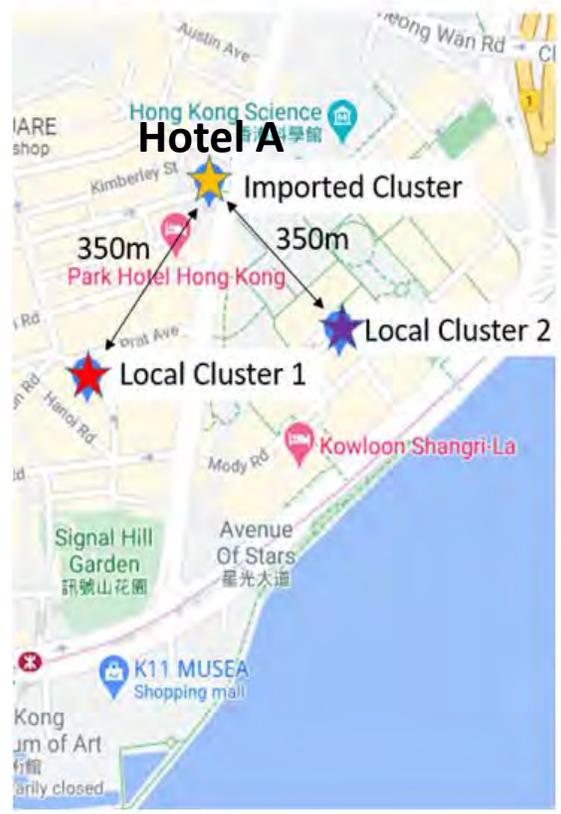


Introduction of **B.1.36.27** variant, causing the wave 4 of COVID-19 in HK

Sept 2020: Imported cases at Hotel A

Sept/Oct 2020: Local clusters 1 and 2 at TST

Tsim Sha Tsui



SARS-CoV-2 transmission via hotel settings
(Other examples are not discussed)

Latest Measures For Arrivals To Hong Kong



21 days

HOTEL

Compulsory quarantine period for all arrivals extended to 21 days at designated quarantine hotels

Dec 2020: Quarantine hotel policy

Lockdown in a small community

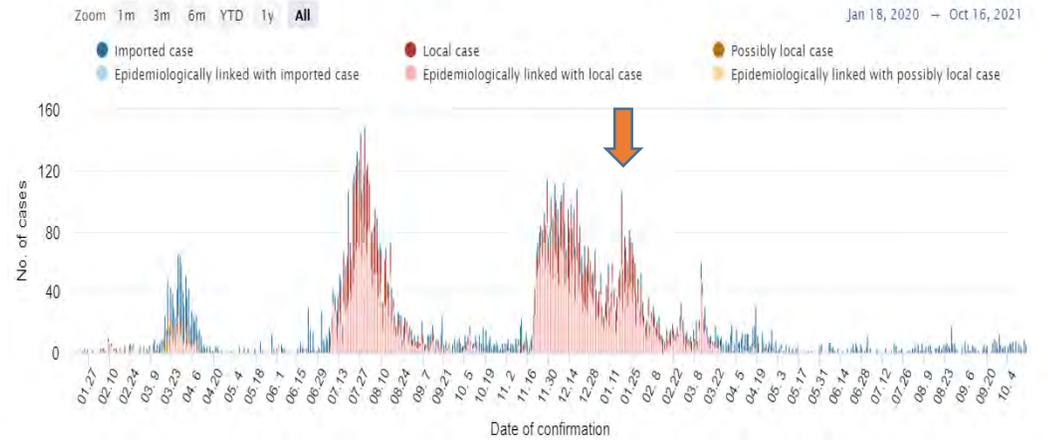
Local case

工友定期檢測 齊齊安心上班

Regular Testing at Sites
Protect Workforce from COVID-19



Epidemic curve by confirmation date and stratified by case classifications



Yau Tsim Mong mandatory testing area

SCMP



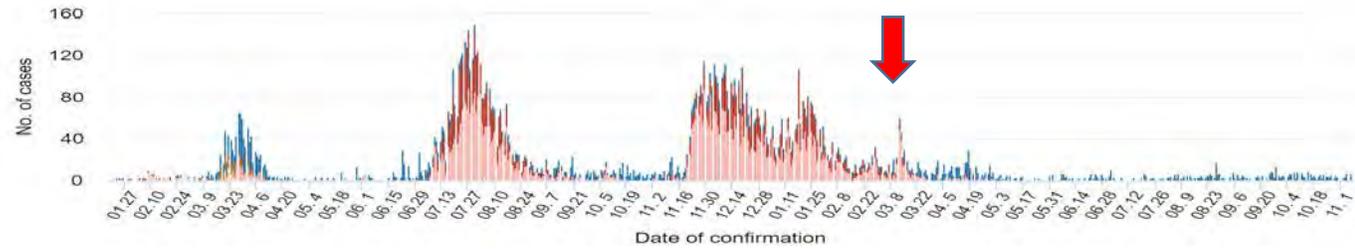
Core zone for mandatory testing even if no new infections are found in them

Lockdown area

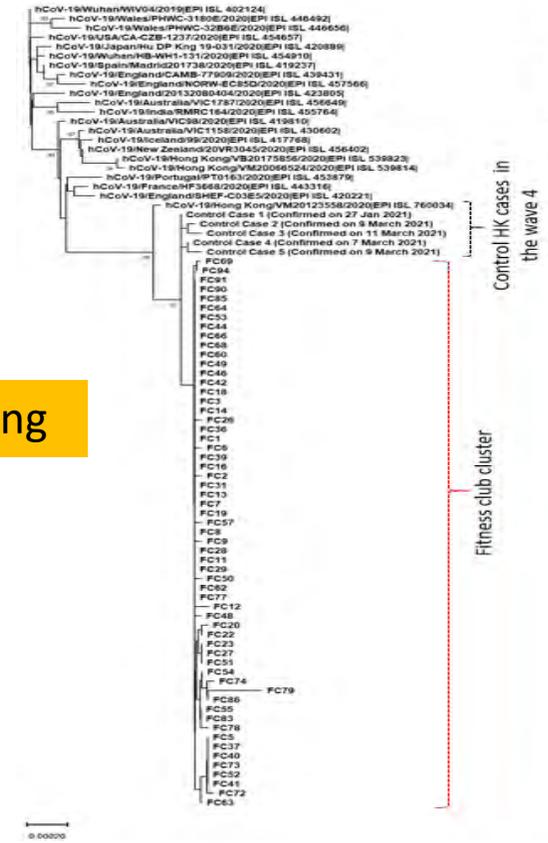
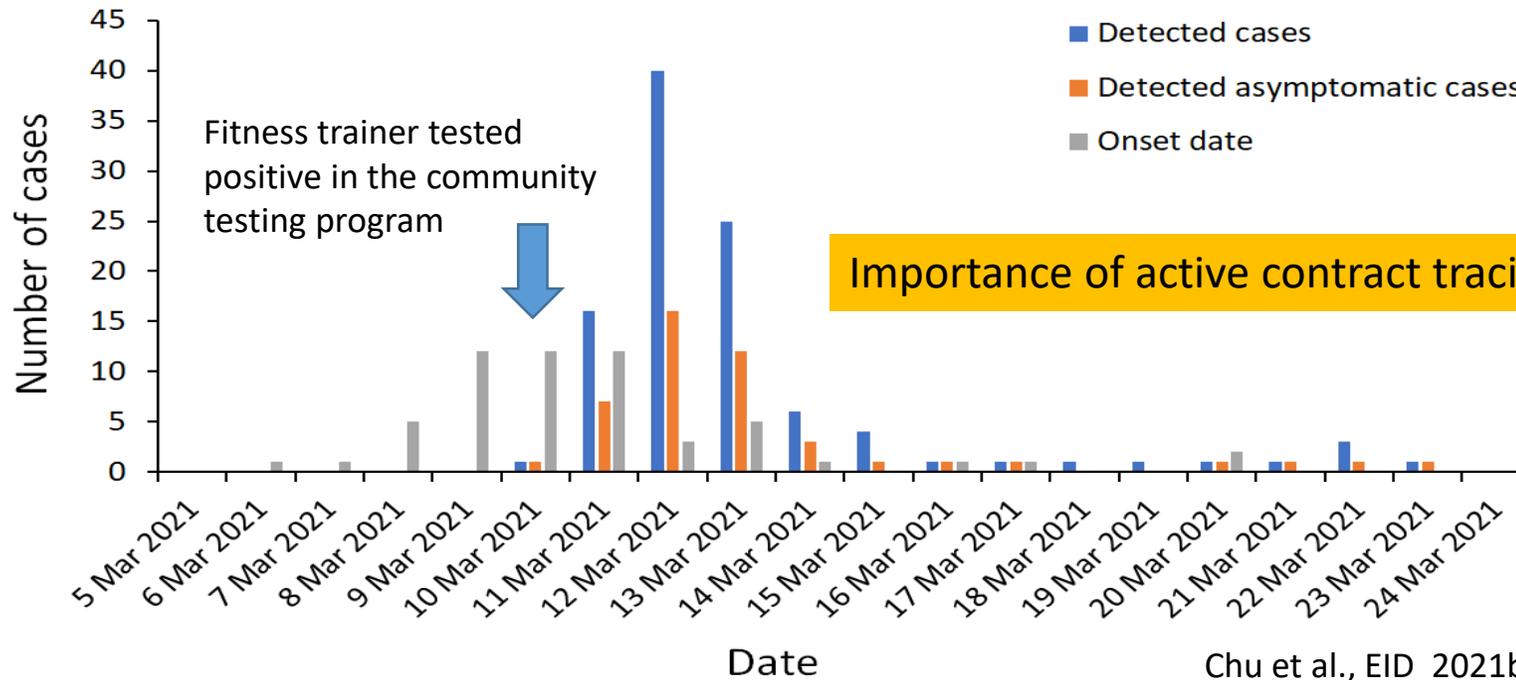


Yau Tsim Mong lockdown on Jan 23

Fitness centre cluster



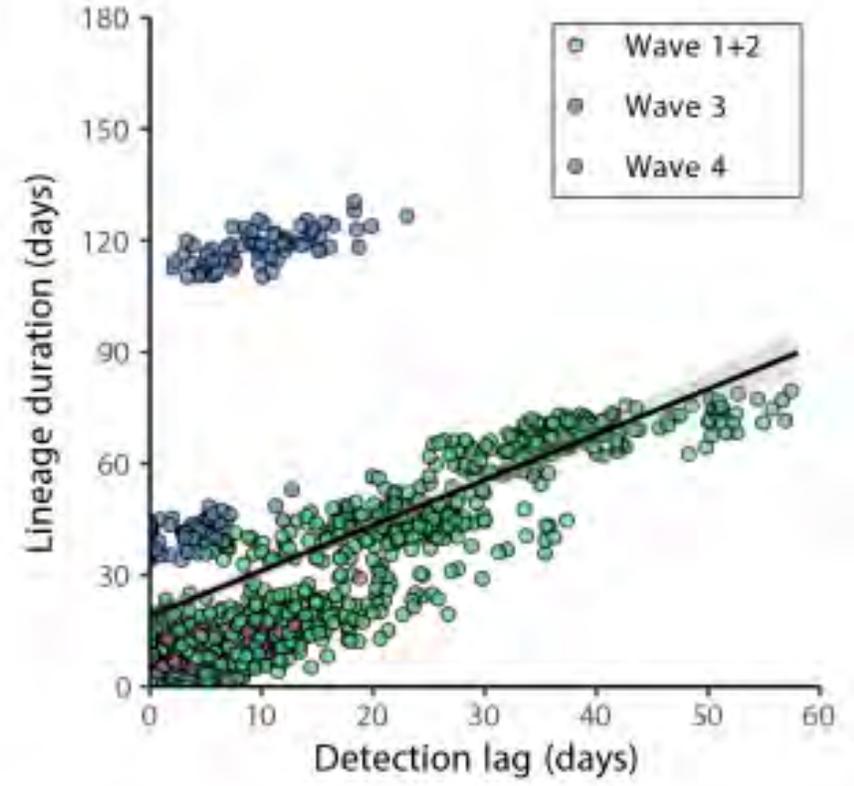
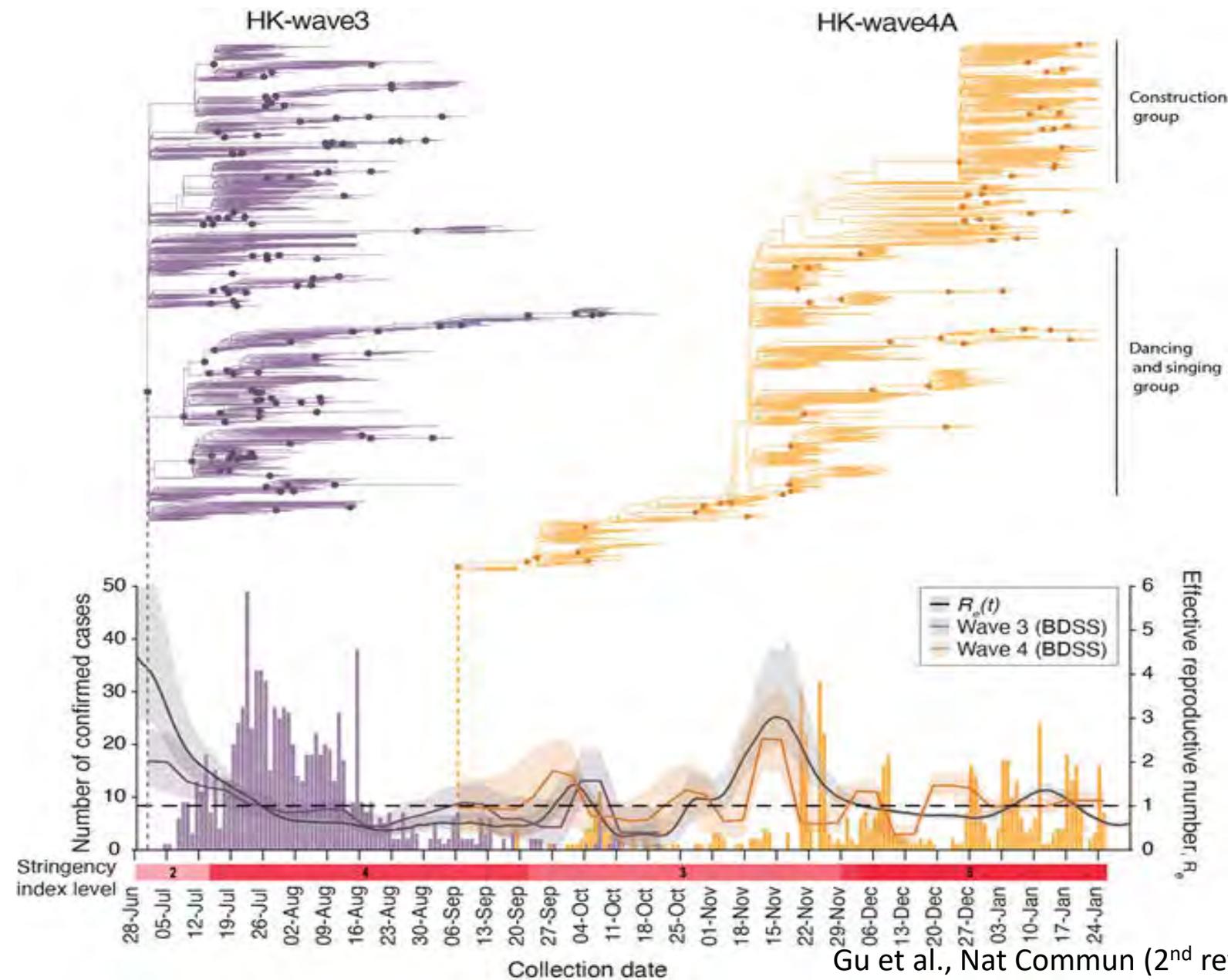
- >300 cases who visited this setting were tested
- 102 RT-PCR positive cases (**unusually high positive rate**)



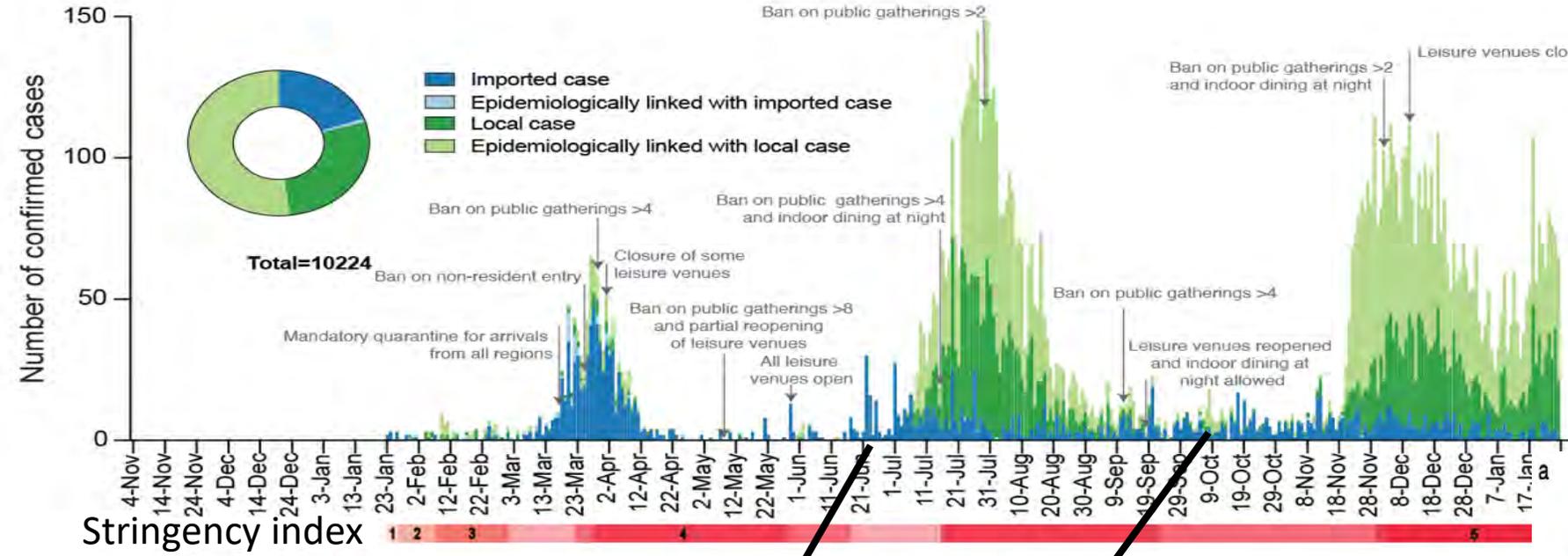
- The centre lacks fresh air and exhaust duct systems
- Issued new guidelines for COVID-19 control in gyms (e.g. Cap. 599F: air-change ≥ 6 per hr)

Estimate the extend of virus circulation

- How many transmission chains at a time?
- Are they spreading to other districts?
- Requires targeted controls?



Effect of changing policy/behaviour on virus circulation

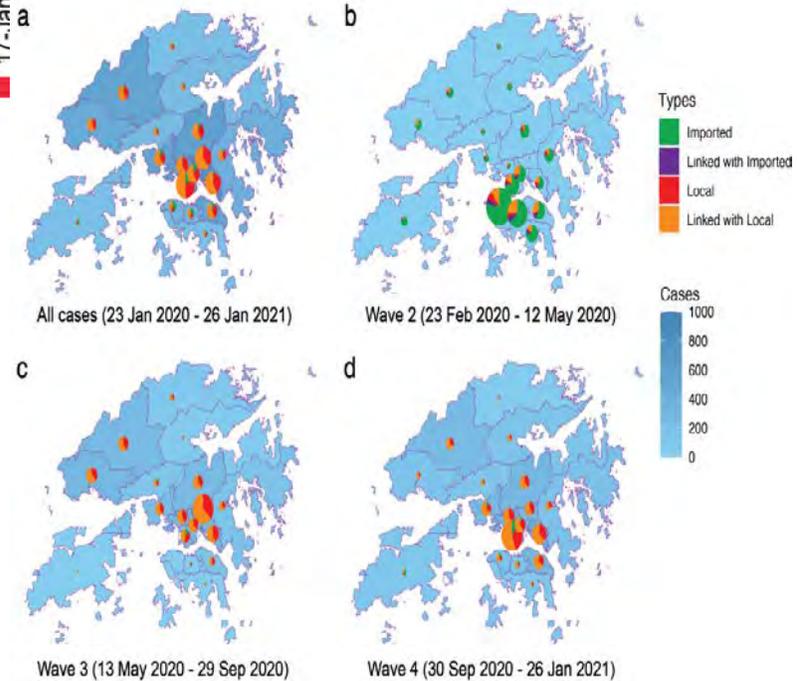
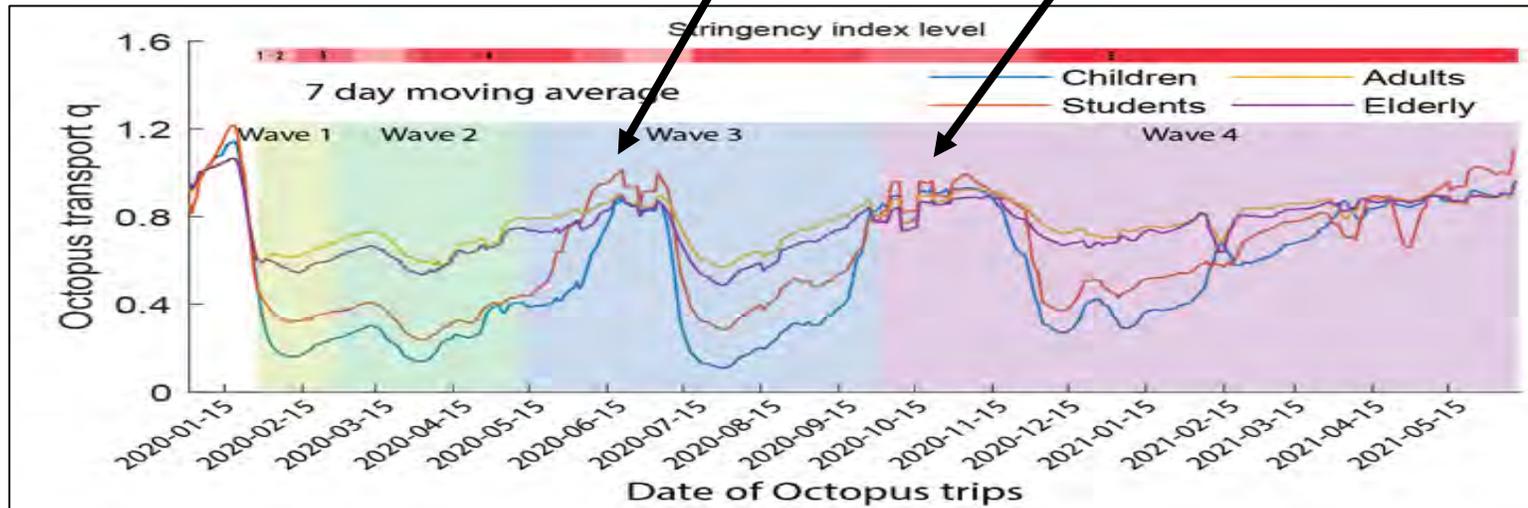


Stringency index

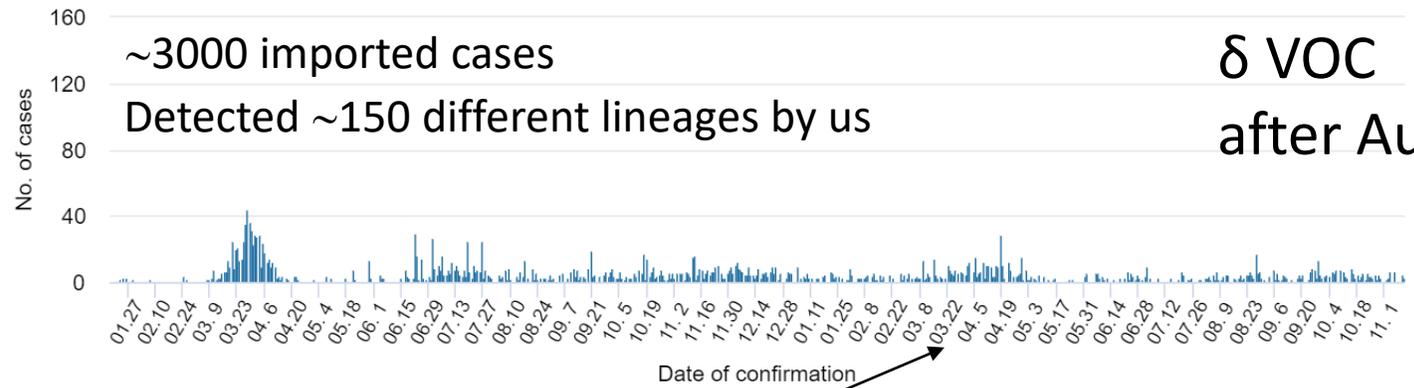
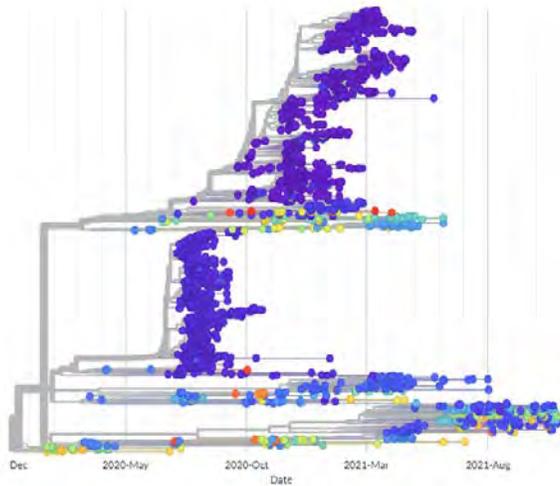
Level 2

Level 3

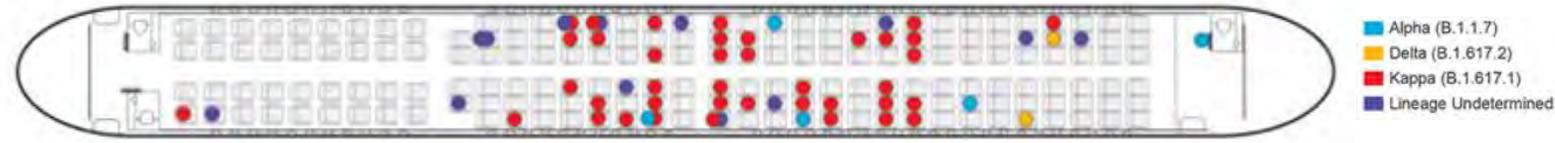
Octopus card usage



Imported cases

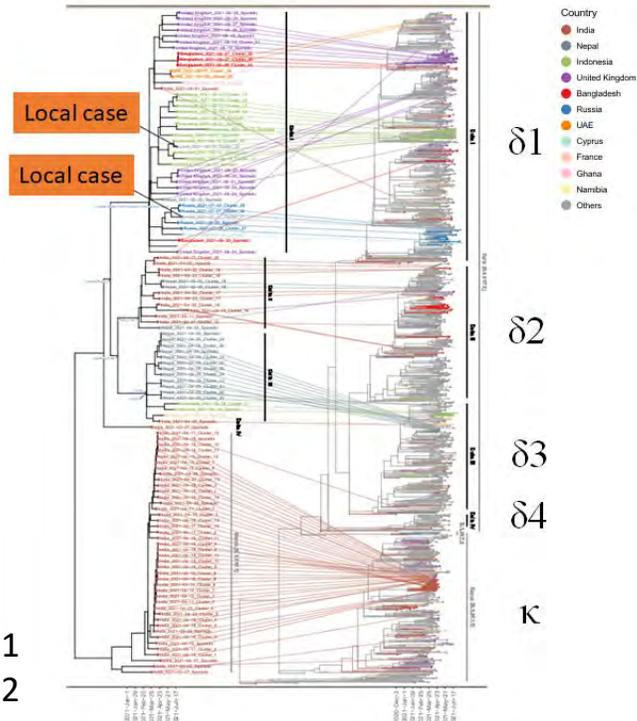


Early April: 58 positive cases from 1 flight

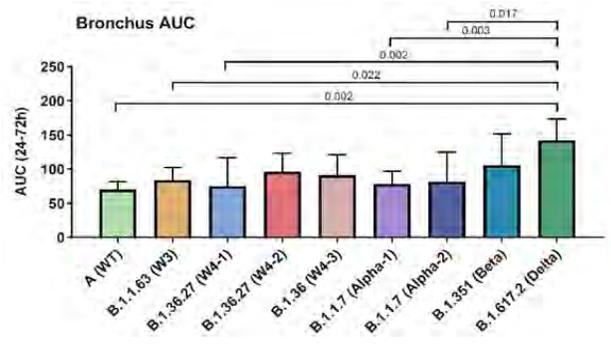


Dhanasekaran et al., J Travel Med 2021

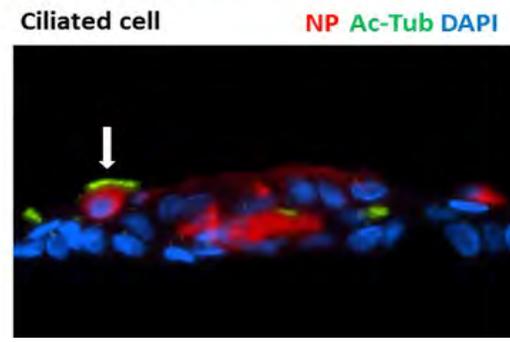
Airport staff



Gu et al., EID 2021
Gu et al., EID 2022



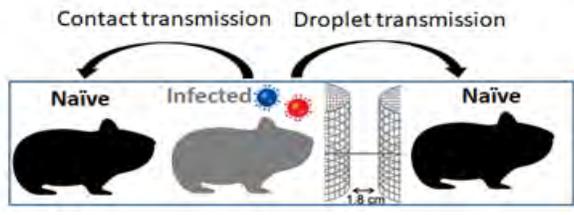
Airway organoid infected with SARS-CoV-2



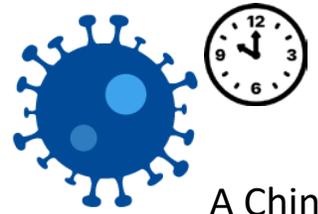
K Hui & M Chan



S Valkenburg & M Peiris



H Yen



A Chin



Jan 2020

Coronavirus disease (COVID-19) technical guidance:
Laboratory testing for 2019-nCoV in humans



Institutions received controls and diagnostic reagents from HKU



April 2020: 170 destinations in 77 countries

Chu et al., Clin Chem 2020

- Detect their index cases (e.g. Egypt)
- Provide technical supports
- Received samples for case conformation

Jan 2021

Genomic sequencing of SARS-CoV-2

A guide to implementation for maximum impact on public health

8 January 2021



- Technical support
- Sample testing
- Result validation



Food and Agriculture
Organization of the
United Nations



WORLD ORGANISATION
FOR ANIMAL HEALTH



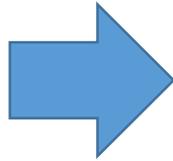
World Health
Organization



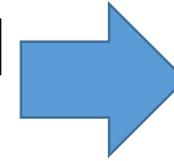
IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Summary:

Molecular epidemiology



- Understand transmission
- Monitor situation and trend
- Identify gaps
- Lead to better science

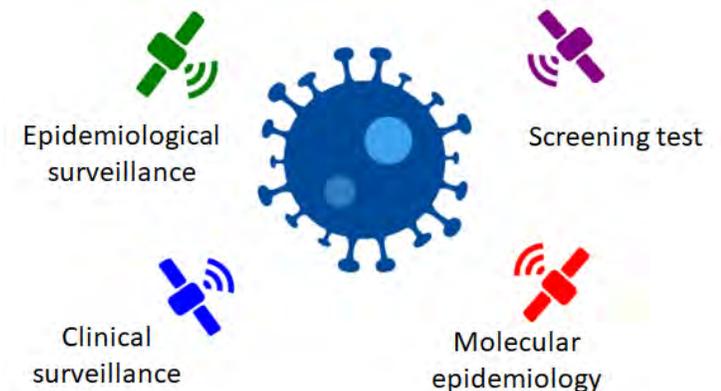


Real world impacts

- All tools have their pros and cons
- They should be used as a package

Publications supported by COVID19025:

- ❖ first **reverse zoonosis** (Sit et al., Science 2020)
- ❖ the **viral dynamic in Hong Kong** (Gu et al., Nature Communications, under 2nd review)
- ❖ world's first **re-infection** (Chan et al., EID 2020)
- ❖ first **inflight transmission** (Choi et al., EID 2020)
- ❖ a **super-spreading** event in a flight (Dhanasekaran et al., J Travel Med., 2021)
- ❖ a **super-spreading** event associated with poor air ventilation (Chu et al., EID 2021a)
- ❖ Hotel with quarantined travellers can be a **hotspot for virus introduction** (Chu et al., EID 2021b)
- ❖ HK might serve as a regional **sentinel site to monitor virus diversity** (Gu et al., EID, 2021 and 2022)



Acknowledgments



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Research Fund (HMRF)



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Department of Pathology, HKU: John Nicholls

Faculty of Engineering: Tong Zhang

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- **CHP, Hong Kong (Colleagues from PHLSB and CDB)**
- AFCD, Hong Kong
- Infectious Disease Centre, PMH, Hong Kong
- HA, Hong Kong
- The Chinese University of Hong Kong
- London School of Hygiene & Tropical Medicine



- Coronavirus study group, ICTV
- WHO
- OIE
- Pasteur network
- CEIRR, NIH
- CREID, NIH



Research Grants Council
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THANK YOU!



From “New normal” to “Real normal”