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DIGITAL INNOVATIONS FOR PANDEMIC RESPONSE IN ASIA:

Lessons for Canada

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EXECUTIVE SUMMARY

The pandemic has accelerated the adoption of digital technology around the world. In several Asian economies, the use of data-driven digital tools has enabled successful early responses against COVID-19. The deployment of digital innovations in pandemic response has drawn both praise for their effectiveness and concerns about their intrusiveness and potential violation of civil and political rights. Often, the success of these technologies in Asia has been attributed to the "collectivist" or "communal" attitudes and low prioritization of privacy concerns among the public, or the ability of more *dirigiste* governments to act in a more imposing manner. However, this report aims to provide a more nuanced understanding and analysis of how institutional and social factors have enabled the successful deployment of these technologies in Asia.

This report provides an overview of different use cases from Asia of digital technology in response to COVID-19 under four different categories: contact tracing, monitoring and surveillance, distribution of medical supplies, and telehealth. Researchers also examine the building blocks necessary to support the development, rollout, and public adoption of digital innovations in pandemic response. The research and analysis also show that Asian governments, much like their western counterparts, strive to maintain tenuous public trust in their operations. Canadian and Asian policy-makers share similar challenges and concerns, particularly pertaining to digital technologies. Finally, we seek to provide recommendations for the government of Canada that address key institutional and social factors to enable the use of digital technologies in future pandemic responses.

The report concludes with four recommendations:

1. **Reform data governance frameworks – in both the short and long term.**

   The ability of governments in Asia to share personal data between different ministries and levels of government was a key factor contributing to the success of digital technologies in controlling COVID-19's transmission. While the more intrusive forms of data collection and usage would not align with Canada's social values, Canadian policy-makers have been consistently informed about the need to develop a more coherent model of data governance at the national level, not just for the pandemic response, but for modernized public administration, health care, and economic competitiveness.[1]

2. **Build channels for public participation – and eventually, public ownership.**

   The effectiveness of programs deploying digital technologies as pandemic response relies significantly on community buy-in to drive high levels of uptake among the public. Digital solutions should be developed in a way that actively channels public input, be it in the form of surveys/questionnaires, requests for comment, information gathering, or real-time feedback. Given methods to engage in the technology deployment process, the public can develop a better understanding of the mechanism and rationales behind these tools and platforms, while at the same time developing a stronger sense of ownership.

3. **Re-think the public-private partnership.**

   The case studies from Asia highlight the need for the government of Canada to re-think the model of public-private partnerships in the development of digital solutions. In Asia, the collaboration between public health agencies and major tech companies such as WeChat, Alipay, Kakao, Naver, or Gojek has enabled the rollout of digital solutions in various areas of COVID-19 response. However, these responses were made possible because of a different type of relationship between the public and the private sectors; governments have a more hierarchical relationship with the firms, and the tech companies are often seen as "national champions" that have a stake in the well-being of the citizens.

4. **Strengthen public understanding – and eventually, trust – in technology.**

   The public engagement with digital solutions introduced by governments in Canada and Asia has underscored the importance of strengthening the public understanding of these new tools. Educating the public on how their data is collected and used and how they can properly address misuse of their data could enhance trust in future rollouts of digital solutions. Asian governments have shown responsiveness to public queries and criticisms of their technology during the pandemic, enhancing trust (or at least, acceptability) of the digital solutions.

RÉSUMÉ

La pandémie a accéléré l'adoption de la technologie numérique dans le monde entier. Dans plusieurs économies asiatiques, l'utilisation d'outils numériques axés sur les données a permis de mener à bien des interventions précoces contre la COVID-19. Le déploiement des innovations numériques dans la réponse à la pandémie a suscité à la fois des éloges pour leur efficacité et des inquiétudes quant à leur caractère intrusif et à la violation potentielle des droits civils et politiques. Souvent, le succès des cas d'utilisation en Asie a été attribué aux attitudes « collectivistes » ou « communautaires » et à la faible priorité accordée par le public aux questions de vie privée, ou à la capacité des gouvernements plus *dirigistes* à agir de manière plus imposante. Cependant, ce rapport vise à fournir des connaissances et une analyse plus nuancées de la manière dont les facteurs institutionnels et sociaux ont permis le déploiement réussi de ces technologies en Asie.

Ce rapport offre une vue d'ensemble des différents cas d'utilisation de la technologie numérique en Asie en réponse à la COVID-19 selon quatre catégories différentes : recherche de contacts, suivi et surveillance, distribution de fournitures médicales et télésanté. Les chercheurs examinent également les éléments de base nécessaires pour soutenir le développement, le déploiement et l'adoption, de la part du public, des innovations numériques dans la réponse à la pandémie. La recherche et l'analyse montrent également que les gouvernements asiatiques, tout comme leurs homologues occidentaux, s'efforcent de maintenir une confiance ténue du public dans leurs opérations. Les décideurs canadiens et asiatiques ont en commun des défis et préoccupations similaires, notamment en ce qui concerne les technologies numériques. Enfin, nous cherchons à formuler des recommandations à l'intention du gouvernement du Canada qui portent sur les principaux facteurs institutionnels et sociaux, afin de permettre l'utilisation des technologies numériques dans les futures interventions en cas de pandémie.

Le rapport se termine par quatre recommandations :

1. **Réformer les cadres de gouvernance des données, à court et à long terme.**

   La capacité des gouvernements asiatiques à partager les données personnelles entre les différents ministères et niveaux de gouvernement a été un facteur clé contribuant au succès des technologies numériques dans le contrôle de la transmission de la COVID-19. Bien que les formes les plus intrusives de collecte et d'utilisation des données ne soient pas conformes aux valeurs sociales du Canada, les décideurs

canadiens ont été constamment informés de la nécessité de développer un modèle plus cohérent de gouvernance des données au niveau national, non seulement pour la réponse à la pandémie, mais aussi pour la modernisation de l'administration publique, des soins de santé et de la compétitivité économique[1].

2. **Créer des canaux de participation du public et, à terme, de ralliement public.**

   L'efficacité des programmes déployant des technologies numériques dans le cadre d'une intervention en cas de pandémie repose en grande partie sur leur adoption au sein de la communauté, afin de susciter un niveau élevé d'utilisation de la part du public. Les solutions numériques doivent être développées de manière à canaliser activement la contribution du public, que ce soit sous forme de sondages/questionnaires, de demandes de commentaires, de collecte d'information ou de retour d'information en temps réel. En raison des méthodes pour prendre part au processus de déploiement de la technologie, le public peut mieux comprendre le mécanisme et les raisons qui sous-tendent ces outils et plateformes, tout en développant un sentiment d'appartenance plus fort.

3. **Repenser le partenariat public-privé.**

   Les études de cas en Asie mettent en évidence le bénéfice pour le gouvernement du Canada de repenser le modèle de partenariats public-privé dans le développement de solutions numériques. En Asie, la collaboration entre les agences de santé publique et les grandes entreprises technologiques comme WeChat, Alipay, Kakao, Naver ou Gojek a permis le déploiement de solutions numériques dans divers domaines de réponse à la COVID-19. Toutefois, ces réponses ont été rendues possibles grâce à un type de relation différent entre le secteur public et le secteur privé; les gouvernements ont une relation plus hiérarchique avec les entreprises, et les entreprises technologiques sont souvent considérées comme des « champions nationaux » qui ont un rôle à jouer dans le bien-être des citoyens.

4. **Renforcer la compréhension — et, à terme, la confiance — du public dans la technologie.**

   L'engagement du public envers les solutions numériques introduites par les gouvernements au Canada et en Asie a souligné l'importance de renforcer la compréhension du public par rapport à ces nouveaux outils. Éduquer le public sur la manière dont ses renseignements sont colligés et utilisés et sur la manière dont il peut réagir correctement à une utilisation abusive de ses renseignements pourrait renforcer la confiance dans les futurs déploiements de solutions numériques. Les

gouvernements asiatiques ont fait preuve de réactivité face aux questions et aux critiques du public concernant leur technologie pendant la pandémie, renforçant ainsi la confiance (ou, du moins, l'acceptabilité) des solutions numériques.

01

INTRODUCTION

The use of digital technology against the spread of COVID-19 by several Asian economies has been widely reported, following their successful initial response to the pandemic. Governments in China, Taiwan, and South Korea, for example, have deployed different digital tools to accelerate and increase the efficiency of their pandemic response, and such uses of digital technology have been reported to contribute significantly to their overall success in limiting the outbreak. The North American coverage and analysis of these Asian cases have largely focused on invasive uses of the technology that could potentially undermine civil rights, drawing attention to the different political, social, and/or cultural contexts unique to Asia and underscoring their inapplicability in the current Canadian settings.

While the critiques above are partially legitimate, these types of analysis reduce a wide array of factors that enable such uses of digital technology to the question of whether Asians care about privacy or not. In addition to providing an overview of the digital tools employed for pandemic responses in Asia, this report aims to provide a more nuanced understanding of the factors that have enabled the deployment of digital technology for public health during COVID-19. Dissembling and analyzing these factors into smaller components yields valuable insights for Canada.

In this context, this report presents the different types of digital technology uses in Asia that have contributed to successful responses to the COVID-19 outbreak. It then analyzes

the different institutional factors and social contexts that have enabled the deployment of these digital tools in Asia. This report was prepared with funding from the Public Health Agency of Canada (PHAC) with the aim of providing recommendations for the government of Canada on the effective preparation and use of digital technology in the event of a future health crisis.

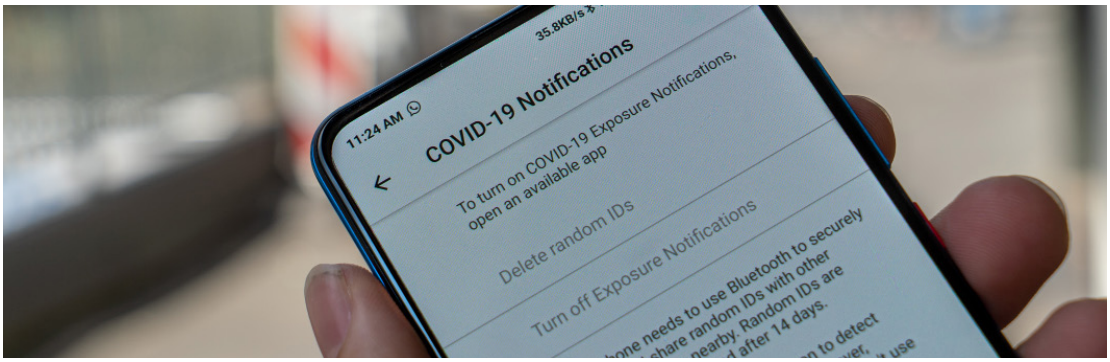
Methodology and Scope

The methodology of this paper is largely quantitative, based on desk research and informational interviews with public health and digital technology experts. Several original language sources in Asia (e.g., Korean, Mandarin, Tagalog) were consulted as part of the research process.

The research report begins with a descriptive summary of four different types of digital technology uses against COVID-19 in Asia. We include examples and descriptions of digital technologies in Brunei, China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan, and Vietnam. Building on this section, the report then breaks down the factors that have enabled the use of said forms of digital technology in Asia, specifically the institutional factors and social contexts. Finally, the report concludes with four recommendations presented to the government of Canada, drawing lessons from regional cases.

02

USE OF DIGITAL TECHNOLOGY IN COVID-19 RESPONSE



The use of digital technologies accelerated during the pandemic. According to a report by McKinsey and Company, the average share of overall customer interactions that are digital went up from 36% to 58% between December 2019 and July 2020.[2] Digital technologies have been leveraged in a variety of ways to lessen the impact of the COVID-19 pandemic. The following functional applications are considered in this report: 1) contact tracing; 2) surveillance; 3) distribution of medical supplies; and 4) telemedicine.

This section presents summaries of different digital innovations used by selected Asian governments in response to COVID-19, highlighting a few key examples. For more detailed descriptions of digital tools and technology-related response efforts for case study countries, please see Appendix A.

FIGURE 1

Digital technology for pandemic preparedness and response

Contact Tracing

Contact tracing is understood as the process of identifying and tracking "individuals who might have come into contact with an infected person."[3] While most economies around the world, and particularly in Asia, had introduced some kind of digital contact tracing by early 2021, this process is still labour intensive since health authorities need to interview confirmed COVID-19 patients and reach out to close contacts via either phone calls or visits to advise them to self-isolate.

In Canada, analog contact tracing requires significant human effort. For instance, health authorities in Alberta hired more than 2,000 contact tracers from the beginning of the pandemic to January 2021.[4] Further, much of this analog form of contact tracing depends on the information provided by the confirmed COVID-19 patient, which is not always reliable. Contact tracing has been deemed a "failure" in developed economies.[5] The City of Toronto even ended its contact-tracing efforts altogether in October 2020 because it was not deemed effective considering the cost.[6]

In this context, the use of digital technology for contact tracing in Asia has drawn significant attention from the western media and policy researchers. Most economies across the Asia Pacific region quickly deployed different forms of contact tracing, relying on technology to reduce human effort and time. Supported by digital technologies, governments throughout the region have traced infection statuses, movement of people, and potential contacts. This has been enabled by strong government capacity, robust digital infrastructure, and seamless government-business data sharing.[7] In the process, however, these practices have raised concerns, in both Canada and Asian economies, over the disproportionate collection and management of data that could lead to potential violations of civil rights.

Singapore, Brunei, Indonesia, and Malaysia have introduced contact-tracing apps like the COVID Alert app in Canada, powered by Bluetooth in mobile phones. In the cases of South Korea, Taiwan, and Vietnam, the governments created data-sharing mechanisms to facilitate rapid contact tracing. South Korea's Epidemiological Investigation Support System collects data from different government ministries and agencies, 22 credit card companies, and all of the mobile service providers to conduct contact tracing. Taiwan's TRACE, its contact-tracing platform, is connected to different government databases that facilitate data collection and real-time monitoring. China has leveraged the omnipresent mobile "super apps" like WeChat and Alipay, connecting them to the National Integrated Government Service Platform for contact tracing and surveillance.

CASE STUDY 1:

"Super Apps" and Contact Tracing in China: WeChat and Alipay

In China, Beijing overcame the need for high public participation in contact tracing by leveraging two super apps that each had one billion users in China – WeChat and Alipay. Both super apps host a "mini app" where users submit their national ID number, contact information, travel history, and health status to the National Integrated Government Service Platform. Users then receive a QR code to access public places and transportation. This gives the Chinese government an immense amount of real-time data with which it can track the movements of suspected COVID-19 cases in detail, including who they encounter.

Monitoring and Surveillance

Following the identification of COVID-19 carriers and close contacts, the next important step is to make sure that these individuals are isolated to minimize the outbreak. Hence, governments around the world have introduced quarantine and self-isolation measures for inbound travellers or close contacts. In various countries such as Canada, the implementation and enforcement of monitoring and surveillance measures have been mostly limited to non-digital methods, not only for logistical reasons, but also because of potential violations of civil rights. In many countries in Asia, however, governments have rolled out digitally enabled solutions for monitoring and surveillance of confirmed and potential COVID-19 carriers.

Brunei and Hong Kong provided wearables (i.e., wristbands) for those undergoing mandatory quarantine to check their locations. South Korea and China leveraged their data collection systems to monitor those under mandatory quarantine. China integrated health data from the health-care system with real-time monitoring systems to develop a health code system with epidemiology maps. Similarly, South Korea's Smart Quarantine System pools travel information, immigration status, health data, and mobile data to check whether incoming travellers have visited high-risk countries and to contact potential COVID-19 carriers.

CASE STUDY 2:

South Korea's Smart Quarantine System

South Korea's Smart Quarantine System provides the government with comprehensive information on incoming travellers by drawing on various government ministries and agencies to consolidate data on travel, immigration status, health, and even roaming service for mobile usage from telecommunication companies. This allows South Korea to efficiently monitor and contact high-risk incoming travellers. Moreover, the data pooling allows government officials to co-ordinate with medical institutions three times a day to prioritize care more efficiently for high-risk travellers.

Distribution of Medical Supplies

The pandemic created a sudden increase in demand for medical resources and difficulties in allocating these in a fair and effective manner.[8] For instance, Canada suffered from a shortage of personal protective equipment (PPE) in the earlier stages of the pandemic, which posed a challenge for public health authorities.[9] The process of providing medical supplies ranges from procurement to distribution, but our analysis focuses on the innovative uses of digital technology for distribution of PPE, vaccines, and other medical resources.

Some key cases from Asia of applying technology to medical supply distribution include facilitating vaccination rollout and PPE dispensation. For vaccination appointment scheduling, apps developed either by the government or through public-private partnerships emerged across several Asian countries such as Malaysia (MySejahtera app) and Indonesia (PeduliLindungi app).

CASE STUDY 3:

South Korea Battles Vaccine Wastage: Naver and Kakao

When rolling out COVID-19 vaccinations, South Korea proactively battled vaccine wastage by partnering with two local tech giants: Naver and Kakao. To begin, the Korea Centers for Disease Control and Prevention (KCDC) established a centralized online booking system for people to schedule their vaccination appointments. The partnerships between KCDC and Naver and Kakao further improved vaccination efficiency and minimized wastage by creating a live map that tracked appointment cancellations or no-shows in nearby vaccination facilities so that others close by could take the dose instead.

Other countries added additional features beyond scheduling to the apps. For example, in South Korea, a collaboration with tech companies Naver and Kakao combatted vaccine wastage by allowing users to track the availability of vaccines as cancellations or no-shows emerged using a map feature. Meanwhile in Singapore, the government app (Health

Hub) also stored digital vaccination certificates. Singapore also took a technological and centralized approach to distributing more common medical supplies like masks, using a website to organize pickup schedules. This was supplemented by the Temasek Foundation program, which distributed free masks using vending machines that required a government ID scan to enforce rationing.

CASE STUDY 4:

Mask Rationing Through Vending Machines in Singapore

In addition to digitally organizing vaccination, Singapore applied similar technological organization in rationing PPE such as masks. The government created a website to organize pickup slots. Government mask supplies were supplemented by private-sector initiatives to provide more masks to the public. The Temasek Foundation, notably, innovatively used vending machines to provide a contact-free method of mask distribution. Users could obtain only two free reusable masks per person after scanning the barcode of any government ID.

South Korea and Taiwan also used centralized tracking systems to ensure the proper rationing of masks. Notably, Taiwan leveraged crowdsourced information as data for the National Health Insurance mobile app, enabling users to make online purchases and reservations for convenient store pickup.

Telehealth

Telehealth refers to "the delivery of health care services by health care professionals, where distance is a critical factor, through using information and communication technologies (ICT) for the exchange of valid and correct information."[10] While there has been much support for telehealth as a way of expanding health-care coverage, its implementation in Canada before the pandemic was limited due to restrictions on physician licensing and payments and doubts about the security of virtual meeting software.[11] However, much like in other sectors, the COVID-19 outbreak has led to a shift in the health-care sector, with governments recommending and even introducing greater support – regulatory and financial – for the expansion of telehealth.[12]

Countries in the Asia Pacific region saw an uptake in the various telehealth services and apps in two general cases: when patients have COVID-related concerns, and when they seek medical advice for other non-COVID-related diseases, conditions, or treatment needs. For the former, Indonesia's Check COVID-19 app, Japan's LINE Healthcare, and China's Ping An Good Doctor are examples of either private sector-led or public-private partnered digital initiatives that have helped screen suspected COVID-19 patients and eased some of the burden on the hospital system. For the latter, Ali Health and We Doctor in China, GrabHealth in Indonesia, Doctor Anywhere in Singapore, and VieVie and Jio Health in Vietnam are examples of digital solutions that offer remote doctor consultations, medication ordering, and even medication delivery options for patients seeking help with common illnesses and chronic conditions, reducing hospital inflows and risks of infection and allowing medical resources to be better prioritized for front-line pandemic-combatting efforts.

CASE STUDY 5:

Telemedicine in Indonesia: GrabHealth

In Indonesia, the rollout of several telemedicine options has been integral to maintaining access to everyday health care for Indonesians staying at home under lockdown. GrabHealth, for example, is powered by the health tech firm Good Doctor, and provides round-the-clock online access to medical professionals. It also streamlines medical purchases and deliveries in the app, so that patients can go straight from an e-consultation to ordering a medical prescription.

Some telehealth and telemedicine apps also added functions to facilitate testing and vaccine booking. Not only have Asian countries taken several steps forward in incorporating advanced technologies like AI robots, blockchain, and cloud computing to their telehealth drives, but they have also been actively building an institutional and legislative environment to enable the frictionless rollout of telehealth initiatives.

Implications for Canada

Asia's successful response to the initial outbreak of the COVID-19 pandemic, helped in part by their use of digital technologies, stresses the importance of these digital tools in alleviating the impacts of a pandemic. For instance, the South Korean government has been able to reduce the average time needed for contact tracing from 24 hours to 10 minutes through its Epidemiological Investigation Support System, which greatly contributed to the success of South Korea's early response against COVID-19. Singapore's TraceTogether was seen as an innovative solution for contact tracing, and it was replicated in Australia and then elsewhere.

But the examination of these digital solutions quickly demonstrates that it is not the lack of ideas or access to technology that makes the deployment of these solutions challenging

in Canada. Instead, this research demonstrates that what has made the rollout of these digital solutions possible in Asia are institutional and social attitudes, which are explored in the following section. It is in this analysis that this study identifies relevant lessons for Canada beyond highlighting interesting technology solutions.

03

BUILDING BLOCKS: ENABLING FACTORS OF DIGITAL TECHNOLOGY DEPLOYMENT

Institutional Factors

Economies in Asia have several institutional factors that contributed to their overall early success in response to COVID-19 and their ability to develop and roll out digital tools for pandemic responses. Their "advanced institutional capacities"[13] can be broken down into the following four factors:

1. Infectious disease-specific laws and protocols, particularly in the event of a major outbreak, delineating clear roles for government ministries and agencies, and providing frameworks for their close co-ordination in pandemic response;
2. New or reformed specialized agencies with clear mandates to monitor, manage, and co-ordinate pandemic responses at a country-wide level;
3. Government agencies with legal access to key information to conduct their duties, and the authority to establish their own systems to fulfil their law-given mandates; and
4. All the previous legal and institutional factors function in accordance to already existing laws governing privacy and data use and collection for health purposes.

RELEVANT LAWS CONTRIBUTING TO THE DEPLOYMENT OF TECHNOLOGY

TABLE 1

Relevant laws contributing to the deployment of technology

COUNTRIES	RELEVANT LAWS
Brunei	*Infectious Diseases Act 2010*
Hong Kong	*Public health exemptions in the Personal Data (Privacy) Ordinance*
Indonesia	*Electronic Information and Transactions Law No. 11/2008, Revision: Law No.19/2016 (EIT Law)*
Malaysia	*Malaysian Medical Council Advisory on Virtual Consultation (During the COVID-19 pandemic, Telemedicine Act 564, Medical Device Act (737) 2012, Medical Device Authority Act (738) 2012*
People's Republic of China	*Drug Administration Law amended in 2019 to legitimize the sale of prescription drugs online*
Singapore	*COVID-19 (Temporary Measures) Act 2020, Infectious Diseases Act (Chapter 173: COVID-19 Stay Orders), National Telemedicine Guidelines*
South Korea	*Law on the Prevention and Management of Infectious Diseases (Article 76-2)* *Quarantine Act (Article 29-2)*
Taiwan	*Infectious Disease Control Act*

Based on their experiences with severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) in 2003 and 2015, respectively, several governments in Asia have established specialized agencies and laws to swiftly respond to a pandemic. The Centre for Health Protection in Hong Kong, the National Centre for Infectious Diseases in Singapore, the Centers for Disease Control and Prevention (KCDC) in South Korea, and the Central Epidemic Command Center in Taiwan were established after the SARS

outbreak in 2002 and 2003. At the onset of COVID-19, these agencies became crucial, co-ordinating the pandemic response across government ministries and levels, and using several digital and analog methods to determine response measures based on timely data.

Infectious disease laws, such as those shown in Table 1, gave governments in Asia, especially the recently established public health agencies, certain key rights that aided in the rollout of digital tools in pandemic response. First, these laws allowed public health agencies to access and manage a wealth of personal and health data from government and private sources to assist them in determining health measures to curb transmission of an infectious disease. Second, in collaboration with government, these agencies established their own electronic systems to better perform their law-mandated duties in the event of a health crisis.

For instance, China concentrated on using information technology to access key population health and contact-tracing data to inform measures during a public health crisis like COVID-19. The government also shared this data with the necessary health authorities to properly assess transmission rates and risks and inform response measures. China's provinces were given the option to link their originally incompatible QR health codes, which had been fragmented during the rollout process, to an intermediary provided through the National Integrated Government Service Platform. Providing a platform on which this data could be managed and shared in multiple formats facilitated the exchange of information and standardization of the risk assessment and travel advisory standards among different jurisdictions.[14]

Similarly, South Korea's Quarantine Law allows the KCDC to designate "countries with localized, high prevalence of infection as 'quarantine inspection required areas'," and mandate travellers from these locations to fill out a health status questionnaire and enter quarantine.[15] To facilitate this process during COVID-19, the South Korean government, in collaboration with the KCDC, created and mandated the use of a smartphone app for travellers entering the country. Inbound passengers had to download it and use it to declare their health status on entry and to report their health condition over a 14-day quarantine. Through the app, travellers can also directly contact the KCDC with medical concerns.[16]

South Korea's Smart Quarantine System is also a key example of an electronic system used by the KCDC to fulfil its duties of monitoring and enforcing quarantines during infectious disease outbreaks. The database gathers data from different ministries, the country's COVID-19 health declaration app for travellers, and even commercial entities (e.g., mobile and credit card companies) and is directly accessible to the KCDC. In turn,

the KCDC can inform and share data relevant for local governments and clinics about potential COVID-19 cases and individuals who may need treatment or monitoring over their quarantine living in their jurisdiction.[17]

Another pandemic-relevant sector that benefited from institutional capacity, especially in legislation, has been telehealth. China amended its Drug Administration Law in 2019 to legalize the sale of prescription drugs online, which granted access to telemedicine to Chinese residents during strict lockdowns in several Chinese cities.[18] Singapore, on the other hand, issued its National Telemedicine Guidelines in 2015 to set out best practices – in areas including consent, privacy, and data storage – for health practitioners providing services in a telehealth context. As part of its broader Smart Nation Initiative, the Singaporean government took an incremental approach and further introduced the Ethical Code and Ethical Guidelines (2016) and Telehealth Product Guidelines (2017) to address emerging issues.[19] Although Singapore is still in the piloting stage before formally licensing telemedicine services, the legal framework-setting prior to the pandemic outbreak has helped the country to respond to changing health-care priorities and continue establishing the governance framework.[20]

The pandemic has changed how people consult medical practitioners, with both Asian countries and Canada experiencing increased demand for telehealth. One study by the Canadian Medical Association reported that while virtual care in Ontario increased slowly from 0.2% of total ambulatory visits in the first quarter of 2012 to 1.8% by the fourth quarter of 2019, the percentage of virtual visits skyrocketed with the onset of the pandemic. During the second quarter of 2020, virtual visits made up 70.2% of ambulatory visits, with the majority of them through phone calls.[21] While a return to a new normal may increase in-person visits, it is likely that telemedicine will remain a popular alternative for doctor consultations. The increased uptake of telehealth among Ontarians hints to telehealth being a viable option for people seeking care in Canada, particularly during another pandemic, and will require evolving legal and institutional support similar to that seen in Asia.

Another aspect contributing to the deployment of any digital technology in pandemic response in Asia was the compliance of electronic systems and digital tools to existing legal and regulatory frameworks governing personal information and data privacy. In South Korea's case, institutional changes that occurred in the very early days of the pandemic were built on the critical lessons learned from the 2015 MERS outbreak. With the Infectious Disease Control and Prevention Act already containing post-MERS provisions for the government's conditional use of personal data during a public health emergency, amendment processes were fast-tracked so that the contact-tracing platform

for COVID-19, Smart Management System, had the legal basis to leverage cellular GPS location and credit card transaction data for much faster tracing and tracking through the Epidemiological Investigation Support System.[22] Another example is Taiwan's TRACE system, developed as part of the Taiwan Centers for Disease Control's four-year project, that aims to build cross-disciplinary information-sharing and thereby facilitate value-added analysis and decision-making during times of infectious diseases.[23]

As for Hong Kong, the recognition of COVID-19 as a "notifiable infectious disease" by the Prevention and Control of Disease Ordinance entails disclosures of the data subject's identity, location, and personal health data to a third party without consent, albeit in the situation when the "absolute right to life and public interest" overrides "personal data privacy."[24] Although such an exemption is designed to facilitate the health authorities' access to information via the contact-tracing apps StayHomeSafe and LeaveHomeSafe, it has often been criticized for the lack of clarity and transparency about who constitutes a legitimate third party.

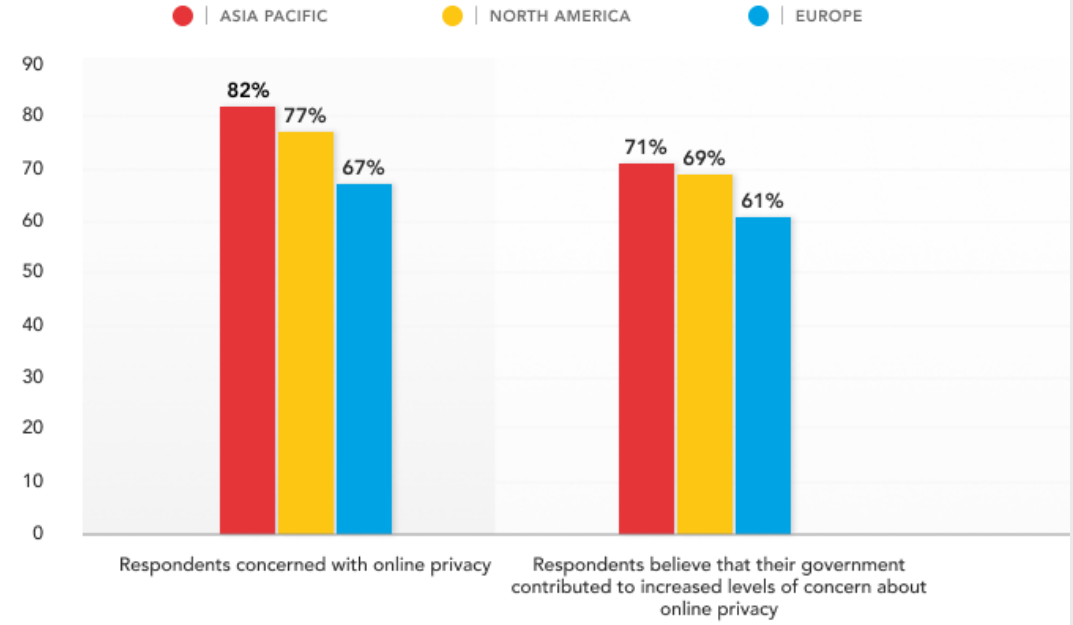
Social Contexts

To further explain the successful deployment of digital technology against COVID-19 in Asia, it is important to examine and gain a nuanced understanding of the social contexts that have enabled the digital measures introduced by governments.

First, it is important to note that Asian citizens share concerns about data and privacy with North Americans and Europeans. According to a 2019 global survey (see Figure 2), respondents from the Asia Pacific tend to be more concerned about their online privacy in comparison to their North American and European counterparts.[25] More importantly, more Asia Pacific respondents credit their governments for contributing to increased concern over online privacy in comparison to North American and European counterparts.[26] These survey results suggest that Asians are as concerned, if not more, about their privacy than North Americans and Europeans.

FIGURE 2

CIGI-IPSOS Global Survey: Internet security & trust 2019



Source: https://www.cigionline.org/sites/default/files/documents/2019%20CIGI-Ipsos%20Global%20Survey%20-%20Part%201%20%26%202%20Internet%20Security%2C%20Online%20Privacy%20%26%20Trust.pdf

In fact, the use of invasive forms of digital technology in response to COVID-19 have raised questions and backlashes in the region. Seoul's collection, storage, and use of personal data for contact tracing and surveillance have raised concerns and criticism from civil society.[27] In Hong Kong, the public has shown great reluctance in digitally providing their personal information, and they have opted to provide their information manually. For instance, the sign-up rate for LeaveHomeSafe was approximately 33% in February 2021, and relevant government agencies have been pushed to provide further explanations and assurances about data privacy.[28] In Taiwan, critics of the island's digital approach to infection surveillance and quarantining still advocate for further transparency and specificity from the government on pandemic data use, retention, and protection.[29] Similarly, the discovery that the Singaporean government used TraceTogether's data for criminal investigation led to a major public uproar.[30]

Additionally, governments in Asia have challenges related to public trust that can impede the use and adoption of digital technology in pandemic response. According to the OECD, European and North American economies, such as Canada (60%), the United

States (46.5%), and the Netherlands (78.1%) generally reported a higher level of trust in government than both Japan (42.3%) and South Korea (44.8%).[31]

In this context, governments in Asia endeavoured to build trust in their public health measures, including digital tools, through the COVID-19 pandemic. In South Korea, the government discloses as much data as possible to the public – including "movement paths, transportation means, medical treatment institutions, and contacts of patients of the infectious disease" – a lesson learned after tight information control during the MERS outbreak led to high public dissatisfaction.[32] This level of data transparency in South Korea is supported by one of the most comprehensive and strict data privacy laws in the region, a key policy piece contributing to enhanced public trust.[33]

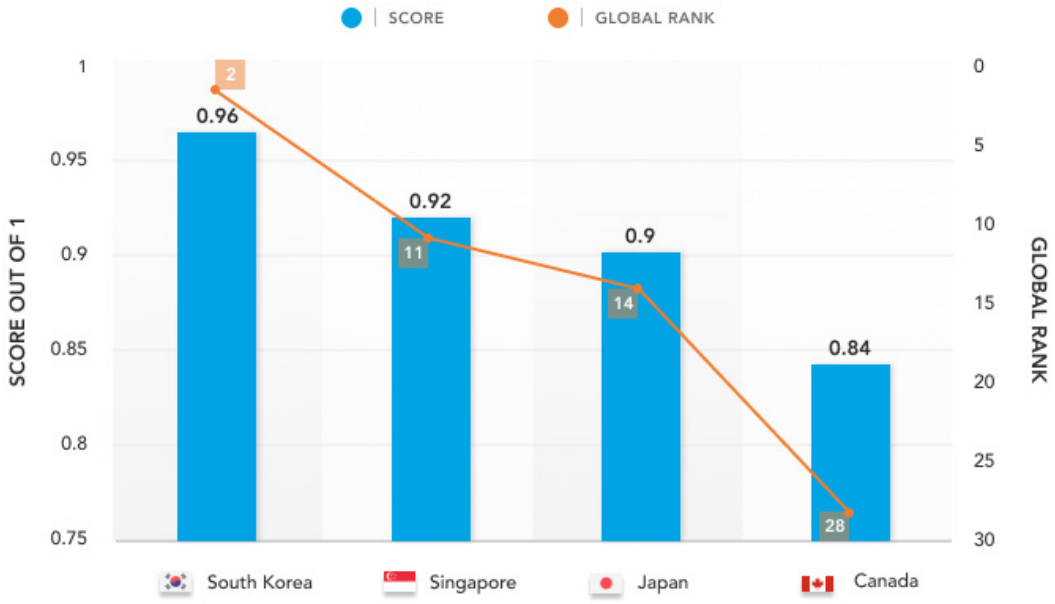
While a national survey showed that over 80% of respondents preferred having transparent information on infection clusters and locations where cases were found, Seoul's transparency policy around infection clusters or movements of anonymized individual cases was not without controversy.[34] The identification and public disclosure of infection clusters in LGBT+ nightclubs in Seoul raised public concerns over the collection and use of data for health purposes. The government quickly moved to offering anonymous testing, lowering the risk that LGBT+ individuals may not get tested for fear of being outed and stigmatized.[35] The government's responsiveness and sensitivity to a public concern, particularly one of a minority group fearing discrimination, enhanced trust as reflected by the increase in the amount of people getting tested through the new service after this particular outbreak.[36]

Further, the South Korean and Taiwanese governments also clarified that data gathered for the pandemic was only accessed, shared with, and used by key health agencies, like the KCDC and the Central Epidemic Command Center, and strictly for public health purposes. Taiwan's efforts in engaging the public in their responses, particularly with Taiwan's civic tech sector contributing to the creation of a mask-availability app, likely also contributed to trust building.[37]

An important point to consider is the familiarity of the Asian public with digital public service and tools. In the 2020 United Nations E-Government Development Index (EGDI) – which scores countries based on their online service index, telecommunication infrastructure index, and the human capital index – Asia as a region scored second highest in the world at 0.64, just behind Europe (0.82) and ahead of the Americas (0.63), with the world average being 0.6.[38] In terms of individual economy rankings, South Korea is a trailblazer, placing second globally behind Denmark. Other Asian e-government adoption leaders are Singapore and Japan. Canada lags behind these three Asian economies and the United States, only outranking China.

FIGURE 3

2020 United Nations E-Government Development Index (EGDI)



Source: https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf

Any country with an EGDI score of 0.75 to 1 is considered "very high." In the 2020 EGDI rankings, Asia, as a region, ranks second in the world for e-government development behind Europe but ahead of the Americas. Individually, 15 Asian countries (32% of the region) achieved spots in the very high EGDI category. Notable Asian frontrunners are South Korea, Singapore, and Japan, who globally ranked second, 11th, and 14th respectively, placing well ahead of Canada (28th).[39] This shows that populations across Asia, particularly in South Korea, Singapore, and Japan, have higher levels of familiarity with digital public services, creating a more welcoming environment for pandemic digital tools like contact-tracing apps or mobile SMS public health warning systems.

Further, collaboration between governments and key tech players to develop and roll out COVID-19 digital tools, either as stand-alone mobile apps or additional functions within an app, contributed to the public's ability to engage with such technologies. Beijing's link-up with WeChat or Alipay for contact tracing, symptom self-checks, and surveillance is a prime example. Likewise, large tech companies Grab and Gojek, which are very familiar

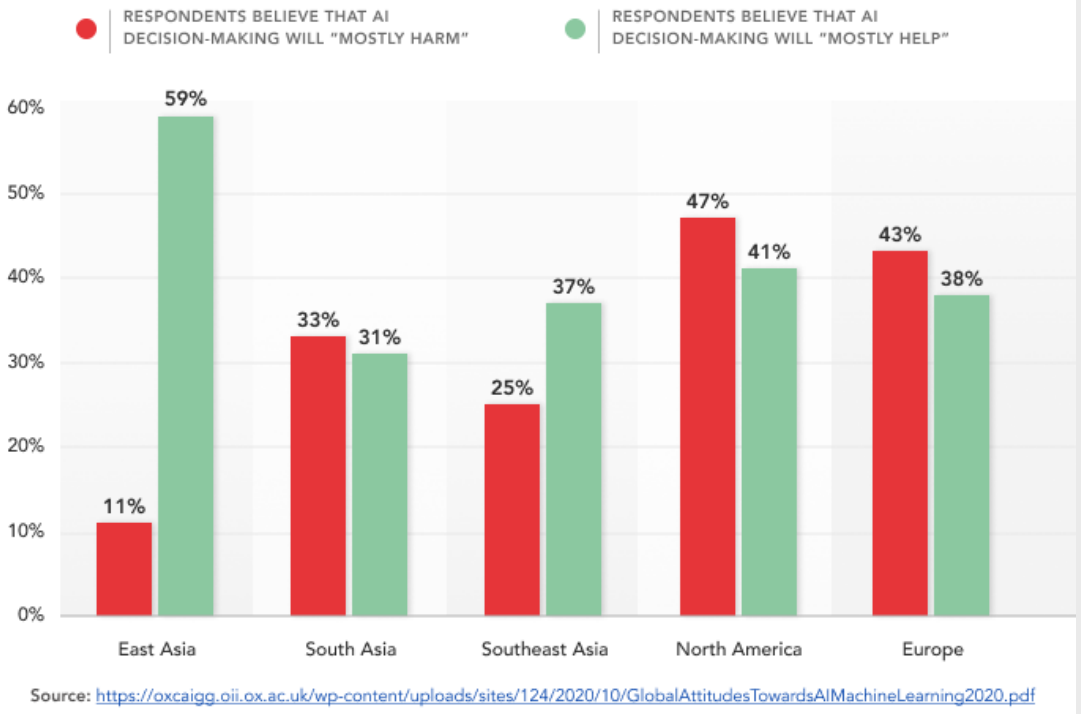
to the public, also partnered with governments in Southeast Asia to provide automated symptom-assessment questionnaires, free physician video consultations, and even drive-through vaccination clinics (especially for health-care workers), all done and booked through their respective mobile apps. Similarly, South Korea partnered up with Kakao and Naver to facilitate vaccine distribution.

The experiences with digital public service and integration of COVID-19 specific solutions with popular, familiar mobile apps and services may have eased concerns about taking up digital solutions proposed by governments in Asia. Also, the platform effects of these ubiquitous services must be taken into consideration. For instance, WeChat and Alipay are so ubiquitous in China that it is almost impossible to conduct day-to-day tasks without them. Apps such as Grab, Gojek, or Kakao enjoy similar statuses in their respective economies. These mobile applications provided an existing and widespread foundation for convenient dissemination of digital pandemic response tools.

Finally, differing attitudes about technology may have influenced the public support or, at least, toleration of digital tools used in response to COVID-19 in Asia. According to a poll by Oxford, there is a sharp discrepancy of global risk perception of AI decision-making by region, with generally more Asian respondents having a positive attitude toward AI in comparison to North American and European respondents (see Figure 4).[40] Furthermore, the public trust in the technology sector on average remains stronger in Asia as well. According to an Edelman study, 20 of 22 economies around the world ranked technology as a top trusted sector in 2016. However, in 2021 this number declined to 7 out of 22. The remaining seven countries – including India, Indonesia, and South Korea – still showed high levels of trust toward their technology sectors. As such, trust in the technology sector remains relatively strong in Asia, even as it declined in other parts of the world. As a result, local populations were likely more amenable to the use of digital tools through the pandemic.[41]

FIGURE 4

Global attitudes towards AI, machine learning & automated decision making (Oxford 2020)



Source: https://oxcaigg.oii.ox.ac.uk/wp-content/uploads/sites/124/2020/10/GlobalAttitudesTowardsAIMachineLearning2020.pdf

Conclusion

All in all, this analysis adds more nuance to the understanding of the institutional and social factors that have enabled the deployment of digital tools in response to COVID-19 in Asia. First, several Asian governments had the institutional capacity and preparedness to roll out digital tools in response to COVID-19. Past experiences with pandemics encouraged Asian economies to better prepare institutionally for new infectious disease outbreaks at regional or global levels. Both legal and institutional factors laid the foundation to employ technology against COVID-19, mostly as a way to facilitate the agile and effective implementation of already existing laws and agency-based procedures legally required for pandemic responses.

It is important to note that although legislation did not necessarily mandate the creation of digital tools, it gave the government and health agencies the power to develop them

to facilitate the performance of their duties during a pandemic. While some countries, like China, chose to use digital tools to centralize certain aspects of their previously decentralized health-care systems, the key takeaway for a Canadian context is that digital tools can better enable government coordination, and improved cross-sectoral and cross-regional data sharing, essential components for properly assessing infection rates, facilitating evidence-based policy-making and building a comprehensive and effective public health response during a health crisis.

This institutional capacity also allowed governments to be responsive when concerns around the use of "intrusive" digital tools in Asia emerged, with some governments taking different, locally specific measures to earn and maintain public support or, at the very least, acceptance, of such practices (as seen with South Korea's quick implementation of anonymous testing). Other key factors enabling the rollout of technology in pandemic responses include prior familiarity and experiences of Asian governments and societies with digital public service, and collaboration with popular and ubiquitous mobile apps and services.

For Canada, the key takeaways are not necessarily the technical aspects of the digital tools for pandemic response seen in Asia, but the enabling factors that allowed for their deployment. As discussed in the following section, the enabling factors relevant to institutions and social contexts need to be addressed in Canada before technology can be successfully implemented in a health crisis. In the following section we provide recommendations and key takeaways for Canada, including legal and institutional frameworks allowing for comprehensive and secure data governance, mechanisms to build trust in technology and digital literacy among the public, and re-defining collaboration between public and private sectors.

04

RECOMMENDATIONS AND KEY TAKEAWAYS

1. **Reform data governance framework – in both the short and long term.**

   One of the key factors of success in the use of digital technologies to fight the pandemic in Asia is the ability of governments to share personal data between different ministries and levels of government. While the more intrusive forms of data collection and usage would not align with Canada's social values, Canadian policy-makers have been consistently advised to develop a more coherent model of data governance at the national level, not just for the pandemic response, but to modernize Canada's public administration, facilitate health-care delivery, and improve economic competitiveness.[42]

   Reform of data governance is not merely a bureaucratic matter; it is a political matter that entails greater conversations about a better definition of a *national* public health act, as well as the standardization of data collection and reform of privacy legislation at both the federal and provincial/territorial levels. COVID-19 has created a window of opportunity to push for reforms on this front. As the case studies from Asia show, the regulatory and policy clarity for data use over the pandemic at a national level facilitated inter-government communication and collaboration. It also allowed infectious disease response agencies like South Korea's KCDC to develop digital tools that furthered its mandate and operations through the

pandemic. Hence, it is critical that the government of Canada continue to support essential data governance programs like the Pan-Canadian Health Data Strategy and its close collaboration with PHAC, as well as provincial and territorial governments. This will be a long-term objective.

A key lesson for Canada from the use of digital tools in Asia examined here, was the infectious disease and data governance legislation that made provisions and protocols for data access and use during health crises. In the short term, Canada should consider creating a nationwide data governance framework or at least a protocol for data sharing tailored for public health emergencies such as COVID-19, which would enable the collection and use of data for digitally-enabled tools and co-ordination among different ministries and levels of government. For the long term, this entails more foundational conversations about the role of federal and provincial/ territorial governments in public health policy, as well as the reform of data governance, especially that of health data, which would enable the flow of data across Canada with greater public trust.

2. **Build channels for public participation – and eventually, public ownership.**

The previous section explained the role of public trust across the Asia Pacific region in the governments' use of digital tools and their approach to personal data. As shown, the effectiveness of programs deploying digital technologies as pandemic response have relied significantly on community buy-in. Digital solutions should be developed in a way that actively channels public input, be it in the form of surveys/questionnaires, requests for comment, information gathering, or real-time feedback. By providing citizens the opportunity to engage in the technology deployment process, the public better understands the mechanisms and rationales behind these tools and platforms and, at the same time, develops a stronger sense of ownership. Such an attitude has been instrumental in the high uptake and subsequent effectiveness of many digital solutions deployed throughout the Asian region for combatting the pandemic.

For example, in Taiwan the mask map portal that crowdsourced mask inventory information became a space for civic participation; the public became co-developers of the solution, as opposed to subjects of data collection or surveillance. In return, the leveraging of civic engagement and collective intelligence creates a greater sense of public ownership and fosters a virtuous cycle of trust building. In the short term,

creating more channels for public input on digital solutions would be useful. In the long term, the integration of digital technology into public health policies should channel greater public input and transparency, and eventually foster a strong sense of public ownership over these digital solutions.

3. **Re-think the public-private partnership.**

   The case studies from Asia highlight the benefit for the government of Canada to re-think the model of public-private partnerships in the development of digital solutions. In Asia, the collaboration between public health agencies and major tech companies such as WeChat, Alipay, Kakao, Naver, Grab, or Gojek has enabled the rollout of digital solutions in various areas of COVID-19 response. However, these responses were made possible because of a different type of relationship between the public and the private sectors; governments have a more hierarchical relationship with the firms, and the tech companies are often seen as "national champions" that have a stake in the well-being of the citizens.

   During COVID-19, the Canadian private sector contributed to the government of Canada's digital solutions, but the lack of co-ordination and consistency in the development and deployment processes make interoperability and data sharing difficult as solutions usually end up being vendor-centric and narrow-focused.[43] According to the Edelman report, the Canadian public's trust in the technology sector is at an all-time low (60%), which compares poorly to its Asian peers such as Indonesia (88%), China (77%), South Korea (71%), and Singapore (70%).[44] Researchers have highlighted concerns about public procurements in technologies like AI primarily benefiting the private sector.[45] In this context, Canada should identify a principled approach to public-private partnerships in the development of digital solutions that foster and maintain public trust.

4. **Strengthen public understanding – and eventually, trust – in technology.**

   The public engagement with digital solutions introduced by governments in Canada and Asia has underscored the importance of strengthening the public understanding of these new tools. This should of course be built on the premise that the government of Canada continue to build digital literacy and technological capacity internally, within its ministries, agencies, and personnel.

Educating the public on how their data is collected and used and how they can properly address misuse of their data could enhance trust in future rollouts of digital solutions, especially those designed for public health purposes. In preparation for the next pandemic, PHAC can have an active role in raising awareness about digital tools for health, the management and use of data, and how data is kept safe.

Nonetheless, education is largely a long-term effort. In the short term, government agencies like PHAC could contribute to digital literacy efforts that strive to establish best practices and guidelines on health data governance for local governments and the private sector.

Asian governments have shown responsiveness to public queries and criticisms of their technology during the pandemic, enhancing trust (or at least, acceptability) of the digital solutions. In the long run, this involves greater investment in education and digital literacy of citizens so they can more easily navigate the government uses of new data-driven technologies with greater trust and confidence.

APPENDIX A

Contact Tracing

BRUNEI

In Brunei, the BruHealth app tracks people entering and exiting public premises and facilities (e.g., places of worship, restaurants, government offices, gyms, schools, hospitals, taxis, and buses) by scanning a QR code. For individuals who do not have the mobile BruHealth app, facility managers can use the PremiseScan app to process them.[46] Complementing these digital efforts, public health officials also have a dedicated team supporting manual contact tracing. The Ministry of Health has made it clear that businesses must post QR codes at entrances. Ignoring these health directives carries legal repercussions as a violation of Brunei's Infectious Diseases Act. Penalties include jail time of up to five months or up to BND10,000 (C$9,070.70). Police and the military have been deployed to help enforcement of the app, particularly at mosques.[47] They have supported contact-tracing efforts as well. Due to this stringent enforcement and high rate of mobile penetration, Brunei has a remarkably high participation rate, with 95% of Bruneians having registered on the app as of September 2020.[48]

INDONESIA

The Communications and Information Ministry and the State-Owned Enterprises Ministry collaborated to launch the PeduliLindungi ("Care Protect") app in March 2020.[49] The app uses Bluetooth to track when people's smartphones come into proximity with each other.[50] Phone numbers are also used to track the movements of confirmed COVID-19 patients for up to 14 days, enabling the government to notify people who have come into close contact with confirmed COVID-19 carriers via text messages.[51] Text messages are used to contact suspected and confirmed COVID-19 cases. Furthermore, the app can be used to identify large crowds and send alerts to the police in real time.[52] The PeduliLindungi app is supplemented by another app called 10 Rumah Aman ("10 Safe Houses"), which uses AI to track the body temperatures of people nearby.[53] The heat-mapping data comes from a

third-party app called Prixa, where users can self-record their temperature.[54] However, use of PeduliLindungi or 10 Rumah Aman is not a legal prerequisite to enter public premises or facilities.[55]

CHINA

Beijing introduced a nationwide pandemic contact-tracing system in late February 2020 after the initial lockdown by repurposing the country's existing data infrastructure supported by platforms WeChat and Alipay. These two mobile applications are often referred to as the "super apps," not only because they have a near-ubiquitous adoption rate with each boasting one billion users in China, but also because they offer a huge variety of services within the app. First introduced as a local project in Ant Financial's headquarter city Hangzhou, the add-on "health code" function runs in the form of a mini app[56] in Alipay – later made available in WeChat and official apps from provincial governments – in which users submit their national ID number, contact information, travel history, and health status to the National Integrated Government Service Platform, to obtain an automatically generated QR code.[57] Leveraging the colossal amount of real-time data on these platforms, government agencies integrate movement data and conduct big data analysis to assign a colour code – green means safe and unrestricted travel, yellow and red mean quarantine and isolation – to decide if the individual can travel to another municipality or enter public spaces.[58] Requiring users to scan their QR code when entering public places and transit systems, the system allows for backward tracing of contacts if a confirmed case is identified. The users can, conversely, obtain travel advisories and real-time information on infectious risks they might have been exposed to through these built-in functions. When a confirmed or suspected case is identified, a thorough survey will be conducted on the individual's movement history and potential close contacts, using a combination of analysis on data collected through the health code system, community-based manual investigation, and calls for self-reporting through neighbourhood committees and the internet.[59] In this way, the infected individual's trajectory and past activities can usually be tracked down in a very detailed manner every two hours.

MALAYSIA

MySejahtera was specifically developed by the Malaysian government to help manage the COVID-19 pandemic and promote Malaysia's Prevention and Control of Infectious Diseases Act 1988.[60] The app allows users to monitor their health through self-assessments and find medical facilities for COVID-19 screening and treatment.[61] The app contains a

check-in feature where QR codes are used to track people entering public facilities.[62] For people who do not have a smartphone, one person in the family or the household can add multiple people on the app as dependants.[63] MySejahtera is not legally mandatory all over the country but has recorded 21 million active users as of February 2021, with 18 to 20 million check-ins daily.[64] The government has only made use of the app mandatory for areas of the country with access to high-speed internet as of February 9, 2021.[65] Aside from the national MySejahtera, some state governments have rolled out their own contact-tracing apps. The Selangor government, for example, released its app Selangkah in May 2020 and rolled out an updated version in February 2021.[66] The updated version has compatibility with the national MySejahtera app, as it allows scanning for both MySejahtera and Selangkah QR codes.[67] It also offers GPS check-in as an alternative to QR code scanning. In addition to contact tracing, Selangkah also tracks crowd trends (e.g., how busy a place is), places where COVID-19 infection has been detected, users' exposure risk based on location history, and a dashboard for police to monitor visitor numbers.[68]

SINGAPORE

Singapore's approach to contact tracing revolves around the mobile application Trace Together and location check-in system, SafeEntry. TraceTogether was launched in March 2020. After the user registers with personal details in the app, TraceTogether generates an anonymous identification number for the phone's user. Later on, the app uses Bluetooth signals to exchange the anonymous identification number with other phones running TraceTogether within proximity.[69] No GPS or location data is collected, only the record of anonymous ID's the phone came within close contact. The data is stored locally on the phone. Only the Ministry of Health can de-crypt and associate the anonymous ID with the real personal information used on sign up. This and the exchange records are only accessed by health authorities if the user tests positive for COVID-19 and is contacted for contact tracing purposes.[70] For demographics (e.g., children and senior citizens) that do not have mobile phones, small Bluetooth-enabled tokens with unique QR codes have also been introduced. If the token user tests positive for COVID-19, the token is then turned over to the authorities, since unlike the mobile app, the token cannot upload data via the internet.[71]

TraceTogether works in concert with SafeEntry, Singapore's digital check-in system which distributed unique QR codes to public locations considered high-traffic areas. This included work offices, malls, public transport and restaurants. Use of both systems became mandatory in December 2020.[72] Starting in June 1, 2021, only the TraceTogether app or token were accepted to fulfil the mandatory SafeEntry check-ins at public premises and facilities.[73]

Singaporeans must scan the locations' QR code with their TraceTogether app and submit personal information (name, identification number, and mobile number) to gain access to stores, restaurants, taxis, train stations, schools, offices, and so on. Likewise, people must scan the code again when leaving to check out of a location. Similarly, people using the TraceTogether token can check-in by tapping the token on a SafeEntry scanner device.[74] As of April 22, 2021, over 90% of the population have either downloaded the TraceTogether app or collected a token.[75]

The data from SafeEntry and TraceTogether are analyzed by teams of contact tracers working round the clock, who verify the data and closely monitor follow-up actions such as quarantine, swab tests, and further surveillance.[76] Additionally, Singaporean police and the military were also pulled into contact tracing, using CCTV footage and data visualization to trace people who were not immediately identifiable through the apps.[77] People who have been found to be in close contact with a person who tested positive for COVID-19 are required to go into quarantine for 14 days, and breaking quarantine can result in a fine and/or jail time.[78] Businesses who do not comply with the contact-tracing regime could face penalties under the COVID-19 Act.[79] At the start of the pandemic, there was a four-day average in identifying and quarantining the close contacts of a person diagnosed with COVID-19, but with the use of new technology, that average dropped to 1.5 days.[80]

SOUTH KOREA

Seoul's Epidemiological Investigation Support System (EISS) is an AI-powered smart city management platform that conducts contact tracing of confirmed COVID-19 patients, cutting down the process from 24 hours to 10 minutes. The Ministry of Land, Infrastructure, and Transport (MOLIT) developed the EISS in collaboration with the KCDC, Ministry of Science and ICT, Financial Services Commission, National Police Agency, 22 credit card companies, and all three mobile service providers. The EISS collects GPS, mobile, and credit card transaction data from these entities, and identifies the movements and potential close contacts on the map-based interface under the Law on the Prevention and Control of Infectious Diseases. The EISS was based on MOLIT's smart city data hub technology, and its management was passed onto the KCDC a month after its development.[81]

TAIWAN

The Central Epidemic Command Center in Taiwan, a government agency that is activated during serious disease outbreaks, plays a pivotal role in the integration and co-ordination

of pandemic-combatting efforts. It works with major telecommunication companies across the island to set up a GPS-based Intelligent Electronic Fences System (IEFS), which makes use of individuals' cell phone signals.[82] The system monitors the location of the quarantined and their potential contacts to be tracked in a relatively accurate and efficient manner when needed. For instance, in the Diamond Princess Cruise incident where more than 700 cases were confirmed while it docked at several cities in Taiwan, the IEFS helped track down as many as 600,000 potential contacts, which allowed measures to be taken to prevent community outbreak. Deployment of technology and online platforms has been particularly helpful in Taiwan's case given its relatively small health workforce. When a confirmed case with unknown origin is identified, places the patient visited are uploaded onto a contact-tracing platform called TRACE, established in 2017 by the Taiwan Centers for Disease Control. Since TRACE is connected to other government databases, it can facilitate collection of contacts' information through self-reporting and real-time monitoring. Following the generation of a contact list, TRACE is then used for automatic text messaging between health officials and the potential contacts to keep track of their quarantine and health conditions.[83]

VIETNAM

For contact tracing, the country mainly used an app called Bluezone, which uses GPS or Bluetooth technology to log users' locations, personal information, and close contacts.[84] The government has leveraged high public trust to garner 20 million downloads of the app by the end of July 2020.[85] Manual contact tracing supplements the app, with face-to-face interviews used to extract more information.[86] In enforcing quarantine and social distancing, local neighbourhood watchers report to the authorities.[87] In addition to Bluezone, Vietnam also used the health self-declaration app NCOVI early on the pandemic to complement its contact-tracing efforts.[88] As of February 2021, there have been "7.8 million installations, 18 million medical declaration records, 52.95 million health monitoring records, and 7.25 million QR code scanning records" for NCOVI.[89]

Monitoring and Surveillance

BRUNEI

For people found to be positive for COVID-19 and their family members, the Brunei government has implemented a stringent surveillance mechanism using the iMSafe bracelet. The bracelet contains a Bluetooth chip locator and a QR code that pairs with an

Android mobile phone. The bracelet and phone must always remain on – switching them off automatically results in a violation of Brunei's Infectious Disease Act.[90] Switching off the device or leaving the established quarantine premises results in real-time alerts sent to the police.[91] The surveillance system has a nearly 100% penetration rate of the population as it uses digital patient records from the national health database.[92]

HONG KONG

The Office of the Government Chief Information Officer was given the task in late January 2020 of coming up with tech-driven surveillance solutions to support the 14-day mandatory quarantine for inbound travellers, while at the same time protecting the privacy and data of the individuals.[93] On entering Hong Kong, everyone is issued a wristband with a unique QR code, which is then scanned and paired with the StayHomeSafe app, allowing the government to monitor whether these individuals stay within their designated places of quarantine.[94] Using the geofencing technology, the app creates a composite signature of one's dwelling by detecting the set of unique environmental communication signals, including Wi-Fi networks, cellular networks, and Bluetooth, thus triggering an alert that's sent to the health authority and police when the user goes out of range.[95] Such technology is deemed suitable for large-scale monitoring and quarantine arrangements in a densely populated city like Hong Kong, as it detects cases when the user is travelling vertically in the same apartment building, which would otherwise be regarded as no movement using GPS.

Designed to only detect whether the quarantined individual is inside or outside of the range, or if the wristband is removed, the Hong Kong government also ensures the preservation of privacy by employing geofencing technology that will not track or record users' exact location. The StayHomeSafe app's decentralized data storage model (i.e., personal data is only stored on each individual's mobile phone and is not collected by the government or solution provider, unless infection is confirmed) is in compliance with the Hong Kong Personal Data (Privacy) Ordinance.[96] In fact, the Hong Kong government has often been challenged by the public on personal data protection issues and thus has to make sure it clearly communicates and explains the use of technologies and addresses public concerns.[97] More generally, when the interest of public health prevails and collection of data becomes necessary, authorities must ensure the measures are necessary, appropriate, and proportionate.[98]

CHINA

Building on the health code system's ability to accurately track contacts and movements, China's health surveillance ecosystem helps ensure potential sources of transmission can be quickly identified and isolated from the public, while at the same time minimizing disruptions to personal and economic activities. The government deploys its existing "Internet Plus" – a series of policy initiatives that apply internet technology to traditional industries and social services to enhance connectivity and productive efficiency – to boost the effectiveness of the health code. By integrating health data from the country's health-care system with the real-time, automated system monitoring and updated information on users' movements, the health code system helps produce "epidemiology maps" that inform people of infectious risks, thus allowing them to self-regulate their mobilities accordingly. Such an approach to surveillance technologies also gives the municipal governments room to tailor their solutions to local needs.[99] Starting in April 2020, the health code also became a requirement for all inbound travellers entering mainland China. To board their transportation, they need to get a negative result for both nucleic acid and IgM antibody tests.[100] Another feature of the Chinese health surveillance ecosystem is the deployment of AI-powered technologies, for example when monitoring residential compound lockdowns, particularly in the early months of the pandemic. AI-based contactless temperature detection software, leveraging facial recognition technology and infrared thermal technology, has also been installed at entrances to public spaces to identify people with higher temperatures to screen suspected cases.[101]

SOUTH KOREA

Following the MERS outbreak in 2015, the KCDC created the Smart Quarantine System, which pools data on travel, immigration status, health information, and roaming service for mobile usage from relevant ministries and agencies (such as the Ministry of Foreign Affairs, Ministry of Justice, and Health Insurance Review & Assessment Service) and telecom companies. Basically, this system allows the government to check whether incoming travellers have visited high-risk countries, communicate with potential COVID-19 carriers, and share information about high-risk incoming travellers with medical institutions three times a day so that they can receive prioritized care.[102]

In addition, Seoul rolled out two mobile apps for monitoring and surveilling confirmed and potential COVID-19 carriers: the Self-Check Mobile App and Self-Quarantine Safety Protection App. The Self-Check Mobile App was developed by the Ministry of Health and Welfare and released on March 12, 2020, to monitor incoming travellers. Designated

incoming travellers must install this app upon entry and provide their passport number, name, contact information, and address in South Korea, and then conduct self-screening through the app over 14 days. The data collected through the app is cross-checked by the Ministry of Justice, which is responsible for the immigration portfolio, and then shared with local health authorities.[103]

The Ministry of Public Safety and Security also launched the Self-Quarantine Safety Protection App on March 7, 2020, for more general monitoring of those mandated to self-isolate. Users provide the address of quarantine and conduct self-screening for COVID-19 through this app twice a day. The results of self-screening are sent to the public health official who is responsible for monitoring the individual who is quarantining. Also, if the quarantining individual leaves the location of quarantine, the app sets off an alarm for both the individual and the public health official.[104]

Distribution of Medical Resources

INDONESIA

The national government is organizing vaccination appointments using the PeduliLindungi app, a government website, the telephone, and WhatsApp. Vaccination for front-line medical workers began in January 2021. The Ministry of Health and the Communications and Information Ministry have partnered with the state-owned telecommunications company PT Telekomunikasi Indonesia to launch the One Vaccination Data integrated database, which lists medical workers according to their identity card number.[105] The Minister of Health, Budi Gunadi Sadikin, announced in January the goal of vaccinating 1.5 million health-care workers by February, followed by public servants and then the general public within 15 months. The overall government goal is to vaccinate 181.5 million people (roughly two-thirds of the population) by the end of the year. Unfortunately, government vaccination efforts are lagging (only nine million people have been fully vaccinated as of May 2021), hampered by data issues.[106]

In an effort to speed up vaccination and reduce the expense of the government's free vaccination program, the national government approved the Indonesian Chamber of Commerce and Industry's proposal of launching a private vaccination scheme on May 17, 2021, called Vaksinasi Gotong Royong (VGR), which roughly translates to "vaccination mutual assistance."[107] Under the VGR, private and state companies can purchase their own vaccines for employees and their dependants, with priority given to labour-intensive companies, especially those operating in areas at high risk for COVID-19. The companies

register for the program and acquire vaccine doses through Kimia Farma, which is a subsidiary of the government-owned vaccine manufacturer Bio Farma.[108]

In the private sector, telemedicine startup Halodoc raised $80 million in funding to co-ordinate national vaccination drives with the Health Ministry using its scheduling technology. Halodoc also partnered with ride-hailing giant Gojek to run drive-through vaccination services in Jakarta for the elderly.[109] As of April 2021, the Halodoc-Gojek operation is running seven drive-through vaccination clinics.[110] Gojek, Halodoc, and the Hermina Hospital Group are also operating a drive-through vaccination drive specifically targeting Gojek motorbike and car taxi drivers. This drive complements the government program to inoculate public service workers, including those working in transportation.[111] The vaccine procurement program is being led by the Indonesian Chamber of Commerce and Industry. The Health Ministry also partnered with Gojek's rival, Grab, in late February 2021 to run vaccine drives, with the aim of vaccinating 70% of the Indonesian population by March 2022. Grab's drive-through vaccination centre in Bali was the first of its kind in Southeast Asia.[112]

MALAYSIA

The Malaysian government began rolling out vaccines in late February 2021, beginning with front-line workers. To facilitate vaccination appointments, the MySejahtera app is being used to register for the vaccine and receive confirmation. Other methods of registration include a hotline, the Special Committee on COVID-19 Vaccine Supply Access Guarantee (JKJAV) website, public and private health-care facilities, and outreach programs in rural areas.[113] People eligible for the vaccine will receive two weeks' notice on the MySejahtera app regarding the time and place, along with reminders via SMS and text three days before the appointment. Adults can register both themselves and their dependants. Once a person has received two doses of the COVID-19 vaccine, they will be issued a digital vaccination certificate as proof.[114] According to JKJAV, approximately 34% of the population have registered for vaccines as of early April 2021.[115] In the private sector, Grab launched a program in February 2021 to promote vaccine access and education. The company announced that all Grab employees and their families would be given free vaccines if they were not covered by the national vaccination program. Grab also partnered with the government to display information about the COVID-19 vaccines on its app to combat disinformation and encourage vaccination.[116]

SINGAPORE

The Singaporean government launched a public distribution of five million masks in February 2020 amid news of stores running out of masks. The government used the Mask Go Where website to co-ordinate the effort.[117] Developed by the Government Technology Agency, the website tells Singaporeans their designated place, day, and time of mask collection based on their postal code and using real-time data.[118] Under the program, each household was entitled to a pack of four masks. The program was concluded on June 14, 2020.[119] In addition to the government program, Singaporeans also had access to private supply drives. Notably, the Temasek Foundation, the philanthropic arm of state-owned enterprise Temasek Holdings, launched four, two-week-long mask distribution programs.[120] Temasek started its programs in June 2020, complementing three earlier government-run programs. The Temasek program provided two free reusable masks per person, distributed via vending machines that scanned the barcode of any government ID.[121] Temasek's most recent supply distribution occurred in March and April 2021, distributing both masks and alcohol-free hand sanitizer.[122]

Singapore also has an extremely efficient vaccine distribution system in place, powered by a national virtual system that encompasses all 38 of the country's vaccination centres. As of mid-April 2021, the system was processing 50,000 vaccination records a day for both Singaporean citizens and foreigners living in Singapore.[123] Singaporean residents register for vaccination appointments on a government website using their names and phone numbers and receive a unique booking link within a few days to a week later. The booking process includes a questionnaire about physical health and allergies that must be answered before an appointment slot is provided. Vaccination appointments at national hospitals can also be made through the government health app, Health Hub, which also tracks COVID-19 test results and stores a digital copy of vaccination certificates once a person has been fully vaccinated.[124]

SOUTH KOREA

During the earlier stages of the pandemic, South Korea suffered from a severe shortage of masks. Hence, Seoul introduced the Official Mask Sales System on February 29, 2020, which sought to limit hoarding and ensure fair distribution for everyone. While the Official Mask Sales System itself was not digital, its operation was dependent on datasets from the Health Insurance Review & Assessment Service (HIRA), such as the Drug Utilization Review program, a nationwide database that shows a patient's real-time health history as it is pertinent for prescribing medicine, to which both doctors and pharmacists have

access.[125] The Official Mask Sales System also relied on information from the Ministry of Food and Drug Safety, the National Information Society Agency (NIA), and the Ministry of the Interior and Safety (MOIS).[126]

Collaborating with partner agencies like NIA and MOIS, HIRA managed the data – such as mask inventories and pharmacy locations – and disclosed it to inform the public.[127] HIRA also managed the sales of masks in pharmacies, allowing South Koreans to purchase their masks in any pharmacy, while preventing hoarding, as the program displayed whether an individual exceeded their weekly quota of two masks per week or not. Further, NIA and private developers used the data on mask availability to create websites and apps that displayed real-time availability of masks in each pharmacy. These tools provided centralized, real-time data on mask distribution that stabilized the supply at the onset of the pandemic.[128]

As for vaccine distribution, the KCDC has a centralized online booking system, much like that in other countries. A noteworthy innovation is the agency's collaboration with South Korean tech giants Naver and Kakao (equivalent to Google and Facebook/WhatsApp), through which doses of vaccines newly available in nearby pharmacies or clinics as a result of cancellations or no-shows are displayed on their map app so that doses are not wasted.[129]

TAIWAN

Taiwan's name-based mask rationing system improved through its three phases by introducing several tech solutions as it developed. To address the problem of panic-buying and stockpiling during the early days of the pandemic and ensure sufficient mask supply, Taiwan's Ministry of Health and Welfare implemented the Mask Rationing Plan 1.0. It leverages the pre-existing National Health Insurance (NHI) database, with a near-universal 99% coverage rate, to distribute surgical masks through NHI-contracted pharmacies across Taiwan. The system then incorporated a real-time mask-availability map, leveraging crowdsourced information from the public, that provides users with information on mask inventories in their proximity in version 2.0. Mask Rationing Plan 3.0 further allows users to make online purchases and reservations for convenient store pickup on the NHI mobile app.[130] As such, the use of digital means greatly improved the rationing system's efficiency and helped minimize physical contact during lineups. In return, digitizing the mask distribution process also allows data to be reported back to the system, thus providing timely feedback for further planning and decision-making in the subsequent management and allocation of medical resources.[131]

Telehealth

INDONESIA

Indonesia has several telemedicine resources, led by private sector tech startups. Halodoc, in collaboration with Gojek, launched the Check COVID-19 app, which screens users who have COVID-19 symptoms.[132] The app guides users through automated questions about symptoms, and then classifies them into low, medium, or high risk. Those with medium- or high-risk ratings proceed to an online chat with a doctor while those with a low-risk rating are informed about preventive health procedures. Through the rating procedure, the Halodoc-Gojek app helps take the stress off of hospitals in Indonesia. Halodoc has also partnered with Blibli (an e-commerce site) to enable access to Check COVID-19 on the Blibli site. Halodoc also released a new feature for its telemedicine service for booking rapid tests and swab tests online.[133] Alodokter is another app also providing online consultations with doctors through an app, recording 32 million visits in March 2020 alone.[134] Both Alodokter and Halodoc have AI chatbots where users can access information about COVID-19 for free. Gojek's own COVID-19 Info Centre also has access to Halodoc's telemedicine app, enabling users to get medication and schedule rapid COVID-19 swab tests in addition to the online medical consultations.[135]

GrabHealth, powered by Good Doctor, is another telemedicine alternative. It provides round-the-clock medical consultations and also provides medicine purchases and deliveries.[136] Meanwhile, Indopasifik Teknologi Medika Indonesia has created a pharmacy app called Lifepack that allows users to order medication and consult doctors for prescriptions, all online.[137] In addition to startup initiatives, there have also been public-private partnerships, such as a collaboration between the Ministry of Health, ride-sharing service Grab, and digital health app Good Doctor Technology Indonesia to allow COVID-19 screening online and give users access to advice from doctors based on their symptoms, thereby reducing hospital inflows.[138]

JAPAN

In Japan, the Medical Practitioners Act (1948) requires doctors to meet with their patients in person, technically.[139] Therefore, telemedicine had been restricted to a limited number of specific diseases, and there were many restrictions on treatment rules that prevented doctors from introducing telemedicine services.[140] However, following the COVID-19 outbreak, the Ministry of Health, Labour, and Welfare (MHLW) issued a guideline for online treatment, which has temporarily allowed doctors to provide telemedicine

treatment, and Tokyo proceeded to make this change permanent even after the pandemic ends.[141] Over 10,000 clinics have started to offer telehealth (telephone and online) since the beginning of the pandemic.[142] LINE, a messenger app with over 84 million users in Japan, collaborated with the MHLW to provide telehealth services related to COVID-19, and announced the plan to roll out a telehealth specific app. Startups such as Medley and MICIN, which provide telehealth platforms for doctors, have seen an uptick in sign-ups as well.[143]

MALAYSIA

In Malaysia, the primary means of accessing digital health services is through the website DoctorOnCall. DoctorOnCall is a telemedicine service that enables users to consult doctors and order medicine using video call, audio call, or chat on their smartphones or computers.[144] Patients can also upload medical reports or pictures of physical symptoms (e.g., rashes).[145] DoctorOnCall strives to make health care more accessible to Malaysians by reducing wait times and offering remote service.[146] The service was founded in 2017 but has become increasingly important during the COVID-19 pandemic.[147] In February 2020, the Ministry of Health announced a partnership with DoctorOnCall to provide free health advisory services related to COVID-19, in an effort to stem disinformation about the pandemic and reduce the need to physically visit health facilities for advice.[148] The COVID-19 portal also offers a self-assessment test with the option of consulting with a doctor to verify symptoms and get advice on next steps.[149]

CHINA

Innovation in delivering health care virtually has been an ongoing trend in China prior to the pandemic as part of the greater effort in promoting Internet Plus Health Care. The pandemic accelerated this trend by prompting many first-time users to switch from in-person medical visits to online consultations, for both COVID-19-related services and other health concerns. Ping An Good Doctors, the health-care arm of insurance giant Ping An, launched a service through its app in the early days of the pandemic to virtually link over 10,000 medical professionals to users seeking consultation on the new disease.[150] Similar services were offered by Ali Health (run by Alibaba and available through the Alipay app) and WeDoctor (run by Tencent and available through the WeChat app), which are easy to access and easy to use.[151] These telemedicine platforms are also used by the country's primary-care system to offer a more efficient, time-saving alternative to patients who need follow-up treatments for common illnesses or chronic diseases during the pandemic,

alleviating workload for front-line medical workers and minimizing COVID-19 infections during hospital visits. Experiments with blockchain and robotic technologies have been initiated to find ways to deliver medications more easily and quickly to patients in need.[152]

For the country's immunization campaign that started in December 2020, provinces launched various local versions of online appointment booking platforms, mostly available through a mini app inside WeChat or as a stand-alone mobile app. In Shanghai for example, vaccination appointments are booked through the pre-existing health-care app "Health Cloud," where many users already have health profiles set up.[153] When making an appointment, the app provides users information on the date and location of vaccine availability and gives real-time updates on any changes that occur after the booking. Some modifications and customizations have been made to the vaccine booking functions to better cater to the needs of certain groups of people. Elderly people who have difficulties coping with the digital means can book instead through the lite version of Health Cloud available at physical terminals in their neighbourhood, with a much-streamlined process.[154]

SINGAPORE

Singapore has a well-structured telemedicine sector regulated by the Ministry of Health under the Licensing Experimentation and Adaptation Programme Regulatory Sandbox launched in 2018, with the aim of thoroughly exploring potential risks in the telemedicine industry.[155] The government aims to fully license telemedicine by 2022 under the Healthcare Services Bill.[156] In February 2021, the government closed the sandbox program and announced the beginning of the transition to fully licensed telemedicine. While the transition is in process, the government released a voluntary listing of telemedicine providers that have met certain requirements and are authorized to provide services.[157] With the release of the list in February 2021, the Ministry of Health also provided a statement highlighting the importance of telemedicine in fighting COVID-19.[158] As of April 2021, there are over 600 authorized telemedicine providers on the list.[159] A notable telemedicine service is the Doctor Anywhere app, which provides doctor consultations through its virtual clinic (video calling) medication delivery services.[160] The video consultations cost between $15 and $20 per call and are run by medical doctors licensed by the Singapore Medical Council.[161] The number of app users increased three to four times since January 2020.[162]

VIETNAM

In the private sector, Singapore-based health startup, Doctor Anywhere, has been operating since 2019, offering 350 telemedicine consultations a day – a 600% increase since the start of the COVID-19 pandemic.[163] Some of Doctor Anywhere's key local partners in Vietnam include Saigon Eye Hospital, DoLife Hospital, and Thu Cuc Hospital.[164] Vietnam also has home-grown telemedicine initiatives, such as VieVie, Jio Health, and MyDoc.[165] VieVie is an app founded in 2017 that allows Vietnamese residents to access doctor consultations by registering with a cell phone number.[166] Patients have the option to either use chat messages or call a doctor. Although use of the app is generally free, certain services can only be accessed by paying for the premium subscription service, VieVie Gold.[167] Another option is Jio Health, a telemedicine app founded in 2014 in the United States that later relocated to Vietnam.[168] Jio Health has a physical clinic in Saigon in addition to its app services.[169] Finally, there is Docosan, which specializes in a booking system to help manage crowded waiting rooms and connect patients with health specialists using a cloud-based scheduling system.[170] The app is a free directory to find and make appointments with health-care professionals in Hanoi and Ho Chi Minh City. The app also enables patients to manage their own medical records by integrating e-payment and insurance services in the app.[171]

In April 2020, the Ministry of Health partnered with the Ministry of Information and Communications to launch new telemedicine projects in response to the increasing importance of remote medical services during the COVID-19 pandemic.[172] For example, the Hanoi University Medical Hospital ran a two-month pilot digital hospital project to test remote doctor-to-patient communications.[173] The Ministry of Health also approved the remote health examination and treatment[174] project for 2020-2025 to further develop national telemedicine programs.[175]

ABOUT APF CANADA

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The Asia Pacific Foundation of Canada (APF Canada) is a not-for-profit organization focused on Canada's relations with Asia. Our mission is to be Canada's catalyst for engagement with Asia and Asia's bridge to Canada.

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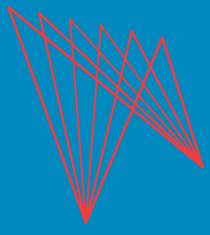

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