

How Can a Democracy Effectively Respond to COVID-19: Lessons from Taiwan

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VIEWPOINT

Response to COVID-19 in Taiwan Big Data Analytics, New Technology, and Proactive Testing

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Taiwan is 81 miles off the coast of mainland China and was expected to have the second highest number of cases of coronavirus disease 2019 (COVID-19) due to its proximity to and number of flights between China.¹ The country has 23 million citizens of which 850 000 reside in and 404 000 work in China.^{2,3} In 2019, 2.71 million visitors from the mainland traveled to Taiwan.⁴ As such, Taiwan has been on constant alert and ready to act on epidemics arising from China ever since the severe acute respiratory syndrome (SARS) epidemic in 2003. Given the continual spread of COVID-19 around the world, understanding the action items that were implemented quickly in Taiwan and assessing the effectiveness of these actions in preventing a large-scale epidemic may be instructive for other countries.

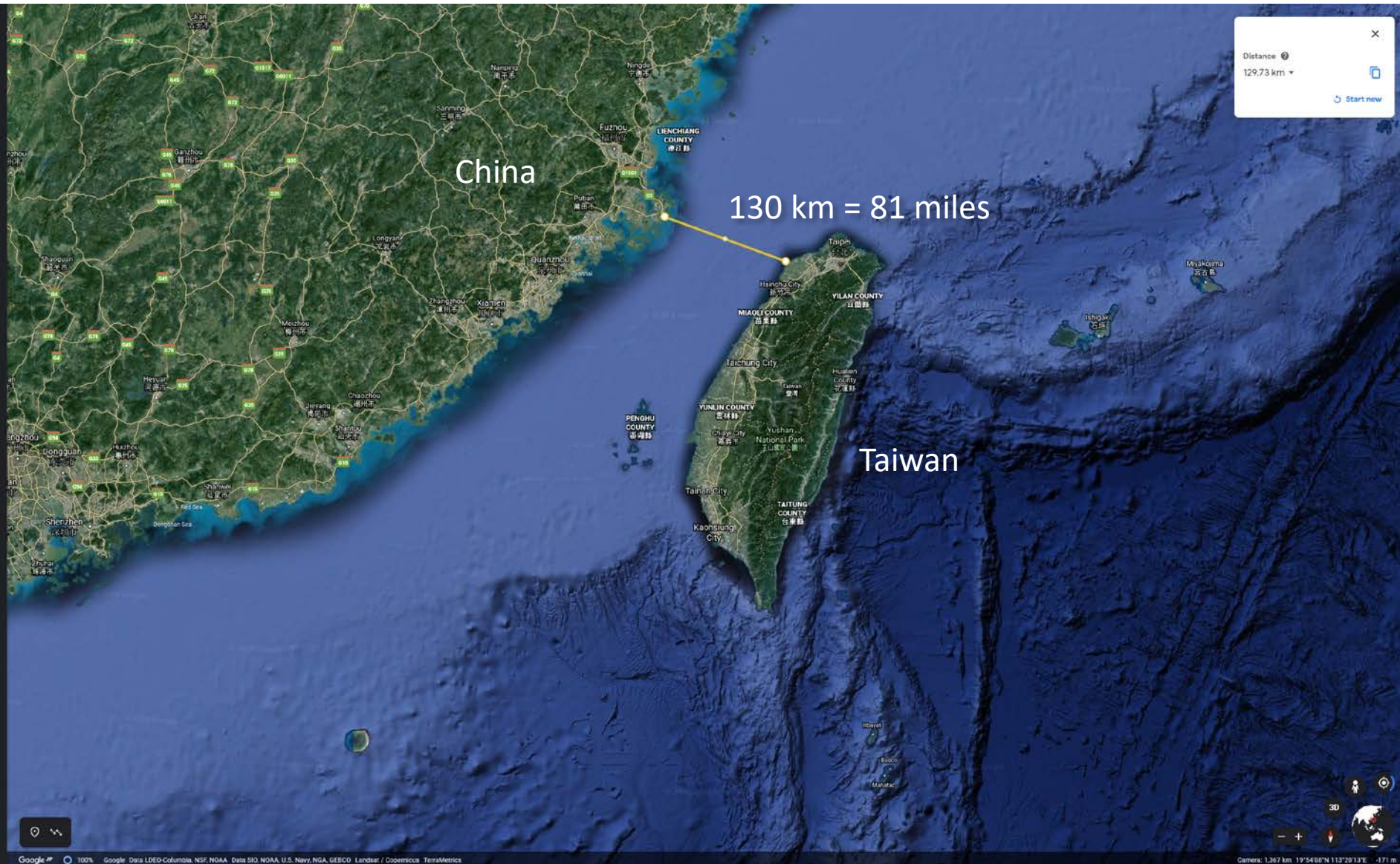
COVID-19 occurred just before the Lunar New Year

Recognizing the Crisis

In 2004, the year after the SARS outbreak, the Taiwan government established the National Health Command Center (NHCC). The NHCC is part of a disaster management center that focuses on large-outbreak response and acts as the operational command point for direct communications among central, regional, and local authorities. The NHCC unified a central command system that includes the Central Epidemic Command Center (CECC), the Biological Pathogen Disaster Command Center, the Counter-Bioterrorism Command Center, and the Central Medical Emergency Operations Center.⁵

On December 31, 2019, when the World Health Organization was notified of pneumonia of unknown cause in Wuhan, China, Taiwanese officials began to board planes and assess passengers on direct flights from

Distance from Taiwan to China



SARS Impact on Taiwan in 2003



- 346 cases, 73 deaths
- 94% of all known infections were transmitted inside hospitals
- All major hospitals were fully or partially shut down
- Doctors and nurses quit for fear of catching the disease because of inadequate hospital infection-control
- Fever clinics set up too late outside hospitals to prevent infections in waiting rooms
- Infected laundry worker at Ho Ping hospital becomes super spreader
- Entire Ho Ping 450-bed hospital shut down to quarantine all 930 staff & 240 patients (lock in)
- Quarantined patients in other areas evaded isolation despite threats of steep fines

Dean, Jason and Pottinger, Matt. "Complacency in Taiwan Led to Revival of Spread of SARS. The Wall Street Journal. May 19, 2003

McNeil, Donald G. "SARS Fears Shake Taiwan Medical Staffs" The New York Times. May 21, 2003

Chang, Yun-ping "SARS Epidemic: Taipei City closes down hospital" Taipei Times. April 25, 2003

Prepared for the next crisis: Communicable Disease Control Act

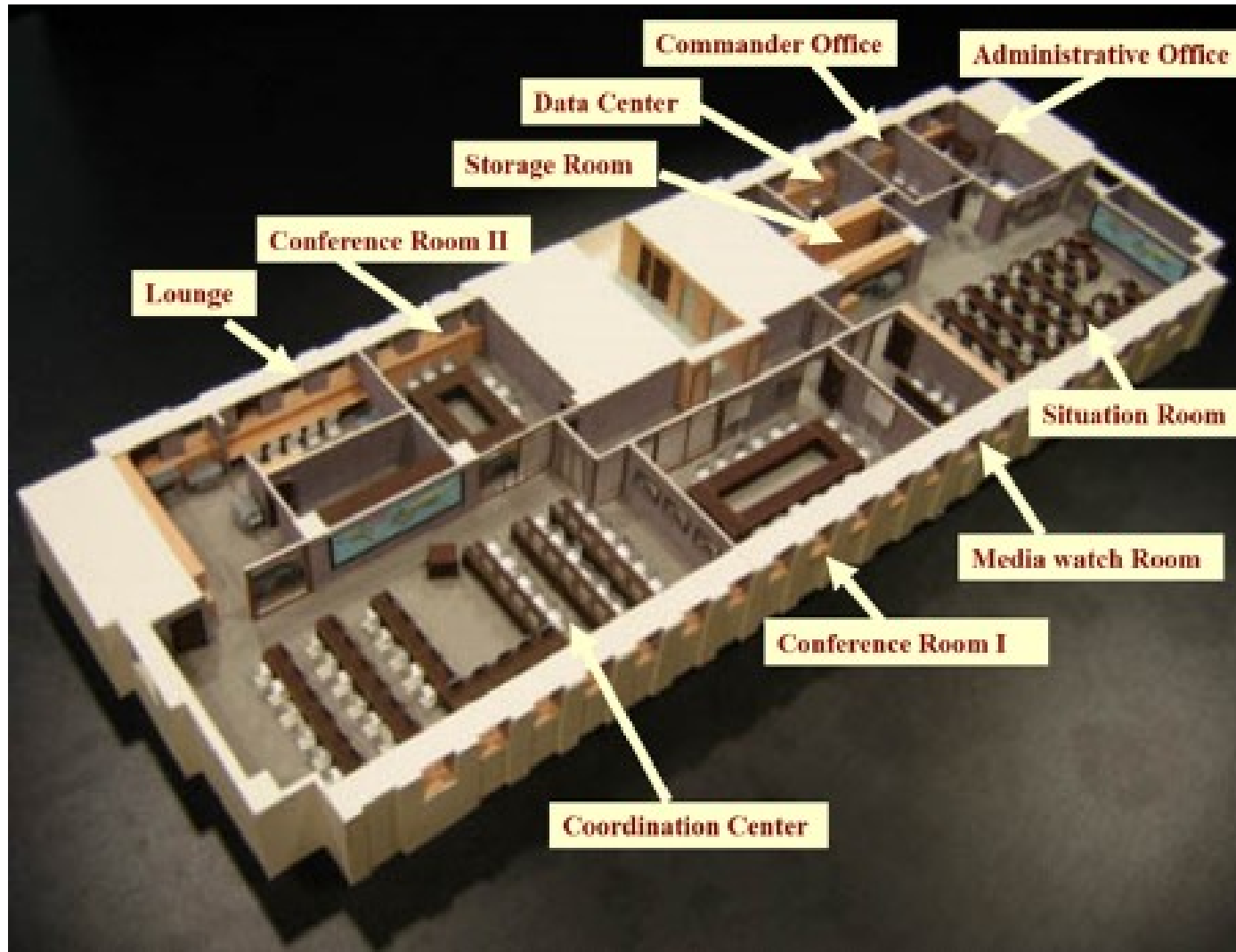


COVID-19 Relevant Points

- Classifies high-risk infectious diseases into five categories and specifies reporting and quarantine requirements
- Formulates policies for prevention and control of disease (e.g. immunization, surveillance, case reporting, lab testing, quarantine, drills, training, **protective equipment stockpile**)
- Allows creation of a **central epidemic command centers** to unify and coordinate government organizations, state enterprises, civic/service groups, and the army
- Creates an integrated communicable disease surveillance system including sentinel and syndromic reporting systems
- Allows for **regulation of gatherings, entry and exit of people, traffic, evacuation, travel restrictions**, and other disease control measures announced by the government
- Specifies **penalties for violating home quarantine/isolation regulations, hoarding resources, disseminating rumors or incorrect information, fines institutions for employees' bad behavior**
- Allows for **tracking and management of people under infectious risk**
- Mandates the **geographic locations and total number of patients be made public**
- Allows for use of public properties and requisition use of private land, productions, buildings, devices, facilities, pharmaceuticals, and medical devices for disease control, facilities for treatment of contamination, and to provide adequate compensation

Prepare for next crisis:

Design of Taiwan's National Health Command Center



- Created in 2004 after SARS
- WHO released command center development guidance in 2015
- Includes the Central Epidemic Command Center, Biological Pathogen Disaster Command Center, Counter-Bioterrorism Command Center, and the Central Medical Emergency Operations Center
- Located on 7th floor of the CDC
- Accommodates 100 people

CECC Information Exchange and Integration



Systems collect real-time data from multiple Taiwan databases:

- National Health Insurance stockpile systems
- Taiwan National Infectious Disease Statistics System
- Media surveillance

Information exchanged with departments and other countries through IHR Focal Point

Recognizing the Crisis: First 30 Days

December 31, 2019
WHO notified of a cluster
of cases of pneumonia of
unknown cause in Wuhan,
China



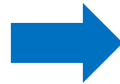
- **Dec 31:** Taiwan officials board and inspect passengers for fever or pneumonia symptoms on direct flights from Wuhan
- **Jan 5:** Taiwan CDC is notified if passenger from Wuhan has fever and/or URTI
- **Jan 20:** Wuhan placed on Level 2 travel alert; **Central Epidemic Command Center activated**
- **Jan 21:** Wuhan placed on Level 3 travel alert; **National Security Council convened to coordinate efforts from various Ministries**
- **Jan 22:** Entry permits canceled for 459 tourists set to arrive from Wuhan in January
- **Jan 23:** Wuhan residents banned and travelers from China required to make health declaration before entering
- **Jan 25:** Tours to China suspended; Hubei province level 3 travel alert; Rest of China level 2 travel alert
- **Jan 27:** NHIA and NIA integrate patients' past 14-day travel history into NHIA database

Recognizing the Crisis: Taiwan Screens Passengers from Wuhan (h2h transmission unknown)

December 31, 2019

December 31, 2019

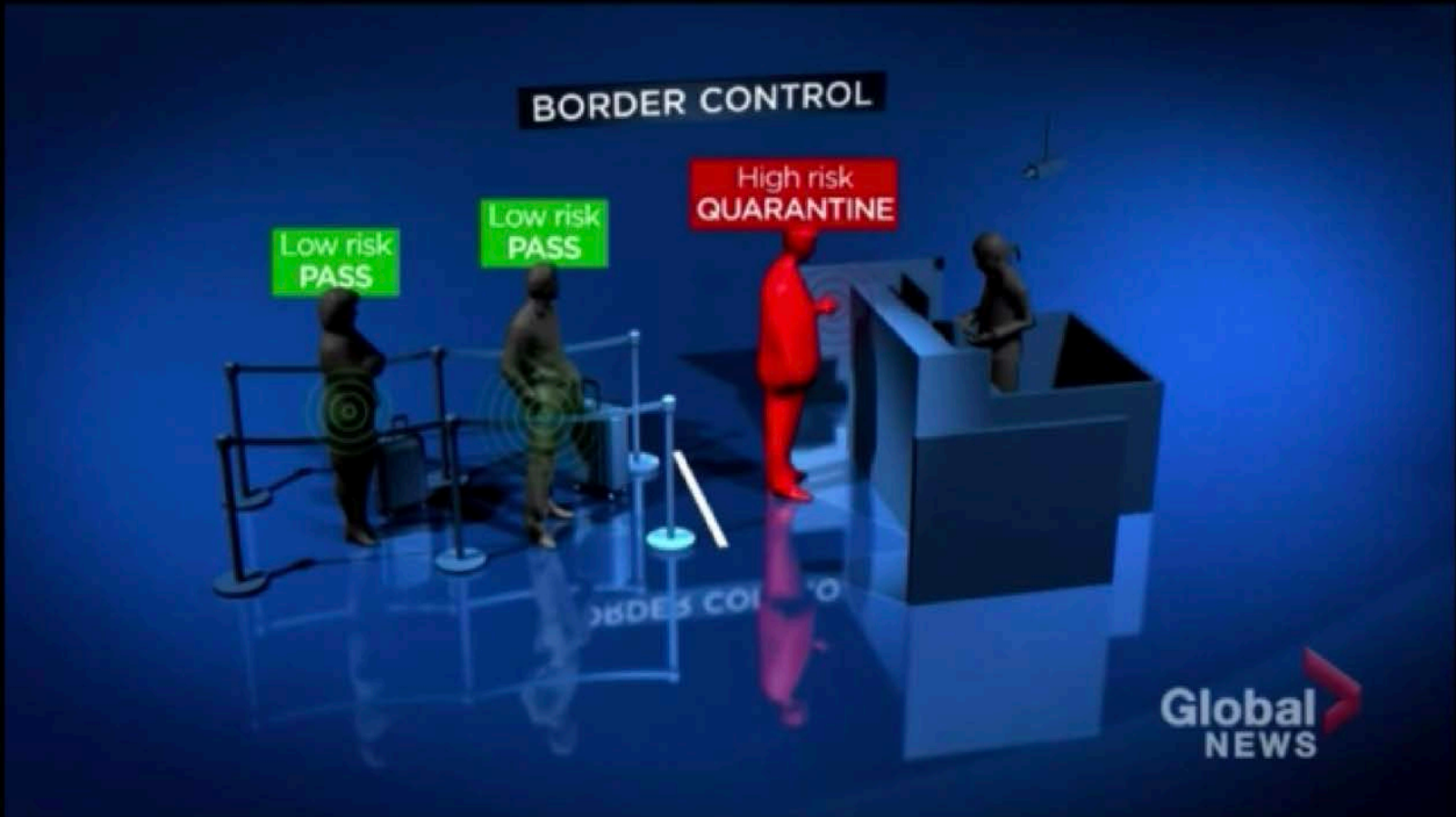
WHO notified of a cluster
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China



Triage at immigration and customs: separate high risk from low risk

10:05 AM Sat Mar 7

68%



Linked datasets for big data analytics

10:05 AM Sat Mar 7

68% 84



Big data

National Health Insurance
Database

Customs and Immigration
Database

Global
NEWS



Doctors alerted at point of care

10:05 AM Sat Mar 7



68%



- **Core public health functions:** case detection; contact tracing; isolation and quarantine.
- **Trust and participation:**
- **New data sources:** cellphones; wearables; video surveillance; social media; internet searches and news; crowd sourced symptom self reports
- **Ethics:** “unethical not to use available data”; ethically justifiable but ethically obligatory? But how?

Innovations against COVID-19

- Disease modeling and forecasting using machine learning:
 - Alipay risk code (controversial): time spent at risky locations and frequency of contact with others; lack of transparency
- Leveraging and linking large datasets for case identification
 - Taiwan linked immigration and customs data on travelers (14-day history sent in batch files) to National Health Insurance data on hospital and clinic visits and shared with health care providers
- Risk-based border security
 - Taiwan developed individual risk assessment using online declaration form that asks travel history, symptoms, contact info to triage risks for self isolation or home quarantine.
- Electronic monitoring of quarantined and isolated individuals
 - Thailand, New Zealand and Taiwan (cell phone location using station positioning)
 - China, Poland and Russia (facial recognition)
- Enhanced contact tracing
 - Singapore (TraceTogether) uses Bluetooth technology
 - Apple/Google to develop Standards
 - Israel (cell phone location on involuntary basis with immediate quarantine orders.
 - South Korea (GPS with out seeking consent)
 - Taiwan used itinerary of disembarked passengers from Diamond Princess ship to send text alerts to people who visited the areas that passengers visited

Ethical Issues Raised

- **Privacy:** cellphone location and text data (cellular signal vs. GPS): except for use of law enforcement, data not ordinarily used for tracking down and imposing consequences
- **Autonomy:** Asking for permission to access personal information; informed consent
 - contact tracing through cellular records: opt in; opt out; mandatory
- **Equity concerns:** new data source can improve representation of some populations in epidemiologic analysis but disparities risk creating bias in new dataset.
- **Minimizing risk of errors:** scope, speed and sources. Need correction mechanism for mistakes.
- **Accountability:** transparency; potential for misappropriation of data.

Policy Recommendations

- Two principles:
 - Evaluate not in abstract but by **reference to counterfactual**: What would be used instead of the technology and is that more or less desirable (mass shelter in place)?
 - **Least burdensome or least restrictive**: available health resources, people's behavior without public health orders; transmissibility of pathogen; stage of the pandemic
- Using algorithms:
 - Deidentified vs. identified data (Alipay)
- Using electronic monitoring to support confined persons
- Using electronic monitoring to enforce restrictions on movement
 - US is problematic: Supreme Court has held that judicial warrant must be obtained; unclear about public health orders
 - Seek to understand reasons for noncompliance
- Using cellphone data for contact tracing
 - Mandatory, **opt-out** or opt-in?
- Process of obtaining **stakeholder input** for use of the data with **oversight to engender trust**

Managing the Crisis:

Assess Capacity & Resource Allocation (PPE)



Jan 20: Government stockpile: 44 million surgical masks, 1.9 million N95 masks, and 1,100 negative-pressure isolation rooms

Jan 22: Daily manufacturing capacity is 2.44M units

Jan 24: Export ban on masks; traveler can carry 250 masks

Jan 30: Limit placed on number of masks purchased per person; Mask price fixed at USD\$0.27

Jan 30: Daily manufacturing capacity is 4M units

Jan 31: Government requisitions surgical masks

Feb 1: Mask price drops to USD\$0.20

Feb 6: Name-based mask rationing system begins

Feb 11: Gov invests USD \$6.66M to increase daily masks by 6M units; reserve troops aid in production

Mar 12: online ordering system for masks begins

Assess Capacity & Resource Allocation: Increase Local Mask Production

隱形台灣之光！

口罩產量衝全球第3

供應鏈完整！上中下游配件全包

上游 不織布原料（聚丙烯PP）：李長榮、台塑、台化

中游 水針不織布（吸水親膚）：南六、福綿、嘉谷、遠東、康那香

熔噴不織布（吸附病菌與有害物質）：敏成、兆豐、康那香、恆大、舜堡

鼻樑壓條

紡點不織布（防潑水）：恆大、松勝

耳掛帶：大豪、雷煌、惠洲

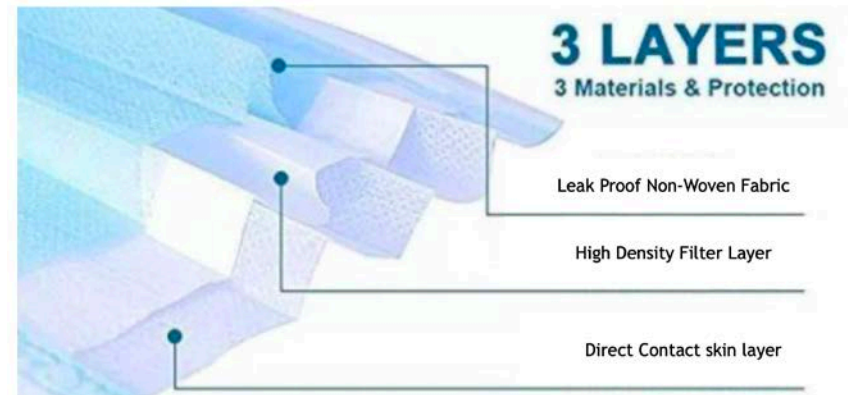
啟名工業社、昌育、漢迪

下游 醫療用口罩：中衛、華新、康那香、康匠、恆大、美德
N95口罩：千佰康、菲得、舜堡

整理：顏茹涵

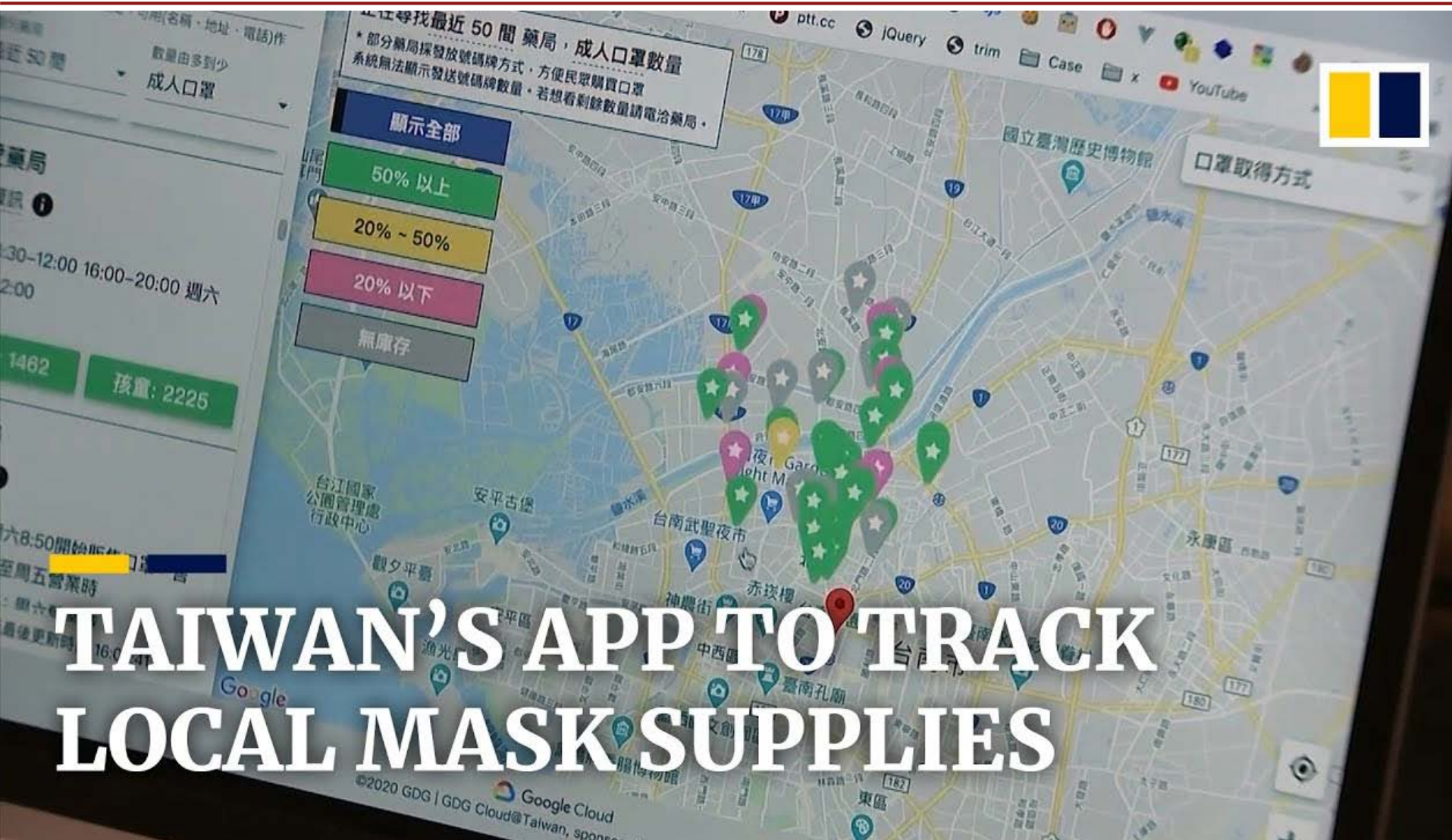


Masks Introduction



Taiwan now makes 10M
masks per day
(2nd largest face mask
producer)

Communication & Politics: High Level of Transparency



Communication & Politics: High Level of Transparency



Taiwan's vice president (Chen Chien-jen), an epidemiologist by training, gave regular public service announcements broadcast from the office of the president



Taiwan's Minister of Health and Welfare conducts daily press briefings to inform the public about latest developments regarding the virus and the government's plans to address it

Outcomes and Future Challenges for Taiwan

Outcomes:

- Sep 14: 499 cases; 7 death.
- School is open; people go to work
- Playing baseball

Challenges:

- Tackling COVID-19 as a nonmember of the WHO: vaccines
- Continuing to detect and contain new imported cases as people are coming to Taiwan to seek refuge (victim of own success)
- Balance of using emergency powers and maintaining civil liberties
- Re-opening strategy and travel bubbles or corridors



Key Lessons to Containing and Mitigating COVID-19



- Logic
- Sequence
- Tempo
- Articulation