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Digital Tools for Addressing Infectious Diseases in the Asia-Pacific Region: Challenges and Opportunities

APEC Health Working Group

December 2021

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FINAL REPORT

APEC Health Working Group

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1. Introduction

This final report is an output of an APEC- ASF Digital Innovation Sub-Fund project of Health Working Group (HWG) from Session 1 of 2020, "HWG 01 2020A - Digital Tools for Addressing Infectious Disease in the Asia-Pacific Region: Challenges and Opportunities". It is co-sponsored by Chile; Indonesia; Japan; Malaysia; Peru; Singapore; Thailand; Viet Nam and the United States.

Infectious diseases continue to threaten human health and economic stability in the Asia-Pacific region. Gaps in capacities of infectious disease surveillance in the APEC region challenge the region's surveillance network to better respond to threats posed by infectious diseases. Digital technologies and artificial intelligence (AI) can support the diverse needs and approaches for early warning, forecasting epidemics, improving decision-making in outbreak response and simulation tools.

This project aims to identify opportunities for APEC developing economies to adopt digital infectious disease surveillance. Chinese Taipei seeks to share its experiences with other APEC member economies and help illustrate some potential ways of combatting COVID-19 through the project. APEC economies' valuable lessons are worth sharing and learning through a platform for dialogues, cooperation, and sharing best practices and challenges regarding COVID-19 and other infectious diseases. The skills will benefit APEC developing economies in their efforts to mitigate the economic impact of the current COVID-19 pandemic.

This virtual conference was held from August 25 to 26, 2021, through the platform of Cisco Webex. Apart from the keynote speech, the 2 half-day conference consisted of 4 main sessions: "Surveillance: Detection, Forecasting and Risk Assessments", "Response: Resources, Allocation and Mobilization", "Innovation and Collaboration: Industry, Academia, Government", and "Data Privacy and Protection". The agenda of the conference is in Annex 1.

There was a total of 165 participants from 15 member economies and 4 non-member economies joining in the conference. These member economies are Australia; Canada; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; New Zealand; the Philippines; Russia; Singapore; Chinese Taipei; Thailand; the United States; Viet Nam, and the 4 non-APEC members economies are Israel; Denmark; Germany and United Kingdom.

2. Topic-Based Summaries of Presentations

2.1 Keynote Speech – Chinese Taipei Model: From Surveillance, Resource Mobilization to multi-sector Collaboration

This keynote speech was delivered by Dr Chien-Jen Chen, academician of the Genomics Research Center at Academia Sinica.

Dr Chen first gave a brief overview of the current global COVID-19 pandemic. He stated that, as of today, the pandemic containment in Chinese Taipei can be divided into two phases, with the first containment phase (December 2019 to November 2020) focusing on the interruption of viral transmission, and with the second phase (December 2020 up until now) focusing on the interruption of viral transmission and the goal of achieving herd immunity.

Dr Chen said that Chinese Taipei was among one of few member economies with the lowest COVID-19 mortality rate while also maintaining a positive GDP growth rate during the first COVID-19 containment phase. This successful containment was due to Chinese Taipei's past experience combating the SARS epidemic from 2002 to 2003 and the H1N1 influenza outbreak from 2009 to 2010. This enabled Chinese Taipei to respond efficiently with key epidemic prevention principles such as prudent action, rapid response, early deployment, transparency, public trust and solidarity.

Due to Chinese Taipei's rapid and precise response to the COVID-19 outbreak in the first phase, no citywide lockdown was conducted, and with the use of smart technology, the outbreak was successfully contained.

Digital tools have been also adopted to help prevent outbreaks. Those tools include ICT and AI technology, cell broadcast, an e-quarantine system for strict border controls, ICT and big data analysis for contact tracing, a digital fencing system and LINE Bot system to monitor people in home isolation/quarantine, precision (targeted) testing for reported suspected cases with symptoms/signs, big data monitoring for isolation treatment, and also disinfection robots adopted in hospitals to enhance infection control.

Dr Chen also stressed that, in a democratic area, privacy is a very important issue. Therefore, in order to handle a trade-off between privacy protection and disease control, Chinese Taipei implemented the principle of proportionality. Chinese Taipei ensured that all information collected would be used only for disease prevention and control, and made sure that we complied with all regulations such as the Communicable Disease Control Act, Personal Data Protection Act, Cyber Security Management Act, etc. Chinese Taipei understands that transparency, public trust, and

solidarity are fundamental elements in a vibrant democracy, therefore has put in great effort to ensure the public has open access to transparent information. Dr Chen pointed out that, the Central Epidemic Command Center (CECC) has held daily press briefings since January 2019, and has earned public trust which in turn encourages citizens to follow government rules, creating good cooperation between government and citizens.

Dr Chen also stated that, early deployment of COVID-19 containment was also very important. The government assured adequate and name-based supply of PPEs and medical materials, enforced non-pharmaceutical interventions, engaged in financial relief and economic stimulus, implemented QR code contact information registration, invested in R&D of rapid diagnostics, anti-virals and vaccines, promoted registration and reservation of vaccines through Apps, and advocated international collaboration for PPEs, pharmaceuticals, and technologies.

Preparing for future pandemics, Chinese Taipei believes that global solidarity and international collaboration are essential. Infectious diseases respect no border, and any pandemic would be detrimental to global health, economic development, security, and regional peace. No member economies can fight a pandemic alone, and transparency and honesty in global information and technology sharing are the best policy. The WHO should play a better coordination role with more professionalism and political neutrality as only through international collaboration without deglobalization can the pandemic be contained successfully.

2.2   Session I –Surveillance: Detection, Forecasting, and Risk Assessments

New Zealand's COVID-19 Experience: The Role of the Digital Tools, Professor Shaun Hendy, New Zealand

Professor Hendy first gave an overview of New Zealand's response to COVID-19 starting in March 2020, then he talked about the use of digital tools in New Zealand, and went on to discuss a mathematical model developed in New Zealand that aimed to assist digital contact tracing.

He stated that New Zealand adopted the "go hard, go early" approach in combating the virus, meaning to use the hardest restrictions that could be feasibly imposed as early on as possible, and results have shown that this approach was able to eliminate the virus at the border and delay domestic transmissions for longer periods of time.

Furthermore, he stressed that the March-April lockdown was one of the key reasons New Zealand enjoyed successful containment of the virus. This response of Alert Level 4 in March 2020 was amongst the most stringent in the world, including a stay-at-home order, temporary closure of non-essential businesses, travel restricted to recreation in local neighborhood, and testing of symptomatic individuals with travel history or close contacts. In addition, New Zealand used genomic information as an input for a mathematical model and made lockdown decisions based on the modeled outbreak size at detection.

He then talked about the adoption of digital tools in New Zealand, especially the ones used for contact tracing. New Zealand used a voluntary QR code-based smartphone app which used a decentralized Bluetooth solution. Dr Hendy pointed out that, QR code scans are reactive; people start using the app only when active cases are found in the community, and people stop scanning when case numbers are low. In his opinion, it is unlikely the app has had a significant impact on the government's virus control abilities, but the digital information New Zealand acquired during outbreaks has helped decision makers gain a better picture of the outbreak situation and understand the scope of outbreak better. As for Bluetooth functionality, it wasn't featured in the app until 2020. The uptake has been slow but steady, currently reaching about a 30% usage rate. It is hoped that digital tools can be integrated into the current (manual) contact tracing model, building easier digital tracing to collect data and assist in disease simulations. However, in order for this integration to be significantly effective, an uptake rate of 80% is required, whereas the current uptakes are only around 30%-40%. Thus, with the current uptake rate of digital tools in New Zealand, they are not yet making a significant impact.

Overall, the elimination strategy, based on tight border controls, adopted in New Zealand has been highly effective, the stringent "go hard, go early" approach has stamped out cases in the community, and allowed it to enjoy some of the lowest domestic restrictions worldwide. However, New Zealand is planning to gradually lift border restrictions once vaccination rates reach 70%-80% in this year or next year. With the wide-spread Delta variant, digital technologies will no doubt become increasingly important as contact tracing become more relied upon.

Surveillance: Detection, Forecasting, and Risk Assessments- the Philippines Experience, Director Enrique A. Tayag, the Philippines

Director Tayag reported on the Philippine experience. He started with the case number in the Philippines, which has surged by around 15,000 cases as of August 15, 2021, due to the ongoing community transmission of the COVID-19 virus including the

Delta variant. He stated that the Philippines continues to restrict mobility in high risk areas, including the metropolitan Manila area by imposing hard lockdowns. However, COVID-19 vaccination campaigns continue in priority populations despite the containment strategy.

There remains challenges and opportunities in the use of digital tools that allow the government to recalibrate its response, even as it copes with the negative impact on the economy. And more importantly, it deals effectively with the consequences of a widespread disruption in the health system. It is imagined that the adoption of digital tools will bring just enough cushion in mitigating the harmful impact of this pandemic, and ensure business continuity in the most affected sectors. These tools should be exploited and much more so, more innovations must be explored. Technology, science and public health should finally converge towards an economic and social advantage with better health outcomes. For many months now, the Philippines Department of Health has adopted digital tools that allow decision makers to analyze data so that the Inter-Agency Task Force (IATF) on Emerging Diseases is able to guide the COVID-19 response. The IATF is composed of government agencies and other key actors in the COVID-19 response. It is the primary direction-setting policymaking body for COVID-19 response. Its actions are based on the evidence that Department of Health provides to them.

Director Tayag also stated that, in order to get ahead of the epidemic, a robust contact tracing system was needed so that quarantine and isolation can be observed in haste to stamp out further spread. There are ongoing attempts to integrate digital contact tracing tools into a unified space in a single contact tracing warehouse.

However, the identification of variants changed the course of this pandemic. The Philippines maintains its capacity to describe the occurrences of this virus to the Philippine genome center. The data collected are added to the already huge databases that now require complex digital technologies. Likewise, the Philippines' capacity to perform COVID testing was a priority, and adequate digital tools were needed, including API's for interoperability and a centralized COVID-19 data repository system to secure data from laboratory testing centers.

The Philippines risk assessment algorithm was created, to guide IATF to identify specific areas of concern. The Health System capacity, for example, is measured through real-time tracking of bed-use rates and ICU-use rates using mobile applications available for reporting hospitals. The same data are used to allow patient referrals so hospitals can run smoothly.

Director Tayag said that, the use of technology and innovation has indeed become indispensable for calibrating and recalibrating that covered response, so that timely

and accurate data and information are analyzed and used as evidence to guide subsequent actions, such as different guidelines on the implementation of community quarantine.

A Vaccine Information Management system was also put in place, which is a presentation of collaboration between agencies in the Philippines, such as the Department of Health, the Department of Information and Communications Technology, and the Department of Interior local government with the National Vaccine Operations Center. Information on COVID-19 vaccination activities are also posted in public facing dashboards for transparency and to boost trust in vaccination.

Director Tayag pointed out that the Philippines is not limited to its own digital tools for this pandemic. Early on, the World Health Organization assisted the Philippines in undiscovering surveillance by donating apps developed for this purpose. Vigiflow was adopted to monitor adverse events following immunization, allowing the Philippines Food and Drug Administration to inform the public and thus, assure them of the safety of these vaccines and thus manage vaccine hesitancy.

Furthermore, forecasting requires machine learning to make it sustainable, or at best feasible. The Philippines is able to forecast the impact of lockdowns. But of course, its capacity is only just evolving and not quite mature yet.

He stressed that, data must be triangulated with other data systems as well so that the most optimal observations do not lose their objectivity.

The Philippines continues to explore new ways on how to respond to the pandemic. It aims to involve the public, not only by making hotlines available, but also providing virtual services such as tele-medicine.

Director Tayag pointed out that one silver lining in this pandemic is the rapid adoption of digital tools, which has enabled the delivery of right messages to the public and the key actors.

COVID-19 Surveillance and Risk Assessment in Chinese Taipei, Dr Jen-Hsiang Chuang, Chinese Taipei

Dr Chuang first introduced Chinese Taipei's very comprehensive surveillance framework that includes an indicator-based system and event-based system, which were established after the SARS outbreak in 2003. The indicator-based surveillance system consists of data on case-based notifiable disease reporting, laboratory surveillance, school-based surveillance, etc., while the event-based system includes information on sentinel communication, media surveillance, social network etc. Previously, much of the data and information collection for these systems required

intense human labor, but over the years, digital solutions have been introduced to data collection through measures such as keyword searching or other AI techniques.

Under the COVID-19 scenario, Chinese Taipei has responded with both international surveillance and domestic surveillance. The main objectives of international surveillance are to monitor the status of COVID-19 in other areas, conduct risk assessments for imported cases, and understand epidemiological and virological characteristics. The methods mainly focus on event-based surveillance, which conducts qualitative/ quantitative evaluations, integrates the information, and displays data on dashboards/tabulation. In order to facilitate data collection, it has also adopted the Nature Language Processing (NLP) technique as well. As for domestic surveillance, the main objectives are to reach early detection and intervention, monitor the COVID-19 epidemic in order to balance and maintain public health and healthcare resources. The methods adopted are mainly event-based surveillance, case-based surveillance, laboratory surveillance, etc.

For COIVD-19 case reporting, there is an infectious disease reporting surveillance system, which has adopted an automatic reporting mechanism through the use of the IC-chipped National Health Insurance (NHI) Card to upload patients' information and laboratory testing results. All testing, screening, medical attention seeking information will be automatically uploaded to the economy-wide disease surveillance system through the NHI Card, which has to be presented for any medical services.

Dr Chuang stated that the digital technologies adopted in Chinese Taipei have played a very important role in combating COVID-19. Even with a very comprehensive surveillance framework, the most important task is still to use the surveillance data and take appropriate actions. With the experience of combating SARS outbreak in 2003, Chinese Taipei considered the information about the undiagnosed pneumonia outbreak in Wuhan crucial and was able to take proactive responses accordingly. The daily information collected enabled us to make appropriate risk assessments and adjust responses timely. The government collaborated with academia in creating a framework for estimation of effective reproduction number and epidemic forecasting. To evaluate the probability of ending an outbreak at the county-level, a model was developed and served as a reference for the government to set guidelines for COVID-19 control. He emphasized that risk assessment based on the surveillance data is the key to Chinese Taipei's successful control of the COVID-19 epidemic.

2.3 Session II –Response: Resources, Allocation, and Mobilization

ISRAEL vs. COVID: Technology vs. Virus, Mr Ido Hadari, Israel

Mr Hadari began with a quick review on the Israeli health system, where there are 2.5 million members (25%) with digital engagement, prior to COVID-19. This engagement rate was found to be an advantage and crucial to Israel's success in combating the COVID-19 virus. Figures show that during the COVID outbreak, 98% of 20,000 COVID-19 positive cases were treated at home digitally through tele-health services, during which two-way communication between patients and health care workers was conducted digitally, meaning that their health conditions could be monitored frequently. Moreover, he stated that Israel deployed PCR stations all over the economy and established the largest public lab for PCR tests, which can do over 30,000 PCR tests per day.

Next, the most important thing is vaccination rollout. Israel has an extremely high vaccination rate where booster shots have started already. There are three parts that make up this success, which are supply, logistics, and public engagement. The Israeli government were well prepared in terms of vaccine supply and logistics. The biggest challenge for Israel was public engagement.

Mr Hadari pointed out that Israel set up a variety of vaccination stations. They may be a single mobile unit, big compounds with 12 or 13 stations, with the largest one even having 5 stations that can service over 400 people each day, or even a drive-thru site where people could be vaccinated in their own vehicles. To encourage the public to get vaccinated, the government must first, create trust and confidence; second, provide open and transparent information with clear instructions. In times of emergency, people need 80% more information and are 80% down from their normal ability to absorb information. And the third is to provide two-way communication channels, so members of the public know that they can ask questions and get answers. The message to the public to get vaccinated must be cognitive and also psychological. He stressed that the government has publicized the vaccination campaign through mass media platforms and digital tools. Therefore, it has become an issue that people talked and cared about. Once it became an issue of discussion, a very sophisticated digital scheduling system was established to the general public to make vaccination appointments in the ways that are convenient to them. With regard to individuals who did not make appointments, the government targeted them specifically with phone calls or with reminders on their regular doctors' appointments. The vaccination process is also digitalized with the smart waiting system. The government's efforts resulted in great success.

Mr Hadari stated that, looking into the future, there will be other pandemics. In the next pandemic, it will be also mysterious, it will become a global emergency, and it

will lead to global fear, which may result in economic threats. People will expect the health organizations to respond faster and more significantly.

In terms of PCR tests, treating patients and vaccination, Israel was quite successful but also must do better in the future. Areas of improvement include better global data sharing, more telehealth options or platforms, larger scale of mass testing, new ways of lockdown enforcement. He stated that, people will need to jump outside the box, think locally based on a global perspective, and come up with innovative regulations that allow man to run faster than the virus. No single entity or member economy initiative is sufficient in this war of humanity against virus, global data and experience sharing is crucial in this united fight against the virus.

COVID-19 in Bavaria, Germany – Challenges and Lessons Learned from a Public Health Perspective, Dr Merle Böhmer, Germany

Dr Böhmer first described the overall pandemic situation in Bavaria, Germany. The first cases of COVID-19 occurred in Bavaria as early as 27 January 2020. Presumably, a major advantage at the beginning of the pandemic was that Bavaria was the only administrative division with an infectious disease rapid response team on the regional level. The first outbreak of COVID-19 could therefore be contained through quickly and consistently implemented measures such as contact tracing, isolation and quarantine. This may have delayed larger virus spread in Germany by a few weeks. Large-scale community transmission did not occur until March 2020, when SARS-CoV-2 was brought into the border mainly by travelers returning from risk-areas. By 15 August 2021, 659,373 COVID-19 cases had been reported to the Bavarian Health and Food Safety Authority (LGL), of which 15,371 (2%) died. At the moment, Bavaria is likely at the beginning of a fourth epi-wave of the pandemic. Regarding vaccination coverage, approximately 60% of the Bavarian population have received one dose and over 55% have been fully vaccinated now. In the course of the pandemic, several control measures were implemented in Bavaria including contact tracing, quarantine, isolation, border controls, travel bans, contact restrictions, school closures, extensive testing, and of course wearing masks in public.

Dr Böhmer stated that Germany has faced three important challenges in fighting this pandemic. First, the 76 Bavarian health offices responsible for case management and contact tracing at the local level were very heterogeneously equipped –both in terms of staffing and further areas, for example digitalization. Bavaria reacted to this situation, among other things, by declaring an economy-wide emergency and supporting the local health offices with contact tracing teams (CTTs) and personnel from the armed forces. One problem to be mentioned in this context is that there was

initially a lack of specialized personnel and the training took some time. The second challenge was the electronic reporting system. At the beginning of the pandemic, only the regular electronic reporting system for infectious diseases was in place. This system was not designed for pandemic management, with thousands of cases to be processed daily, and this system soon reached its limits. Moreover, the well-functioning digital system for management of contact tracing was largely lacking and notification software was not uniform. The third challenge is the need for a well performing vaccination campaign, which is undoubtedly an essential component in fighting COVID-19. However, there is a need for improvement in Bavaria, which currently does not have a digital vaccination register. Many important resources were unnecessarily tied up because GPs had to call their patients individually to ask whether they had already received a vaccination at one of the vaccination centers.

Dr Böhmer further pointed out that the lessons they had learned so far were, first, to strengthen the public health sector at the local level in the long term. Monetary and other enticements should be provided to make medical work in the public health service more attractive, and it must be ensured that employed public health personnel are well trained in infection control and are unable to expand their knowledge on an ongoing basis. The second lesson is that the digital reporting system should be improved. An economy-wide, uniform, digital reporting system that can be quickly adapted for new pathogens/situations and can also be used for contact tracing might be helpful for successful control of pandemic situations. Third, it is necessary to optimize the current vaccination campaign. In order to optimize the current vaccination campaign and increase vaccination rates, the implementation of an economy-wide and digital vaccination register would be reasonable. However, data protection law needs to be adjusted first to implement such a system.

Experience Sharing on Developing the Oxford COVID-19 Government Response Tracker (OxCGRT), Executive Director Toby Phillips, United Kingdom

Executive Director Phillips first introduced themselves, saying that they were a group of researchers and students at Oxford's Blavatnik School of Government at Oxford University who have developed the Oxford COVID-19 Government Response Tracker (OxCGRT), a dataset that addresses the need for continuously updated, readily usable and comparable information on policy responses to the pandemic. He explained that the database was built in real time during this unfolding global crisis throughout which many unique challenges were met, such as significant policy variation within jurisdictions, and the emergence of new policy interventions over time. He stated that, it was hoped that through the development of this dataset, researchers and

policymakers would be able to explore the effects of policy responses on the spread of COVID-19 cases and deaths, as well as on economic and social welfare.

The global dataset quantitatively records policies in a systematic way, currently there are 20 policy indicators such as school closures, income support provisions, stay-at-home orders, mask mandates, vaccine eligibility, etc., and the results is a data product that informs real time decision making. It is an intelligence and monitoring tool, and the high level of aggregated index represents the strength of government responses and the changes over time. There are over 200 trained volunteers around the world collecting and inputting data, and over the course of the pandemic, over 1,000 volunteers have been included to work on the project. The team has yet to find a way to digitally automate the process of finding and interpreting policy measures. It is truly a project that requires human efforts.

Next, on the challenges that the team has faced, first being the regional variation where they found massive variations with member economies on how they responded. It was a huge challenge when they tried to bring a whole member economy's policy response into a binary variable. The other challenge was that policies changed in every member economy and they needed to constantly update and accurately record each government's response, and because of this change over time, they weren't able to predict the course of the pandemic, and could not predict which policies would be important in 12 months' time.

As for the results and findings of their research, they discovered trends on the policies carried out during the initial stages of the pandemic, regional trends in the use of stay-at-home orders, patterns on how policy compliance over extended periods of time, and finally on path dependency and decision making, and how sensitive decision makers are based on case levels. On this they've found the concept of desensitization; member economies that have largely contained the virus have become highly sensitive, and continue using stay-at-home orders, such as Australia or China that have not contained the virus have become less sensitive and require high case levels to trigger lockdown measures, such as the Philippines or the United Kingdom.

Dr Philips stated that moving forward, they will continue to expand their indicators and aim to stay at the frontier of understanding and monitoring the response to the pandemic.

COVID-19 and Mass Gathering Events in Japan, Dr Tomoya Saito, Japan

Dr Saito stated that since the emergence of COVID-19, Japan has focused on early detection and active field investigations to discover the characteristics of the virus.

Three main environmental risk factors for COVID-19 clusters were found, the "3Cs": closed spaces, crowded places, and close-contact settings. As such, Japan has taken measures to prevent such environment and behavior so as to contain the spread of the virus. Japan does not have regulations that enforces a city lockdown, so the Government of Japan (GOJ) instead encourages "behavior change" among citizens so as to refrain from entering high risk environments. The GOJ also declares states of emergency where they request citizens to refrain from unnecessary out-goings so as to reduce social contact. Since February 2021, the GOJ implemented a vaccine campaign, but as the pandemic sees no end, the control over people's behavior has become increasingly difficult and Japan is now facing a fifth wave of an unprecedented surge of positive cases.

Dr Saito stated that Japan was originally scheduled to host the Tokyo Olympics and Paralympics in 2020 (Tokyo 2020) but postponed the event for a year due to the pandemic. Countermeasures against COVID-19 for Tokyo 2020 were drafted in December 2020, but with the emergence of more infectious virus variants, it became necessary to strengthen the set countermeasures. In March 2021, stakeholders decided not to accept overseas spectators. With reference to the government restrictions on public events set in June 2021, stakeholders had originally agreed for domestic spectators to be allowed, with the spectator limits set at 50% of venue capacity, which would allow a maximum of 10,000 people at all venues; yet as the pandemic worsened, not even domestic spectators were admitted into most venues. Relevant mass gathering events such as live site events were also canceled as well.

Under the established "Playbook", athletes and stakeholders were expected to take prevention measures and required to be frequently screened during the games, and a 14-day self-quarantine period was imposed on all entrants into Japan (exceptions were made for visits to pre-approved locations such as training grounds). Additionally, he stated that there are several smartphone applications used as containment measures. For example, the OCHA (an online check-in and health report app) supports Olympic and Paralympic Games Tokyo 2020 athletes and staff manage the procedures smoothly on entering Japan and register their health conditions during their stay in Japan. Another example is COCOA (a contact confirming app) that uses Bluetooth technology to detect and record suspected close contacts between users, and alert close contact with COVID-19 positive users.

Dr Saito concluded that, the hosting of such a major international sporting event during the pandemic was unusual and challenging. Japan put in great efforts and the athletes were well protected by layers of measures (preventive/early detection by an intensive screening/early response system), resulting in that no clusters among athletes were reported in the duration of the games. He stated that the number of

cases and medical needs in Japan are on the increase and that for future upcoming events, the GOJ must recognize this ever-challenging environment and strict implementation of infection control measures.

2.4 Session III –Innovation and Collaboration: Industry, Academia, Government

Digital Health for COVID-19 Decision Support and Epidemic Intelligence in Singapore, Dr Mark Chen, Singapore

Dr Chen first explained the situation in Singapore. He stated that in any pandemic and disease prevention scenarios, there is a problem of diagnosing the patients and bringing them in for testing. Additionally, in the early phase of the pandemic, before testing was widely available, there were a lot of missing cases where doctors were unable to successfully recognize their clinical symptoms and also people were not seeking medical care for symptoms Therefore, they built and attempted a syndromic surveillance algorithm to look for signals in data from electronic healthcare records. The surveillance algorithm relied on free-text notes coded using a Natural Processing Language algorithm previously developed, and was able to discern a faint signal of excess consults in a period coinciding with the rise in confirmed COVID-19 cases in Singapore.

Dr Chen pointed out that, while the need for such a syndrome-based system has now been superseded by widespread testing of all acute respiratory illness episodes for COVID-19, it has provided proof-of-concept that a similar system could be routinely used to scan for case definitions to detect other infections of concern. Such a system may need to be paired with digital health surveillance systems for gathering data not just on syndromes but also on health seeking behavior directly from the public, both for COVID as well as for other infections.

Dr Chen concluded by saying that the future may involve an interactive loop where digital health is also used with surveillance data to drive health seeking behavior, self-testing, and then further collates the results to feed into our systems for infectious disease surveillance using integrated digital health modalities.

Spreading Knowledge Faster than Outbreaks, Dr Kamran Khan, Canada

Dr Khan stated that in the face of a novel virus, there are many challenges faced in combating it. First, fragmented surveillance data that exist across different

geographical areas and in different languages challenge surveillance in such a pandemic. Second, the detection of threat must be assessed for its risks of dispersion and spread and analyze the potential impacts they may bring. As such, BlueDot, with a team of 85 people, has over the past eight years been building a global Epidemic Intelligence platform that aims to generate and disseminate knowledge faster than outbreaks, strengthen early threat detection, facilitate rapid risk assessments, and empower timely responses to emerging epidemics.

Dr Khan stated that these types of capabilities in the platform are to support the response over the life cycle of an epidemic. First of all, the platform detects early warnings of the outbreak, secondarily evaluates key ports of entry, globally and within the region, to identify possible introduction points. Then as the virus makes the landfall and starts to spread locally, the platform helps the local health officials to evaluate the effectiveness of interventions, monitor certain risk areas and utilize resources as efficiently as possible. Ultimately, as the outbreak starts to transition, and perhaps enter into some decline, the platform reassesses the potential for safely reopening travel corridors. Finally, in the post-outbreak period, the platform utilizes historic data to look backwards and provides the lessons one could learn, so that health officials can be better prepared for the next threat. In the end, the vision of BlueDot is to build a resilient whole-of-society ecosystem through international and multidisciplinary collaboration.

COVID-19 Digital Epidemiology, Demography and Creating Tools to Reach a Diverse Population, Dr Benjamin Rader, United States

Dr Rader stated that the COVID-19 pandemic has ushered in a wide range of digital tools to track the global spread of diseases. A subset of these syndromic surveillance systems is meant to capture disease trends and get information in the hands of public health decision makers at a time scale not typically achievable by traditional public health apparatuses. These tools generally aim to gather information on a large and representative sample to accurately report on transmission patterns in the broader population. However, these tools are often only able to capture a small segment of the population whose behaviors are not generalizable.

Dr Rader presented three different tools that aim to overcome this barrier and capture novel information in three unique populations – the young, the privacy-concerned, and individuals residing in low- and middle- income member economies. First of all, "Flu Near You" is a crowdsourced, participatory and syndromic surveillance platform and has been operating for the last decade plus to encourage individuals to report symptoms in real-time so as to complement traditional tracking and provide weekly

reports to the public and the US CDC. Furthermore, they created a new website, "COVID Near You" by collaborating with volunteers from technology companies such as Amazon, Apple and Google in six days. Afterward, they integrated these two platforms to launch the new one called "Outbreaks Near You" to identify current and potential hotspots for the COVID-19 and seasonal influenza outbreaks.

Dr Rader introduced that they collaborate with Google to make it easier for leading research institutions to connect with the potential study participants through "Google Health Studies" app, which harnesses federated learning and differential privacy to gather data. We've partnered with Facebook in conducting the most widely deployed survey around the world, the "COVID Trends and Impact Survey (CTIS)", which is an anonymous online survey by Qualtrics and gives public health insights and helps improve surveillance. These three systems highlight how thinking carefully about sample demographics can improve syndromic surveillance and the ability to track COVID-19.

How to be the helper in the COVID-19 with Surgical Robot Technology, Dr Chieh-Hsiao Chen, Chinese Taipei

Dr Chen first introduced Brain Navi Biotechnology. It was founded in 2015 with headquarters and primary research and development centers in Chinese Taipei, located in Hsinchu Biomedical Science Park. It took Chinese Taipei's advantages in R & D and production in the electronics industry, with Chinese Taipei selected as a research and development and production base. Brain Navi mainly focuses on designing and developing medical devices that can assist surgeons during their medico-surgical interventions, with the outstanding doctors, researchers, and developers to combine technical and clinical application experience, developing products driven by demand. It is well known for its Surface Mapping Auto-Registration Technology (SMART) and NAOTRAC autonomous neurosurgical navigation robot. In the face of the pandemic, where sampling and testing plays such a crucial role, the creation of a "Nasal Swab Robot" with its Zero Contact Robotic Solution to prevent transmissions in the process of sampling has been of great contribution to health care agencies.

Dr Chen pointed out that the world's first and only nasal swab robot was authorized by Chinese Taipei FDA, and has streamlined the traditional 4-8 hour sampling process, standardized the procedure of sample collection, aiming to protect medical staff from the cross-infectious environments. It only takes less than 30 minutes from nasal swabbing to generate RT-PCR report. It has proven to provide high accuracy with the gold standards, and nasal swab taken by the robot can prevent false negative results.

Zero-contact is essential for both medical staff and testing subjects. Its innovation features include first, Zero- Contact, testing subject and medical staff are isolated in different safety zones so that they don't need to put on other protection equipment while proceeding sample collecting or pipetting; second, it provides large-scale testing with the combination of Nasal Swab Robot and Roche Liat system, and stations can generate PCR report within 30 mins. The third is procedure standardization; for medical staff, by lowering the learning curves of the procedure, medical staff are able to do more than just sample collection. Fourth, the Brain Navi Nasal Swab Robot provides high accuracy via the customized nasopharynx depth of each testing subject can lower the rate of false-negative results.

2.5 Session IV –Data Privacy and Protection

Privacy in a pandemic: The work of the Global Privacy Assembly and Australia's experience, Ms Angelene Falk, Australia

Ms Falk first talked about some privacy challenges and how regulators are applying common privacy principles. Second, she talked about how Australia has embedded privacy principles into their technology solutions in combating COVID-19.

In terms of privacy challenges, a significant increase in data sharing was seen. There were more requirements to provide personal information for contact tracing, which led to the introduction of Bluetooth and QR code apps. The attention then turned to digital vaccine certificates or "passports" and an increase in the use of digital platforms both for work and at home.

Ms Falk stated that the Global Privacy Assembly (GPA) has established three strategic priorities in advancing global privacy in the digital age, and its COVID-19 response. The challenges were, first, to advance global privacy in a digital age by establishing common position on novel policy issues such as health data sharing; the second challenge is to maximize the GPA voice and influence through joint statements and holding events with industry, governments and civil society, and the third is to build capacity for the GPA and its members through the compendium of best practices related to COVID-19. The statements the GPA released were, first, to stand firm on the position that privacy regulators must ensure data sharing is for the purpose of COVID-19 prevention and management; the second is to ensure privacy is built into the design of contact tracing apps, and the third is to ensure privacy is safeguarded in vaccine passports and the use of health data for travel purposes. The GPA also conducted a survey about community attitudes to privacy, which found that most

Australians agreed some concessions to privacy had to be made to combat COVID-19 for the greater good, but that they shouldn't be permanent, and that entities should ensure they're complying with good privacy principles and practice.

Ms Falk pointed out that in the Australian experience, there have been two main digital tools that have been employed, in which privacy principles of legitimacy, necessity, proportionality, fairness, and transparency have been built into its design. The first is the COVIDSafe app, which is a Bluetooth enabled technology that enables proximate contacts to be detected. It is a voluntary app, the personal information collected can only be used for contact tracing. Misuse of data collected through the app would form a criminal offence. Besides that, its data is held on the device for 21 days, and its data cannot be accessed for law enforcement purposes. Other kinds of apps in operation in Australia are QR code check-in apps. State and territory government apps only store information for a certain period of time (generally 28 days), only the minimum amount of information permitted can be collected, and the information collected can generally only be used for contact tracing purposes.

Ms Falk last stated that the data protection regulators around the world take an important role to provide advice and guidance to both organizations and agencies and also to individuals. She concluded by saying that the past 18 months has definitely thrust privacy into the spotlight. Privacy has become a mainstream issue, one that needs to be considered up front in any development of new technology, or responses to preventing and managing COVID-19. In the development of digital tools and data sharing, privacy protection must be built in, so that communities can have trust and confidence in the protection of their personal information.

Danish Experience Sharing: sundhed.dk – the Danish health care online, Mr Morten Elbæk Petersen, Denmark

Mr Petersen introduced the portal and the app: MyHealth. It provides 24-hour access to personal health data and general information about health prevention and diseases for Danish citizens and health professionals. As part of the Danish health care sector, sundhed.dk plays a crucial role in supporting transparency and patient empowerment, and providing health professionals with the possibility to access patient health data residing outside of local systems and across sectors and boundaries. Sundhed.dk was launched in 2003 as a collaboration between the state, the regions and the municipalities. It is an integrated part of economy-wide eHealth strategies and is governed by its own political board with representatives from each of its partner organizations. By July 2021 sundhed.dk counts 8 million visits each month and 4.2

million downloads of the MyHealth app. Today sundhed.dk is considered a critical, economy-wide infrastructure in the Danish Health care sector online.

Mr Petersen stated that, to understand the position and popularity of sundhed.dk, it is necessary to highlight some core factors. Those factors are public health care sector built within a democratic setting and financed by state taxes, a long tradition in Denmark for registration of health data, and a high level of IT-maturity and a trust-based culture within the Danish society. When the COVID-19 pandemic spread to Denmark in February 2020, sundhed.dk got an even more significant role than ever. Due to the already widespread use of sundhed.dk and MyHealth at the starting point, it was possible to quickly develop additional, digital tools and services to support citizens, such as visiting a psychologist or dentist online during the pandemic.

Mr Petersen stressed that Sundhed.dk has played a crucial role during the COVID-19 pandemic, providing citizens with different digital tools to help them through the pandemic. The most essential to mention is easy access to COVID-19 information from the theme site, test results, and the Corona passport, and voluntarily report symptoms by COVIDMETER (monitoring and tracing).

Corona- Warn- App Behind the Scenes, Director Thomas Klingbeil, Germany

Director Klingbeil first introduced the German Corona-Warn-App. It was published on June 16, 2020 and has been downloaded more than 32 million times since then. While the main purpose of the app is to notify users about possible exposures to infected people, many new features have been added and the architecture has been changed accordingly. He gave an overview of the app and offered a view behind the scenes regarding those new features and their influence on the overall architecture.

 The Corona-Warn-App is the German contact tracing app based on the Exposure Notification Framework (ENF) from Apple and Google. The app collects as little personal data as possible while at the same time calculating transmission risk based on information about encounters provided in 30-minute exposure windows. Features of the app include warning, test management, wellness certification, vaccination certification, contact tracing, etc. However, while the app provides such services, the data it collects are stored only on the device, and not uploaded to a central server. If test results must be uploaded onto the server, the results will not be linked to the user's personal data. The aggregation of the collected information from personal data thus ensures the privacy of its users.

Summary of the Conference

This web event discussed four main topics, which are (1) disease surveillance and risk assessments; (2) resources allocation and community mobilization; (3) innovation and collaboration between the industry, academia, and government; (4) data privacy and protection. The summary of the conference is as follow.

A. Digital epidemiological surveillance

There are different approaches to digital epidemiological surveillance monitoring. Dr Jen-Hsiang Chuang from Chinese Taipei introduced Chinese Taipei's comprehensive surveillance framework that includes an indicator-based system and event-based system. Under the COVID-19 scenario, Chinese Taipei has responded with both international surveillance and domestic surveillance. The former is adopted the Nature Language Processing (NLP) technique to collect information in a timely manner while the latter is based on the data from event-based surveillance, case-based surveillance, laboratory surveillance etc. The daily information on epidemic intelligence and the following risk assessment based on the surveillance data are essential to Chinese Taipei's successful control of COVID-19 epidemic.

Dr Mark Chen from Singapore pointed out that they built and attempted a syndromic surveillance algorithm to look for signals in data from electronic healthcare records. The surveillance algorithm was able to discern a faint signal of excess consults in a period coinciding with the rise in confirmed COVID-19 cases in Singapore.

Dr Benjamin Rader from the United States introduced three systems and highlighted how thinking carefully about sample demographics can improve syndromic surveillance to track COVID-19 and seasonal influenza by building a global epidemic intelligence platform.

Dr Kamran Khan from Canada stated that they utilize the combination of machine intelligence and human intelligence to build the surveillance platform and support the response over the life cycle of an epidemic. The platform helps detect early warnings of the outbreak, evaluate the effectiveness of interventions, and look backwards and see what kinds of lessons one could learn, so that the government can be better prepared for the next threat in the post-outbreak period.

B. Rapid case identification

In order to get ahead of the epidemic, a robust surveillance and contact tracing system was needed so that quarantine and isolation can be observed in haste to

stamp out further spread. Director Enrique Tayag from the Philippines stated that they created risk assessment algorithm to identify specific areas of concern to support decision making. Dr Jen-Hsiang Chuang from Chinese Taipei has introduced an automatic reporting mechanism via IC-chipped NHI Card to upload patient's information and laboratory testing results. Dr Merle Böhmer from Germany mentioned that an economy-wide, uniform, digital reporting system quickly adapted for new pathogens/situations and used for contact tracing should be helpful for successful control of pandemic situations. Dr Mark Chen from Singapore stressed that a syndrome-based system could be routinely used to scan for case definitions to detect other infections of concern.

C. **Interruption of community transmission**

In most economies, digital tools have been harnessed to contain the spread of COVID, such as contact tracing, vaccination certification, and vaccine passports, etc. to respond the pandemic.

Director Enrique Tayag from the Philippines said that the use of technology and innovation has indeed become indispensable for calibrating and recalibrating that covered response, so that timely and accurate data and information are analyzed and used as evidence to guide subsequent actions, even as it copes with the negative impact on the economy.

Dr Chien-Jen Chen from Chinese Taipei adopted various digital tools to help prevent massive outbreaks, such as cell broadcast, an e-quarantine system, ICT and big data analysis for contract tracing of confirmed cases, a digital fencing system to monitor home isolation/quarantine persons, etc.

Professor Shaun Hendy from New Zealand pointed out that a significant impact required an 80% uptake rate of digital tool.

Mr Ido Hadari from Israel emphasized the importance of the digital engagement rate. The high engagement rate of the members of the Israeli health system was found to be an advantage and crucial to Israel's success in combating the COVID-19 virus.

Mr Morten Elbæk Petersen from Denmark stressed that the sundhed.dk is considered a critical, economy-wide infrastructure in the Danish Health care sector online. It provides citizens with different digital tools, such as access to COVID-19 test results and the Corona passport.

Dr Tomoya Saito from Japan shared the experience of hosting the Tokyo Olympics and Paralympics. They applied several smartphone applications to report health conditions of athletes and contact confirmation.

Dr Chieh-Hsiao Chen from Chinese Taipei shared the experience of developing the nasal swab robot that provides zero-contact from nasal swabbing to generate RT-PCR report and protect medical staff from the cross-infectious environments.

D. Public communication

Dr Chien-Jen Chen from Chinese Taipei emphasized that transparency, public trust, and solidarity are fundamental elements in a vibrant democracy. He pointed that Chinese Taipei has put in great effort to ensure the public has open access to transparent information. The government has held daily press briefings since January 2019, and has earned public trust which in turn encourages citizens to follow government rules, creating good cooperation between government and citizens.

Professor Shaun Hendy from New Zealand mentioned that clear and effective communication from the government is critical to the public.

Director Enrique Tayag from the Philippines pointed out that the digital tools have enabled the delivery of right messages to the public and the key actors.

Mr Ido Hadari from Israel pointed out that the high vaccination rate of Israel can be attributed to the transparency and public communication. To encourage the public to get vaccinated, the government must provide open and transparent information with clear instructions. He pointed out that they've tried to publicize the vaccination campaign through all media channels. Two-way communication channels are also important. Members of the public know that they can ask questions and get answers.

Executive Director Toby Phillips from the United Kingdom demonstrated that the Oxford COVID-19 Government Response Tracker (OxCGRT) is used as an intelligence and monitoring tool to record real-time decision making around the world.

E. Data accuracy, privacy, and safety issue

All speakers agree that the data privacy issue is indispensable.

Dr Chien-Jen Chen from Chinese Taipei stressed that privacy is a very important issue in a democratic area. To handle a trade-off between privacy protection and disease control, Chinese Taipei adopted the principle of proportionality to ensure that all information collected is used only for disease prevention and control and complies with all regulations.

Ms Angelene Falk from Australia revealed that privacy has become a mainstream issue, one that needs to be considered up front in any development of new technology, or responses to preventing and managing COVID-19. The privacy

principles of legitimacy, necessity, proportionality, fairness, and transparency have been complied with.

Mr Morten Elbæk Petersen from Denmark highlighted that the successful factors of Sundhed.dk are trust and democracy within the Danish society apart from database and IT maturity. Therefore, it is able to provide citizens with different digital tools to help them through the pandemic.

Director Thomas Klingbeil from Germany highlighted the German approach to develop the digital tool: collecting as little personal data as possible, storing data in personal device, detaching the user's personal data to ensure the privacy of app users.

Overall, the COVID-19 crisis has highlighted the role of digital technology and accelerated APEC's digital transition in an unprecedented manner. Digital technology can improve an economy's abilities to integrate new data sources, strengthen early threat detection and provide timely responses. This allows for rapid risk or impact assessments and thus enables economies to take evidence-based action during this global crisis. Leveraging big data analysis and mathematical modeling predict disease progression and compare the effects of various interventions in reducing the spread of the virus. In the meantime, privacy protection and regulations must be built in the digital era to protect personal data and information rights.

Public health threats posed by emerging infectious diseases and the concomitant economic losses are ever-present in our lives, and require collaborations between industry, academia, and government to overcome the challenge. As good work cannot be done in isolation, all the APEC economies and other international counterparts need to work closely to formulate more effective pandemic control measures together.

Date: 25-26 August 2021
Time zone: GMT+8

Wednesday, 25 August 2021

Time	Subject	Moderator / Speaker
08:50-09:00	Registrations	
09:00-09:15	Opening Remarks	Jui-Yuan Hsueh Deputy Minister Ministry of Health and Welfare Chinese Taipei
09:15-09:25	Group Photo	
09:25-09:55	Keynote Speech Chinese Taipei Model: From Surveillance, Resource Mobilization to multi-sector Collaboration	Moderator Jih-Haw Chou Director-General, Centers for Disease Control, Ministry of Health and Welfare Chinese Taipei Speaker Chien-Jen Chen Academician, Genomics Research Center, Academia Sinica Chinese Taipei
Session I	Surveillance: Detection, Forecasting and Risk Assessments	Moderator Marjorie Pollack Deputy Editor, ProMED-mail United States
09:55-10:10	New Zealand's COVID-19 Experience: The Role of Digital Tools	Shaun Hendy Professor, Pūnaha Matatini, University of Auckland New Zealand
10:10-10:25	Surveillance: Detection, Forecasting and Risk Assessments The Philippine Experience	Enrique A. Tayag Director IV, Knowledge Management and Information Technology Service, Department of Health The Philippines
10:25-10:40	COVID-19 Surveillance and Risk Assessment in Chinese Taipei	Jen-Hsiang Chuang Deputy Director-General, Centers for Disease Control, Ministry of Health and Welfare Chinese Taipei
10:40-10:55	Panel Discussion I	

Wednesday, 25 August 2021		
Time	Subject	Moderator / Speaker
10:55-11:05	Break Time	
Session II	Response: Resources, Allocation and Mobilization	Moderator Vikki Carr delos Reyes Medical Specialist III, Epidemiology Bureau, Department of Health The Philippines
11:05-11:20	ISRAEL vs. COVID Technology vs. Virus	Ido Hadari Venture Partner, ALIVE Israel Healthtech Fund; Chief, Government Relations & Communications, Maccabi Healthcare Services Israel
11:20-11:35	COVID-19 in Bavaria, Germany – Challenges and Lessons Learned from a Public Health Perspective	Merle Böhmer Epidemiologist, Bavarian Health and Food Safety Authority; Institute of Social Medicine and Health Systems Research, Otto-von-Guericke-University, Germany
11:35-11:50	Experience Sharing on Developing the Oxford COVID-19 Government Response Tracker (OxCGRT)	Toby Phillips Executive Director, the Oxford COVID-19 Government Response Tracker (OxCGRT) United Kingdom
11:50-12:05	COVID-19 and Mass Gathering Events in Japan	Tomoya Saito Director, Center for Emergency Preparedness and Response, National Institute of Infectious Diseases Japan
12:05-12:20	Panel Discussion II	

Thursday, 26 August 2021		
Time	Subject	Moderator / Speaker
Session III	Innovation and Collaboration: Industry, Academia, Government	Moderator Wei-Sen Li Secretary General, National Science and Technology Center for Disaster Reduction Chinese Taipei
09:00-09:15	Digital Health for COVID-19 Decision Support and Epidemic intelligence in Singapore	I-Cheng (Mark) Chen Head, National Centre for Infectious Diseases (NCID) Research Office Singapore
09:15-09:30	Spreading Knowledge Faster than Outbreaks	Kamran Khan CEO, BlueDot Canada
09:30-09:45	COVID-19 Digital Epidemiology, Demography and Creating Tools to Reach a Diverse Population	Benjamin Rader Graduate Research Fellow, Computational Epidemiology Lab, Boston Children's Hospital; United States
09:45-10:00	How to be the Helper in the COVID-19 with Surgical Robot Technology	Chieh-Hsiao Chen CEO, Brain Navi Biotechnology Chinese Taipei
10:00-10:20	Panel Discussion III	
10:20-10:30	Break Time	

Thursday, 26 August 2021		
Time	Subject	Moderator / Speaker
Session IV	Data Privacy and Protection	Moderator Hong-Wei Jyan Director-General, Department of Cyber Security, Executive Yuan Chinese Taipei
10:30-10:45	Privacy in a Pandemic: The Work of the Global Privacy Assembly and Australia's Experience	Angelene Falk Information Commissioner and Privacy Commissioner, Office of the Australian Information Commissioner Australia
10:45-11:00	Danish Experience Sharing sundhed.dk – Danish Health care online	Morten Elbæk Petersen CEO, sundhed.dk - The Danish eHealth Portal Demark
11:00-11:15	Corona-Warn-App Behind the Scenes	Thomas Klingbeil Director, Innovation Enablement, Technology & Innovation at SAP Company Germany
11:15-11:30	Panel Discussion III	
11:30-11:45	Closing Remarks	Jih-Haw Chou Director-General, Centers for Disease Control, Ministry of Health and Welfare Chinese Taipei