



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.jfma-online.com



Perspectives

Initial rapid and proactive response for the COVID-19 outbreak — Taiwan's experience

Hao-Yuan Cheng ^a, Shu-Ying Li ^b, Chin-Hui Yang ^{c,*}

^a Epidemic Intelligence Center, Taiwan Centers for Disease Control, Taiwan

^b Research and Diagnostic Center, Taiwan Centers for Disease Control, Taiwan

^c Division of Acute Infectious Diseases, Taiwan Centers for Disease Control, Taiwan

Received 13 March 2020; accepted 15 March 2020

On December 31, 2019, Taiwan Centers for Disease Control (Taiwan CDC) detected the news about an outbreak of atypical pneumonia with unknown etiology in Wuhan, Hubei Province, China, from social media. It was soon confirmed by the Chinese government on the same day. One week later, the Chinese government announced the pathogen was a novel coronavirus, formally named severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) afterwards.¹

By February 29, 2020, the number of confirmed coronavirus disease 2019 (COVID-19) cases in China reached almost 80,000, with about 2800 deaths. The outbreak affected more than 60 countries around the world with over 6,000 cases and 106 deaths, only two months after the virus was discovered.² The first case of COVID-19 in Taiwan was detected on January 21.³ By February 29, there were 2,192 suspected cases reported, and 39 COVID-19 cases were laboratory-confirmed, including 21 (54%) locally-acquired cases. Only 11 cases (28%) have Wuhan-related travel history.

At the early stage of the outbreak, the strategy in Taiwan had three pillars: real-time surveillance with rapid risk assessment, border control and quarantine, and laboratory capacity building. Before the outbreak, Taiwan CDC has established comprehensive surveillance systems that included laboratory and social media surveillance.⁴ Once

the outbreak was detected by social media surveillance, our surveillance team continued collecting outbreak news from social media, government reports, and official press releases to monitor the progress in China on a daily basis and periodically updating rapid risk assessment to provincial level for decision making. Considering the huge flow of cross-strait travelers (up to one hundred thousand travelers per day), risk assessments need to be tailored to the sub-nation level, so policymakers could modify travel restriction and quarantine measures with limited impacts. In this way, Taiwan step by step expanded travel restrictions over a month for Wuhan at first, later extended to Hubei, Guangdong, Zhejiang, and finally, China, including Hong Kong and Macau (Fig. 1).⁵

The travel alerts were aligned with public health response as well. Taiwan CDC initiated onboard inspection for direct flights from Wuhan on December 31, 2019. Any passengers presenting with fever or respiratory symptoms at the entry fever screening sites of international ports would be referred to designated hospitals for evaluation. According to the different risk of COVID-19 importation from individual countries, passengers were required to conduct home quarantine or self-health monitoring for 14 days. These measures were adjusted rapidly based on intelligence gathered. For example, travelers returned from South Korea and Italy were home-quarantined starting February 24 and 27, respectively, because of worsening local outbreaks.

To strengthen response preparedness and ensure coordination of different government agencies, we listed

* Corresponding author.

E-mail addresses: inf@cdc.gov.tw, yangch55@gmail.com (C.-H. Yang).

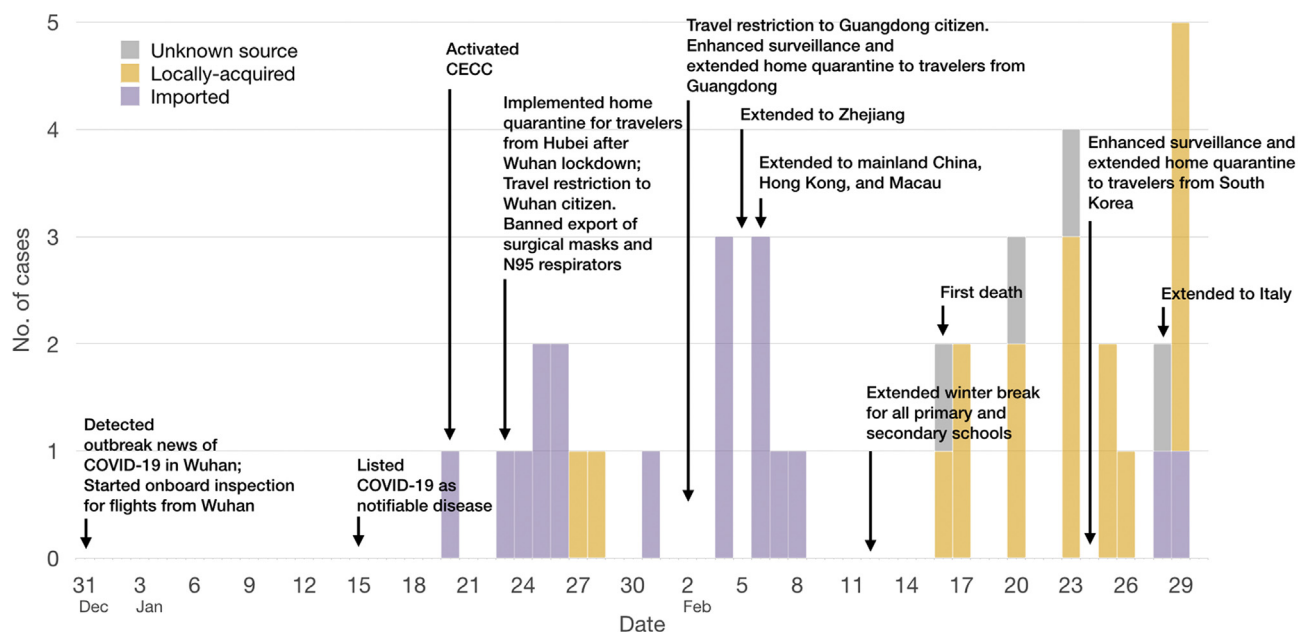


Figure 1 The number of confirmed COVID-19 cases in Taiwan by reporting date, January 15–February 29 and the implementation of disease control measures.

COVID-19 as a notifiable disease, named “Severe pneumonia with Novel Pathogen”, on January 15 and activated the Central Epidemic Command Center (CECC) on January 20.⁵ CECC then announced several policies in response to the worsening outbreak in China, including border control and home quarantine requirement for travelers from affected countries and areas; export ban of surgical masks and N95 respirators to secure the domestic use; strengthening the preparedness of Communicable Disease Control Medical Network for patient isolation and clinical management; and risk communication with the public through daily press and social media such as Line app and Facebook.

From lessons learned in responding to other emerging diseases such as SARS and avian influenza, we believe that laboratory capacity for rapid diagnosis is pivotal to outbreak response.⁶ After China released the whole genome sequence of SARS-CoV-2 on January 10, Taiwan CDC’s national reference laboratory immediately set up the real-time reverse transcription-polymerase chain reaction (RT-PCR) test for the virus.^{7,8} The laboratory protocol and reagents, including primers, probes, and positive control, were then distributed to designated laboratories. To expand laboratory capacity, Taiwan CDC started a capacity building program via the national laboratory diagnostic network after CECC was activated. By February 21, Taiwan had 27 laboratories that could perform up to 2250 molecular diagnostic tests for SARS-CoV-2 a day.

The first death, also the first patient without exact infection source in Taiwan at the beginning, was confirmed on February 16. At the meantime, the majority of COVID-19 cases in surrounding countries also changed from importation to local transmission. Therefore, Taiwan CDC modified the original case definition of suspected COVID-19 to include patients with undiagnosed pneumonia, regardless of travel history. The diagnostic capacity was also scaled up

to 3000 tests/day by recruiting more laboratories and streamlining the testing algorithm. Because of this enhanced community surveillance, we detected four local clusters of COVID-19 cases in the following two weeks (Fig. 1).

When the number of the local clusters increased, widespread community transmission might be just around the corner. CECC already charted the next steps in COVID-19 outbreak response using a blended approach: mitigation with continued containment efforts, and aims to find ways to mitigate the impact on human health, healthcare system, and the economy.

Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article.

References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020 Feb 20;382(8):727–33.
2. World Health Organization. *Coronavirus disease 2019 (COVID-19) situation report — 41*. Geneva, Switzerland: World Health Organization; 2020. Available from: <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200301-sitrep-41-covid-19.pdf>. [Accessed 23 March 2020].
3. Cheng SC, Chang YC, Fan Chiang YL, Chien YC, Cheng M, Yang CH, et al. First case of coronavirus disease 2019 (COVID-19) pneumonia in Taiwan. *J Formos Med Assoc* 2020;119:747–51.
4. Jian SW, Chen CM, Lee CY, Liu DP. Real-time surveillance of infectious diseases: Taiwan’s experience. *Health Secur* 2017 Mar;15(2):144–53.

5. Wang CJ, Ng CY, Brook RH. Response to COVID-19 in Taiwan: Big Data Analysis, New Technology, and Proactive Testing. *JAMA* 2020. <https://doi.org/10.1001/jama.2020.3151>. Published online 03 March, 2020.
6. Yang JR, Teng HJ, Liu MT, Li SY. Taiwan's public health national laboratory system: success in influenza diagnosis and surveillance. *Health Secur* 2017 Mar;**15**(2):154–64.
7. Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DK, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. *Euro Surveill* 2020 Jan 23;**25**(3):2431.
8. Zhang YZ. Novel 2019 coronavirus genome. *Virological*. 2020. Available from: <http://virological.org/t/novel-2019-coronavirus-genome/319>. [Accessed 23 March 2020].