

Tackling COVID-19 with the help of big data and AI

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1. Taiwan's Digital Minister leveraged big data to upgrade name-based rationing system for face masks.

1.1. Taiwan's pioneering name-based rationing system for face masks

On January 31, the Taiwan government announced that it would requisition all face mask factories in order to centrally manage the distribution and production of face masks in the country. A total of 2.8 million face masks were released daily for the general public through convenience stores, drug stores, and pharmacies. Each person was limited to three masks per purchase. However, stores received relatively small face mask shipments, and these shipments arrived at different times each day. As a result, many people complained they were not able to purchase face masks, leading to panic buying and hoarding and impeding epidemic prevention efforts.

Following careful deliberations, the government launched the name-based rationing system for face masks (version 1.0) on February 6, which allowed people to purchase face masks at pharmacies contracted by the National Health Insurance (NHI) Administration with their NHI cards. Prior to the implementation of this system, an engineer from the private sector named Wu Chan-wei developed an app showing user-provided data on face mask availability at convenience stores, which proved to be very popular. Digital Minister Audrey Tang therefore recruited Wu Chan-wei and

other private sector engineers through the online g0v community, and together they developed an app within 48 hours that showed inventory levels at pharmacies. This new app was launched simultaneously with the name-based rationing system in a bid to relieve people's anxiety with regard to face mask purchases.

Digital Minister Tang facilitated communication between the government and private sector, obtaining open data for app development as well as user feedback. NHI Administration data was renewed with even greater frequency, going from updates every 30 minutes to updates every 30 seconds.

1.2. Online ordering added to the name-based rationing system.

Even after the implementation of the name-based rationing system, demand was still not fully met. Long queues formed outside pharmacies because there are only 6,026 NHI-contracted pharmacies and local public health centers nationwide. Manpower was also limited. The government continued to discuss possible solutions, such as once again including convenience stores with sufficient manpower and large geographical coverage among distribution points and enabling people to order face masks online.

The government realized that pharmacies in remote areas often had a surplus of face masks and that office workers and students, who needed face masks for their daily commute via public transportation, were not able to purchase them because they lacked the time to line up outside pharmacies. In order to distribute face masks more evenly, the government worked tirelessly with the private sector as well as IT experts to develop and test an updated system. The updated

system (version 2.0) was launched on March 12, approximately one month after the initial launch.

In addition to face mask purchases at NHI-contracted pharmacies and local public health centers, the updated system gave people the option to order face masks online by logging into the eMask website with their NHI card or Citizen Digital Certificate. They could also use the NHI app to order face masks on their mobile phones. People were given one week to go online and order face masks, which they could then pick up at their designated convenience store. Once an online order had been placed, a text message was sent to the person making the order showing payment information. This information could also be found online after logging into the system. Payment options included ATM transfer, online banking transfer, and credit card. Those who made the payment within the given deadline could then pick up their face masks at their designated convenience store with the text message and their NHI card, National ID Card, or driver's license (anyone of these three).

The government planned to provide seven million face masks (equal to the weekly allotment of 2.33 million people) for the first batch of online ordering. If the number of people ordering face masks online exceeded the available amount, lots would be drawn publicly the day after the ordering period ended. The system was not run on a first come, first serve basis, so as to prevent a rush on the system on the first day and subsequent website traffic issues. Fortunately, since the launch of the online ordering mechanism, the number of face masks ordered online has not exceeded the available amount. There has been no need to draw lots, and everyone who ordered online has

been able to obtain face masks.

The upgraded version of the name-based rationing system has gained widespread praise, mainly because the addition of convenience stores as distribution points increased service coverage to a great extent. The four major convenience store chains in Taiwan operate more than 10,000 stores nationwide. Convenience stores are also often closer to people's homes, and make it easier for people to pick up their face masks during their lunch break at work. Convenience has thus been greatly enhanced. In addition, the upgraded system works better with people's daily schedules and has reduced queuing at pharmacies, thereby also lowering the risk of infection as a result of large crowds. For convenience stores, distributing face masks is not a heavy burden on their personnel and can help attract more customers, thus boosting sales. Many convenience stores were therefore glad to participate and even came up with promotional sales, such as two cups of coffee for the price of one. People no longer had to squeeze time out of their schedule just to line up and buy masks. They can order online and pick up face masks whenever they wish, and even enjoy promotions at convenience stores. People have been recommending the online ordering mechanism to one another, and usage has increased considerably. It has benefited all parties involved, including the government, the public, and convenience stores.

The updated system was developed by an interdisciplinary team, consisting of dozens of IT technicians from Trade-Van (which developed the software for online tax filings), the NHI Administration, the Bank of Taiwan, Chunghwa Post, and others.

Their main tasks were adapting the tax filing software, establishing the eMask website, adding new functions to the NHI app, and integrating backend systems, payment flows, logistics, and databases.

1.3. Third iteration of the name-based face mask rationing system

With the increase in face mask production, the government has sought to resolve the problem of elderly people still lining up outside pharmacies. Therefore, the third iteration (version 3.0) of the name-based face mask rationing system was officially launched on April 30 following careful planning. Restrictions on face mask purchases at pharmacies related to National ID Card or Resident Certificate numbers ending in odd or even numbers have been cancelled. When picking up previously ordered face masks at convenience stores, people can now also order face masks for the next batch at the same time by simply inserting their NHI cards into kiosk machines at these stores. Digital Minister Tang posted a video on Facebook at the beginning of April showing the new procedure, which enables people to complete their order within one minute. The implementation of this new upgrade aims to reduce the amount of time people spend standing in line for face masks, alleviate the burden on pharmacies, and help convenience stores boost sales. With regard to the issue of personal information, Minister Tang reassured the public via Facebook that the convenience store kiosks only verify National ID numbers and check the validity of NHI cards; they cannot access any other information.

To help other countries combat COVID-19, the Central Epidemic Command Center (CECC) launched a campaign entitled “Protect

Taiwan, Help the World” on April 27, which allows the public to donate their masks to other countries in need through the NHI app. This campaign has been enthusiastically received: more than 500,000 people had donated around four million face masks as of early May.

2. Technology has helped upgrade quarantine and epidemic containment efforts.

2.1. Building a multilayered epidemic containment network

The Taiwan government’s quarantine approach consists of border and home control. As the number of confirmed cases continued to rise rapidly around the globe, it became essential that inbound travelers fill out entry forms truthfully and in detail. On February 16, the government implemented the Entry Quarantine System. Inbound travelers were requested to scan a QR code prior to their flight or upon arrival to fill out a health declaration and other information. This helped speed up customs clearance and ensured accuracy of information provided.

Traveler information was then integrated into the Home Quarantine Information System, which tracks people under quarantine or isolation for 14 days, and a digital fence system, which uses phone signals to monitor the location of people under home quarantine or isolation. If people under quarantine or isolation leave their prescribed location, they immediately receive a warning via text message. Civil affairs authorities, health agencies, and local police are also notified in order to keep track of these individuals. Those who leave their location without permission are subject to large fines, as are people who conceal symptoms associated with COVID-19.

As travel notices continued to get stricter, more people returning from abroad have been placed under quarantine or isolation. The government plans to enlist HTC's help in designing and developing a system via Line's bot platform that will operate automatically, allowing those under home quarantine or isolation to report their health condition through this platform and also receive relevant information. This will help alleviate the burden on frontline personnel.

The government is also employing NHI big data. By collaborating with the National Immigration Agency and Taiwan Centers for Disease Control, the NHI Administration can crosscheck the list of citizens returning to Taiwan from abroad with their NHI records. Doctors on the frontline can check their patients' travel history for the past 14 days and thereby help curb the spread of the disease. Using the NIA and CDC databases, the government can conduct big data analysis to identify COVID-19 cases through travel histories and reported symptoms.

2.2. Epidemic containment made more precise with AI and big data.

As for the use of artificial intelligence, Vice Premier Chen Chi-mai posted an article on his Facebook page on March 26 entitled "Using AI and Big Data to Accurately Tackle the COVID-19 Outbreak." He wrote that as early as late January, the Executive Yuan formed a big data task force to widely use smart technology in the fight against the outbreak. They invited experts, including the founder of Taiwan AI Labs Ethan Tu, to brainstorm together. Some of their early ideas included: (1) using AI to assist clinical physicians with diagnosing

COVID-19 by implementing big data and integrating outbreak surveys, clinical and laboratory testing, and virus analysis to make epidemiological predictions; (2) using AI to help enforce and manage home quarantine and isolation measures: home treatment and quarantine and isolation can be carried out through a two-way communication channel that puts people in touch with the CECC; they can report their symptoms and health conditions and also receive more information regarding health and medical care; (3) drug repurposing platform: using AI, doctors have identified effective treatment drugs and are now continuing to analyze and investigate more drugs in laboratories.

Vice Premier Chen worked with experts at the CDC, the Executive Yuan's Department of Cyber Security, the NHI, and National Taiwan University's College of Public Health to compose an article explaining how the Taiwan Model has applied big data analytics to prevent further spread of COVID-19. The article was published in the *Journal of Medical Internet Research* on May 6, covering topics such as big data analytics, smart contact tracing technology, and cell broadcast SMS warning messages.

2.3. Effectively managing high-risk groups and conducting community-based prevention

In addition, in order to prevent cluster infections resulting from long queues outside public places, with people waiting for staff to take their temperature with handheld forehead thermometers, Microsoft Taiwan, MediaTek, and other companies have been using artificial internet of things (AIoT) to detect face masks and body temperature and develop remote working tools. They have come up with a

one-stop station for mask detection and infrared temperature reading, using cameras and infrared thermal imaging technology to simultaneously determine whether people are wearing masks and whether their body temperature is within a normal range.

In order to track down suspected or confirmed cases, National Yang-Ming University's Digital Medicine Center developed a platform that monitors people for signs of COVID-19. The center is providing it free of charge to domestic companies and health care institutions to help them monitor the health conditions of people in their organizations around the clock to effectively curb the outbreak. This cloud-based platform includes features such as body temperature monitoring, GPS tracking, contact history tracing, and automatic warnings. Health management personnel can log into the backend system via computer or mobile phone and check on the health condition of their members. AI can be used to classify risk levels and provide recommendations for epidemic prevention measures. The platform can be used in companies of all sizes, long-term care facilities, hospitals, and other organizations. It can be operated in multiple languages, including English, Japanese, Korean, Indonesian, Vietnamese, and Thai.