

# Innovating Solutions to Covid-19



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大家好

Da le ho

Ja ba muy?

呂淳祺

阿祺

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# First Day out of Quarantine

## 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.<sup>1</sup> The country has 23 million citizens of which 850 000 reside in and 404 000 work in China.<sup>2,3</sup> In 2019, 2.71 million visitors from the mainland traveled to Taiwan.<sup>4</sup> 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 during which time millions of Chinese and Taiwanese were expected to travel for the holidays. Taiwan quickly mobilized and instituted specific approaches for case identification, containment, and resource allocation to protect the public health. Taiwan leveraged its national health insurance database and integrated it with its immigration and customs database to begin the creation of big data for analytics; it generated real-time alerts during a clinical visit based on travel history and clinical symptoms to aid case identification. It also used new technology, including QR code scanning and online reporting of travel history and health symptoms to clas-

### 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.<sup>5</sup>

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 Wuhan for fever and pneumonia symptoms before passengers could deplane. As early as January 5, 2020, notification was expanded to include any individual who had traveled to Wuhan in the past 14 days and had a fever or symptoms of upper respiratory tract infection at the point of entry; suspected cases were screened for 26 viruses including SARS and Middle East respiratory syndrome (MERS). Passengers displaying symptoms of fever and coughing were quarantined at home and assessed whether medical attention at a hospital was necessary. On January 20, while sporadic cases were reported from China, the Taiwan Centers for Disease

# Never Been More Proud to Be a Taiwanese-American

Population (Taiwan : USA): **1 : 13.8**

Covid-19 Cases (Taiwan : USA): **1 : 7,184**

Covid-19 Deaths (Taiwan : USA): **1 : 19,429**

**Problem with being a dean ...**  
**Know a little of everything & a lot of nothing**

# Innovations We Are Planning or Testing at UC Berkeley

1. Saliva testing
2. Rapid diagnostics
3. Pooled testing
4. Adaptive surveillance
5. Environmental surveillance
6. Digital behavior change
7. Digital contact tracing
8. Instructional redesign
9. Preventions of future pandemics

**Public health needs more tools than an on-off switch**



**How do you bring 45,000 students & 15,000  
faculty and staff back to school safely?**

# Conditions for Reopening Campus Safely

- Reentry testing
- Outbreak surveillance
- Infection control
- Rapid response

# Reentry Testing

# 1. Saliva Testing

- **FAST**

- Free Asymptomatic Saliva Testing Study
- Spit into tube
- RT-PCR at IGI
- Sample Quality?



- **LAMP**

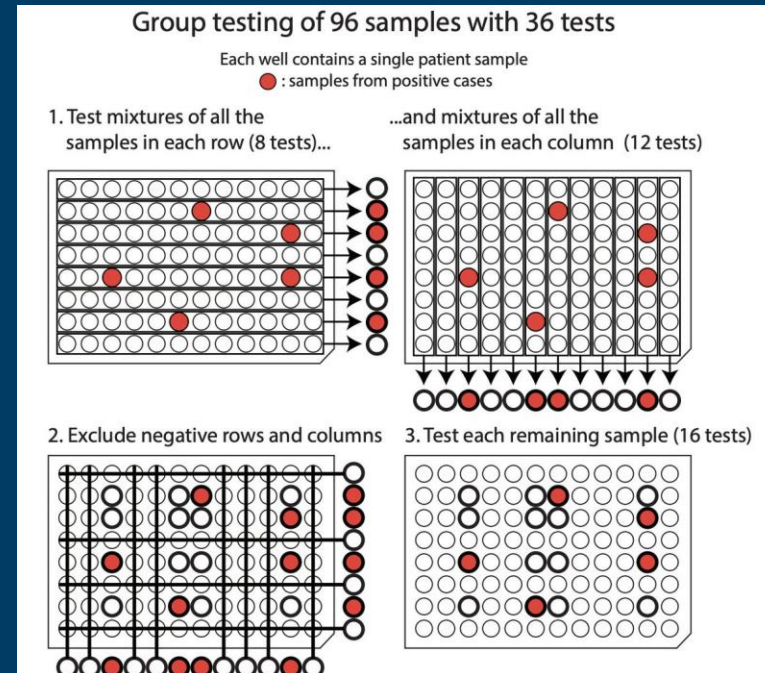
- Loop-mediated isothermal amplification
- Faster & cheaper than RT-PCR
- Colormetric detection in 30 minutes
- <https://www.biorxiv.org/content/10.1101/2020.06.23.166397v1>



## 2. Pooled Testing

- **Pooled Testing**

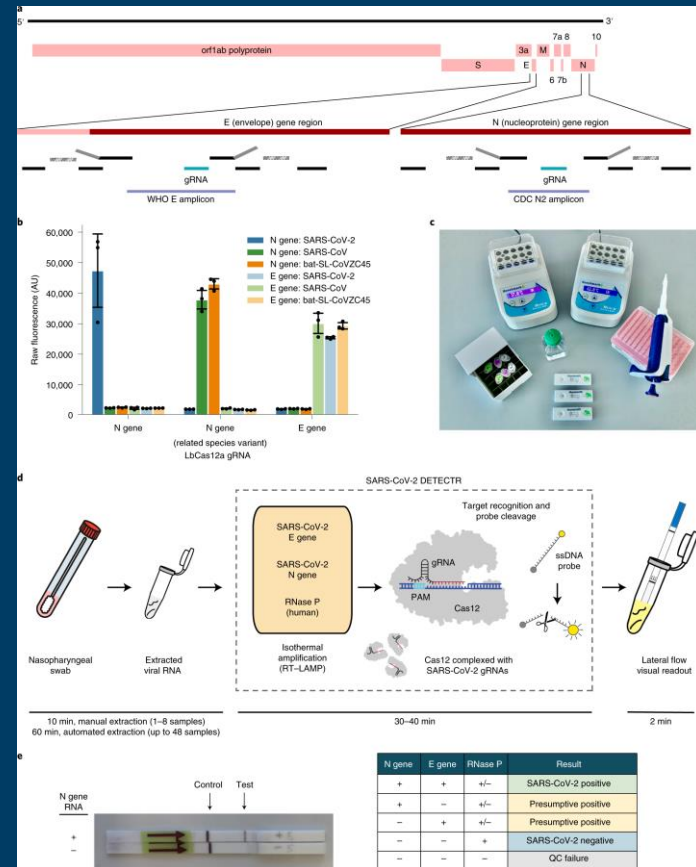
- 45,000 students
- Pool 10 samples into 1 test
- 4,500 pooled tests
- Prevalence of 5% = 225 positive pools
- Retest samples in positive pools =  
 $225 \times 10 = 2,250$
- Total Tests = 6,750 tests
- Pool size should not be greater than 50
- Pools of 50 and prevalence of 1% = 1,350 tests
- Machine learning can improve risk pooling
- Accessioning problem



# 3. Rapid “Point-of-Care” Diagnostics

## • CRISPR meets Mobile Phone

- Guide RNA detects viral RNA
- Cas13 activated
- Cas13 cleaves viral RNA & probe RNA
- Probe RNA releases fluorescent light
- Detected by mobile phone camera
- Allows for point-of-care diagnosis



# Outbreak Surveillance

## 4. Adaptive Surveillance

- **Early Warning System**
  - **Machine learning to sift through big data**
    - Syndromic data
    - Behavioral & location data
    - Environmental data
    - Local public health data
    - Prior testing data
  - **Identify geographic hotspots, target testing, create early warning**
  - **Integrated system for outbreak surveillance in local communities**

## 5. Environmental Surveillance

- **Sewage Water Testing**
  - Sewage surveillance for Sars-Cov-2
  - Virus RNA detected in wastewater 1 week before 1<sup>st</sup> clinical case
  - Genomic testing for new strains
- **Air Sample Testing**
  - Testing air filters for Sars-CoV-2
  - Mobile air-sampling technology

# Infection Control

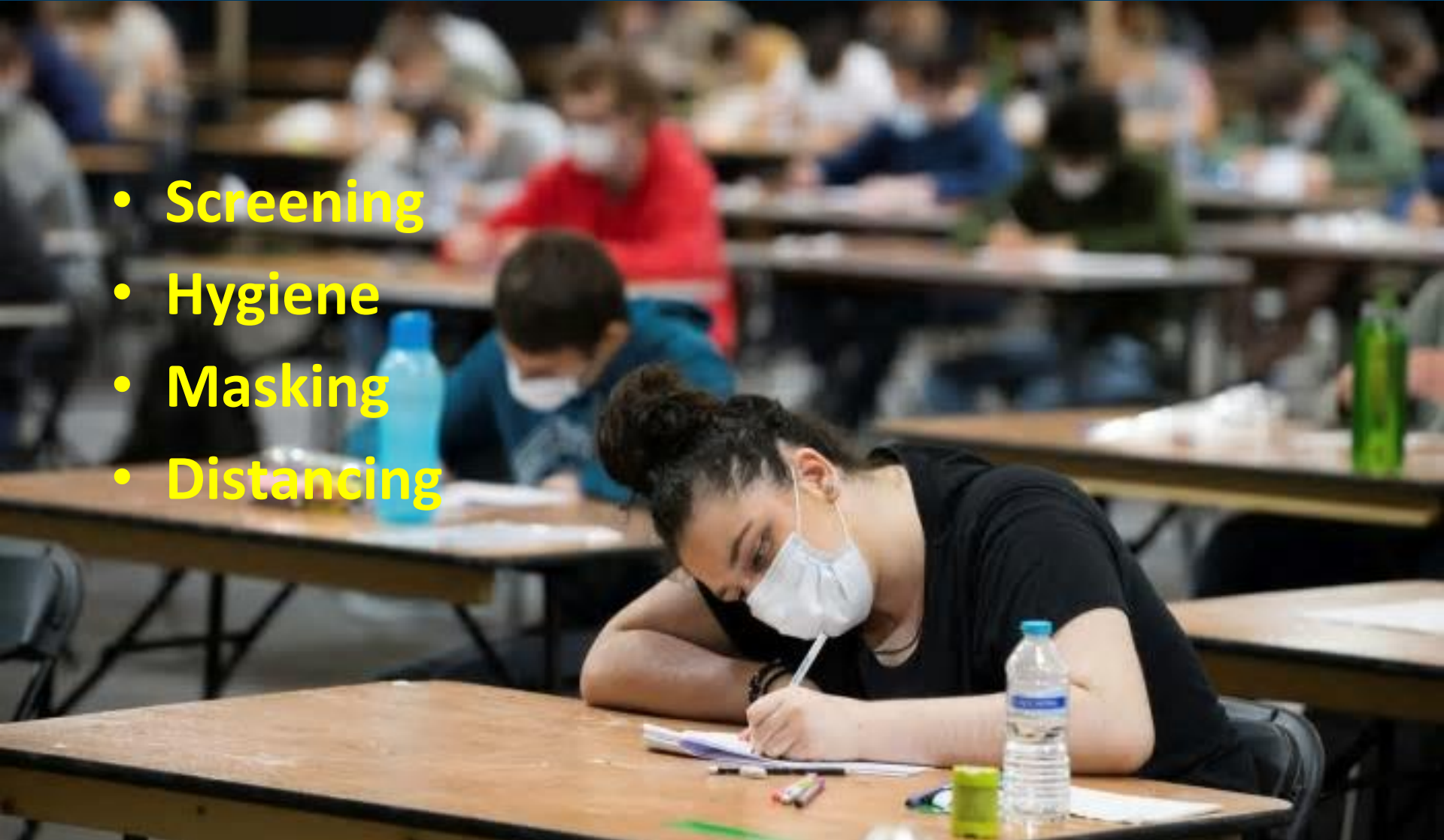
# Environmental Modifications

- Dedensification
- Disinfection
- Ventilation



# Behavioral Modifications

- Screening
- Hygiene
- Masking
- Distancing



INVITE ONLY



## 6. Digital Behavioral Change

- Design thinking
- Social Norming
  - **Autonomy app (Bitmark.com)**
    - Block Chain Technology
    - Syndromic and behavioral reporting
    - Neighborhood forecasting
    - Behavioral nudge
    - Social norming

# Rapid Response

## 7. Digital Contact Tracing

- **Centralized, public-health first**
  - China: “health code” on Alipay-WeChat
  - Taiwan: “geofence” those under-quarantine using cellphone triangulation
  - South Korea, UK, France, Norway
- **Decentralized, privacy-first**
  - CovidSafe (Aus), TraceTogether (Singapore), Apple/Google (US)
  - Germany, Ireland, Switzerland, Ireland, Italy
  - Bluetooth, voluntary, low uptake
- **Other technologies**
  - Block chain
  - Encryption
  - Identify security & privacy weaknesses

## 8. Instructional Redesign

- Preparing for remote/hybrid instruction
  - Opportunity to improve, innovate, transform public health curriculum & pedagogy
    - e.g. “flipped classroom”
  - Challenges
    - Field practicum?
    - Create community in an environment of remote learning?

## 9. Prevention of Future Pandemics

- **Primary Prevention**
  - **Prevent zoonotic spillovers**
- **Secondary Prevention**
  - **Global early warning system**
    - Zoonotic reconnaissance + AI surveillance + outbreak investigation
- **Tertiary Prevention**
  - **AI-powered drug discovery**

# Conclusions

- **Public health needs more tools than an on-off switch**
- **Solutions will come not by working in siloes, but through transdisciplinary collaboration**
- **Taiwan-Berkeley collaboration can help accelerate innovations to solve global health problems**

# Taiwan-Berkeley Health Innovations Accelerator



Bring us your Moonshots

# 謝謝大家

## Go Bears

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