Research insights about COVID-19 from Hong Kong

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A novel coronavirus was officially announced as the causative pathogen of the outbreak by China CDC.

Emergency monitoring, case investigation, close contact management, and market investigation initiated, technical protocols for Wuhan released; NHC notified WHO and relevant countries and regions; gene sequencing completed by China CDC.

Hunan Seafood Wholesale Market closed.

Outbreak announced by WHC; NHC and China CDC involved in investigation and response.

Pneumonia cases linked to the Huanan Seafood Wholesale Market.

PCR diagnostic reagents provided to Wuhan.

First confirmed case from Wuhan reported outside China (in Thailand).

China CDC emergency response level upgraded to Level 1 (the highest level); national technical protocols for 2019-nCoV released by NHC.

Strict exit screening measures activated in Wuhan, people with body temperature \( \geq 37.3^\circ C \) were restricted from leaving.

First confirmed case reported in another province in China (in a person who had traveled from Wuhan); China CDC issued test reagent to all provinces in China.

NCIP incorporated as a notifiable disease in the Infectious Disease Law and Health and Quarantine Law in China.

Reagent probes and primers shared with the public by China CDC.
What *could*, not *would*, be?
Expansion in laboratory testing, up to ~5-7000/day

- Tier 1
- Tier 2
- Tier 2 updated
- Tier 3
- Tier 4 stage 1
- Tier 4 stage 2
- Tier 5 stage 1
- Tier 5 stage 2
- Tier 6
- Tier 6 updated

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**Expansion of laboratory testing**

**Chinese New Year**

- Activation of the "Emergency Response Level" of the Preparedness and Response Plan against infectious disease outbreak
- Suspension of all hospital visits

**January**

- Set up COVID-19 testing and virus test centres in some A&E departments in hospitals
- Barred entry of non-Hong Kong residents with travel history to Hubei Province
- Flight suspension between Hong Kong and Wuhan
- Quarantine people with travel history to Hubei Province over the past 14 days

**February**

- WHO declared COVID-19 as a pandemic

**March**

- Suspension of temporary test centre
- Gradual resumption of non-emergency services at hospitals
- Door-to-door specimen collection service for COVID-19 testing
- Addition of 450 second-for isolation tests

**April**

- Usage of rapid test for COVID-19 at hospitals
- Holding centre of asymptomatic inbound travellers for test results in operation

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**Number of Cases**

- January 19, 26
- February 2, 23
- March 1, 8, 15, 22, 29
- April 5, 12, 19, 26
- May 3

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**Date of reporting**

- January
- February
- March
- April
- May
Expansion in laboratory testing, up to ~5-7000/day

1. All suspected cases meeting clinical and epidemiological criteria
2. Inpatient pneumonia not responding to treatment with no other known etiology
3. All inpatient pneumonia
4. Outpatients with relevant clinical suspicion at public clinics
5. Outpatients at private clinics
6. Arriving travelers regardless of symptoms

All (or almost all) testing is PCR on saliva samples.

Table 3: Mode of detection for confirmed and probable cases in Hong Kong

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of cases (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Cases fulfilling the reporting criteria of COVID-19</td>
<td>333 (31.8%)</td>
</tr>
<tr>
<td>(2) Enhanced laboratory surveillance in public hospitals</td>
<td>48 (4.6%)</td>
</tr>
<tr>
<td>(3) Enhanced surveillance at Accident and Emergency Departments / General Outpatient Clinics</td>
<td>121 (11.5%)</td>
</tr>
<tr>
<td>(4) Diagnosis / Enhanced surveillance in private hospitals and clinics</td>
<td>85 (8.1%)</td>
</tr>
<tr>
<td>(5) Medical surveillance / Contact tracing by the Centre for Health Protection</td>
<td>212 (20.2%)</td>
</tr>
<tr>
<td>(6) Enhanced surveillance for asymptomatic inbound travelers</td>
<td>249 (23.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>1048 (100.0%)</td>
</tr>
</tbody>
</table>

Clustering of local COVID-19 infections – but majority of infections imported
Clustering of COVID-19 infections

With Dillon Adam
Serial interval and offspring distribution

20% of cases responsible for 80% of transmission events
(overdispersion parameter $k=0.39$ and $0.47$ using two methods)
Limited spread from imported infections

- 14-day mandatory quarantine from affected areas from early February - expanded to all arrivals from late March
  - Most quarantine has been home quarantine
- Ban on visitors from late March
- PCR testing of all arrivals at airport starting from late March
- $R_t$ estimated using method of Cori et al 2013 AJE, modified to allow for pre-symptomatic transmission
Massive reduction in inbound travel at airport

• March 2019: 200,000 passengers a day
• Since late March 2020 500 passengers a day

• All arriving persons now proceed to be tested on arrival and, if negative, given bluetooth wristband and asked to install app on smartphone, before proceeding home or to a hotel for 14 day strict home quarantine. Those without a smartphone are given a parole-style GPS ankle bracelet.
Some onwards spread from local infections

- Limited number of “unlinked” local cases – directly or indirectly from imported infections (previous slide)
- Schools closed and cancellation of mass gatherings from early February
- All cases isolated in hospital (even asymptomatics)
- Close contacts traced and quarantined
- >50% of working population changing to working from home during period marked in yellow
- Orange period - additional measures in restaurants, bars, gyms, leisure centres
- High level of face mask use throughout
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Unpublished data
Stage 1: Interventions were implemented such that $R_t=1$; Stage 2: Interventions were relaxed resulting in $R_t=R^2>1$ when stage 2 began; Stage 3: Interventions from stage 1 were again implemented such that $R_t=1$; Stage 4: Interventions more aggressive than that in stages 1 and 3 ($R_t=R^4<1$ at the start of stage 4) were implemented in order to push the disease prevalence back to pre-relaxation level (i.e. stage 1 level). $T_i$ is the duration of stage $i$.

$R^2$ and $R^4$ referred to the reproductive number when stage 2 and 4 began, respectively. (A) Relative case count compared to no relaxation of interventions. (B) The duration of aggressive interventions required to push prevalence back to pre-relaxation level ($T_4$) relative to the duration of interventions relaxation ($T_2$).

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