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Combating COVID-19 with ICT: Effective Practices and Policies in the Asia Pacific Region

Combating COVID-19 with ICT: Effective Practices and Policies in the Asia Pacific Region

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List of Acronyms

AI	Artificial Intelligence
APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development (United Nations)
App	Applications
AP	Asia-Pacific
COVID-19	Coronavirus Disease of 2019
CWC	Communication with Communities
EHR	Electronic Health Record
ICT	Information and Communication Technology
ICT4D	Information and Communication Technology for Development
ICU	Intensive Care Unit
IDPC Act	Infectious Disease Control and Prevention Act
ILO	International Labour Organization
MERS	Middle East Respiratory Syndrome
MSME	Micro, Small, and Medium Enterprises
PPE	Personal Protective Equipment
R&D	Research and Development
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
WHO	World Health Organization

Background

The world as we know has changed significantly with the rapid spread of the SARS-CoV-2, which causes the COVID-19 disease. At the time of writing this paper, officially, around 28,329,790 people worldwide are diagnosed with COVID-19 and 911,877 of these patients are deceased¹. The United States of America is the country with the highest number of COVID-19 positive cases and has the highest mortality rate (6,341,309 confirmed cases of COVID-19 with 190,787 deaths)². The World Health Organization (WHO) has declared it as the worst global outbreak since the Spanish Flu in 1918³. In the Asia-Pacific (AP) region, the situation is a mixed bag. On one hand, there are many countries in this part of the world with an increasing number of COVID-19 cases. On the other hand, countries like the Republic of Korea, Singapore, Viet Nam, etc. are praised as standard setters for successfully controlling the outbreak of this disease. Figure 1 depicts the global spread of COVID-19 (until week 1 of 2021)

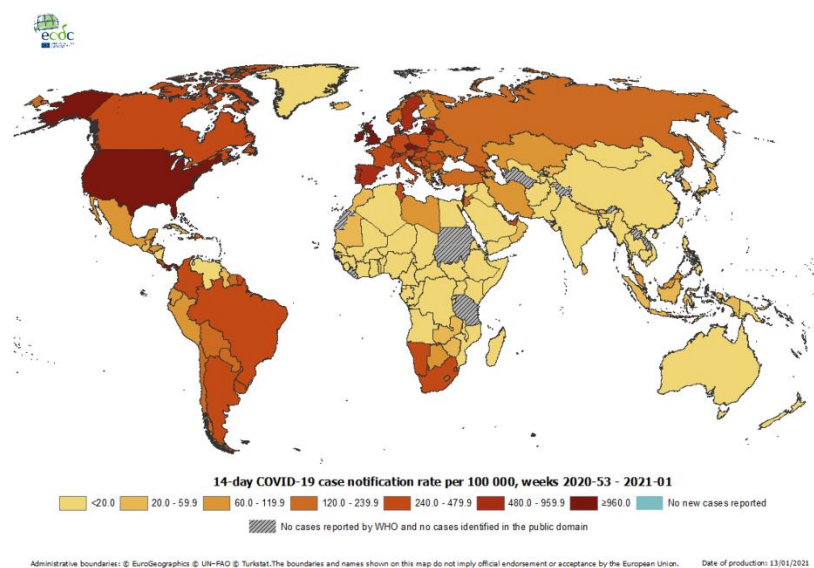


FIGURE 1: GLOBAL DISTRIBUTION OF COVID-19 CASES⁴

ICTs and COVID-19

This global pandemic has affected our normal ways of lives, both at personal and collective levels. The global supply chains and networks for socio-economic and political exchanges, transitions, and interactions are severely disrupted. Public sectors (e.g., health, education, commerce, manufacturing, agriculture, transportation, etc.) in every country are stretched thin, and the situation is especially getting worse for the developing and emerging economies (many of which are in the Asia-Pacific region). Shortage of human and logistical resources, absence of effective policies, lack of proper infrastructure are all adversely affecting the overall fight against COVID-19 in different parts of our world. On such a backdrop, Information and Communication

¹ <https://covid19.who.int/>

² <https://covid19.who.int/region/amro/country/us>

³ <https://www.cdc.gov/flu/pandemic-resources/1918-commemoration/1918-pandemic-history.htm>

⁴ <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

Technologies (ICTs) have emerged as a set of tools, platforms, work methods, which seem to have the ability to assist humanity in its struggle against this global pandemic.

ICTs have been an integral element of modern development. The different transcending and effective applications of ICTs have facilitated sustainable and positive changes in peoples' lives at micro as well as macro levels. The integration of ICTs in creating people-centric services and applications for the health sector has been going on for decades in different parts of the world. With the rapid proliferation of internet penetration, mobile services, and social networks, the integration of mobile and online health solutions, powered by ICTs is fast becoming a regular feature all over Asia and the Pacific. Peltzer highlighted the importance of ICTs in communicating across numerous communities, with the ability to reach the most marginalized groups as well, given that the solutions are developed and deployed with the digital divide in mind⁵. In numerous developing regions' contexts, ICT options are used for critical health applications, such as the detection and surveillance of novel viruses and promotion of life-saving immunization programs⁶⁷. Galaz mentioned that ICTs could provide significant assistance in any type of pandemic situation as well. Development of early warning systems, trans-border networks for global health governance, affordable communications support, real-time citizen services are some of the common services enabled by ICTs during a global crisis⁸.

For the current COVID-19 crisis, we are observing a plethora of ICT innovations and applications around the globe. Until now, we have seen the use of ICTs for a range of citizen services. People in global north and south alike are using ICTs to communicate the most up-to-date pandemic-related information to people seamlessly to detect potential infected people, to predict possible outbreaks, to develop protective gears (e.g., 3-D printing ventilators, face-shields, gloves, etc.), to manage the huge amount of sensitive health information, etc.

Combating Covid-19 with ICTs: Key Initiatives in the Asia-Pacific Region

The Asia-Pacific region is one of the most innovative regions to be when it comes to ICT access, innovations, and applications. At the same time, we have observed uneven connectivity and a digital divide across the region. According to a pre-COVID research, at the start of 2020, the total number of active mobile phone connections was greater than the entire Asia-Pacific population. The same study showed that approximately, 56 per cent and 50 per cent of this region's population are using the Internet and social media actively, as displayed in Figure 2.⁹

⁵ Peltzer K. Application of information and communication technology (ict) in combating human immunodeficiency virus (hiv) and acquired immune deficiency syndrome (aids) in south africa: health wellness. *African Journal for Physical Health Education, Recreation and Dance* 14 (2008) 143–162.

⁶ Hai-Jew S. Ict4d and its potential role in the detection, surveillance, and prevention of novel zoonotic disease outbreaks for global, national, and local pandemic prevention. *Human Rights and the Impact of ICT in the Public Sphere: Participation, Democracy, and Political Autonomy* (IGI Global) (2014), 94–143.

⁷ Amicizia D, Domnich A, Gasparini R, Bragazzi NL, Lai PL, Panatto D. An overview of current and potential use of information and communication technologies for immunization promotion among adolescents. *Human vaccines & immunotherapeutics* 9 (2013) 2634–2642.

⁸ Galaz V. Pandemic 2.0: Can information technology help save the planet? *Environment: Science and Policy for Sustainable Development* 51 (2009) 20–28.

⁹ <https://wearesocial.com/digital-2020>



FIGURE 2: OVERVIEW OF DIGITAL TECHNOLOGY ACCESS IN ASIA-PACIFIC

Consequently, ICTs have been at the forefront of combating COVID-19 for private and public stakeholders across the region. Some Asia-Pacific countries (e.g., Republic of Korea, China, Singapore, etc.) had experiences using ICT innovations to manage the MERS and SARS outbreaks, which were on a smaller scale in comparison to the Covid-19 pandemic.¹⁰

For this research, in the upcoming sections, we have highlighted some of the effective ICT innovations and practices in dealing with COVID-19 in the following sectors: Healthcare, Communication with Communities, Education, Business, and Infrastructure. In this work, we will categorize all the highlighted COVID-19 related ICT-centered interventions or trends using a newly introduced multi-dimensional evaluation model. In 2005, Tongia et al. proposed that the value of ICT for a user depends on four interrelated features, the so-called '4As' of ICT for Development (ICT4D)¹¹:

- **Awareness:** people must know what can be done with ICT and they must be open to using ICT.
- **Availability:** ICT must be offered with reasonable proximity, with appropriate hardware/software.
- **Accessibility:** relates to the ability to use the ICT, spanning literacy, e-literacy, language, and interfaces.
- **Affordability:** all ICT usage together should, ideally, be only a small percentage of one's income (under 10 per cent maximum on average); this covers life-cycle costs, spanning hardware, software, connectivity, and education.

Other researchers argue that the presence of the **4A** factors can be further strengthened by **Inclusive** and **Interoperable** systems, and robust **infrastructure**. In order to achieve better collective actions among different parts of the world facing similar challenges; we would also need sustainable **inter-governmental co-ordinations**¹². Holistically, we can consider these two sets of ICT for Development value propositions as the **4 A-I model**. All the major ICT-centered interventions and/or trends that we are going to mention will be analyzed using this **4 A-I** lens. Such an exercise is in no way going to be an exhaustive one. However, we believe the **4 A-I** categorizations will provide some valuable insights for future implementations, impact analyses, and policy formulations in the field of ICTs combating COVID-19.

¹⁰ <https://www.niaid.nih.gov/diseases-conditions/covid-19>

¹¹ http://www.cs.cmu.edu/~rtongia/ict4sd_book.htm

¹² <https://doi.org/10.1080/13552074.2018.1475924>

Healthcare

As we are dealing with a global pandemic, by default, the majority of ICT-based initiatives are healthcare focused. In order to better classify these ICT applications, we elaborate some of the key examples under the subsections of COVID-19 testing, tracing or tracking, and treatment. These three action-items have been identified as the most important elements for successfully combating COVID-19, especially during this ongoing period, when we do not have access to any effective vaccination options¹³.

ICTs for testing COVID-19

The Republic of Korea is a world leader in successfully harnessing the potential of ICTs while dealing with COVID-19. On January 20, 2020, this country detected its first COVID-19 patient¹⁴. However, it was in Daegu on February 18¹⁵, that the major outbreak of COVID-19 took place, raising alarm for greater pandemic-related catastrophes. A Korean biotech company, Seegene, developed a COVID-19 diagnostic kit using ICTs. This company used high-performance computing and AI algorithm to drastically shorten the development cycle of a diagnostic kit from several months to only two weeks and received a European certification, a further proof of its effectiveness¹⁶. At the early stage of any COVID-19 outbreak, rapid deployment of Seegene's diagnostic kit can help its adopters to contain it. In addition to the AI-powered rapid testing, this innovative technology helped the Korean researchers and healthcare professionals provide an adequate response, based on the severity of the patients. Vuno, Lunit, and JLK inspection are some of the Korean companies, which are using AI algorithms to test a huge number of chest X-ray data, and finding out the presence or absence of major COVID-19 symptoms. Vuno's AI algorithm can find out in three seconds whether a patient needs to be in an intensive care unit (ICU) after reading her/his lungs' X-ray impressions. In addition, AI-powered image analysis algorithms are also installed in portable X-ray equipment in many of the COVID-19 screening centers and ambulances, decreasing the time required for disease diagnosis and relevant treatment¹⁷. Figure 3 shows the AI-powered deep learning technology, performing chest X-ray.

¹³ Flattening the curve on COVID-19: How Korea responded to a pandemic using ICT
(http://www.moef.go.kr/com/cmm/fms/FileDown.do?atchFileId=ATCH_000000000013739&fileSn=2)

¹⁴ <https://www.mk.co.kr/news/society/view/2020/01/80017/>

¹⁵ <https://www.theguardian.com/world/2020/feb/22/coronavirus-south-korea-sees-huge-jump-cases-china-hubei-wuhan-outbreak->

¹⁶ Pg. 21, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

¹⁷ Pg. 24, <https://www.mk.co.kr/news/society/view/2020/01/80017/>



FIGURE 3: AI-POWERED DEEP LEARNING TECHNOLOGY FOR X-RAY TESTS¹⁸

There are many places within the Asia-Pacific region where rapid testing for COVID-19 is not possible, due to either resource constraints or absence of good infrastructure. In such places, simpler ICT interventions can help to quicken the test process as well. For example in China, during the nascent stage of the pandemic, many of the rural areas did not have rapid testing facilities. For these people, the Chinese Government introduced web-based solutions. The potential patients gave call to a common helpdesk and shared their current physical conditions. If many of the symptoms match with a COVID-19 positive patient, the corresponding caller is directed to the nearest specialized health facility. The Chinese government moreover used machine intelligence to analyze the mobile phone-based surveys. It helped them to identify some emerging patterns related to COVID-19 clusters, potential outbreak spots, and the probable levels of exposure to this infectious disease by the callers¹⁹.

The Cambodian Government repurposed an existing low-tech ICT option, its 115 Hotline, as an effective digital response for COVID-19. In addition to the regular calls for health education, the general population has been encouraged to reach out to their government to inform about possible COVID-19 cases. In the absence of a more sophisticated ICT option, this traditional hotline worked as an effective interface for successful COVID-19 patient detection drive.²⁰

The government in Indonesia started a psychological consultation service over phone (by dialing extension 8 on the National COVID-19 hotline of 119). The goal is to ensure general population's mental health during the COVID outbreak. After dialing the hotline, any caller, based on his or her needs, can receive consultation from one of the 162 volunteer psychologists from the Indonesian Psychology Association (HIMPSI).²¹

ICTs and Tracking COVID-19

The Republic of Korea is a global leader for tracking COVID-19 patients successfully and consistently, since this pandemic hit the peninsula. There are many ICT-centric initiatives taken by the Government of the Republic of Korea in order to ensure a sustainable, adaptive, and state-of-the-art COVID-19 tracking mechanism. The Korean Government, in close collaboration with

¹⁸ Pg 25, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

¹⁹ <https://academiccommons.columbia.edu/doi/10.7916/d8-hbbh-e863>

²⁰ <https://www.ictworks.org/cambodia-115-hotline-digital-response/#.X16-HmhKg2x>

²¹ <https://www.thejakartapost.com/life/2020/04/29/psychological-consultation-hotline-launched-in-virus-stricken-indonesia.html>

the private ICT sectors and academia, came up with a series of mobile and web-based applications and services. All these can be classified into three categories: Self-diagnosis App, Self-quarantine Safety App, and Smart Quarantine Information System.

The self-diagnosis application mainly monitors the inbound travelers to the Republic of Korea and provides them with correct medical advice promptly. At the time of writing, all passengers arriving in the Republic of Korea are required to install this app on their smartphones, by providing all the updated immigration as well as health information. The users of this app are required to report their health conditions (including all the symptoms that can be related to COVID-19) on a daily basis, during the mandatory 14-day quarantine period after their arrival. This data is then analyzed, and appropriate actions are taken for people with worsening health conditions, in coordination with the local governments and the Korean Center for Disease Control and Prevention (KCDC). In case of non-compliance or failure in updating health and other information regularly, the users of this app receive system-generated notifications on a regular interval. Further lack of activity can prompt in-person visits from the local police station, which has access to all the required immigration and health data of the non-respondents. This unique blend of human-system interfacing in dealing with COVID-19 diagnosis has resulted in substantial success for the Korean government in controlling the spread of the pandemic. Figure 4 summarizes the main functionalities of the Self-diagnosis App²².

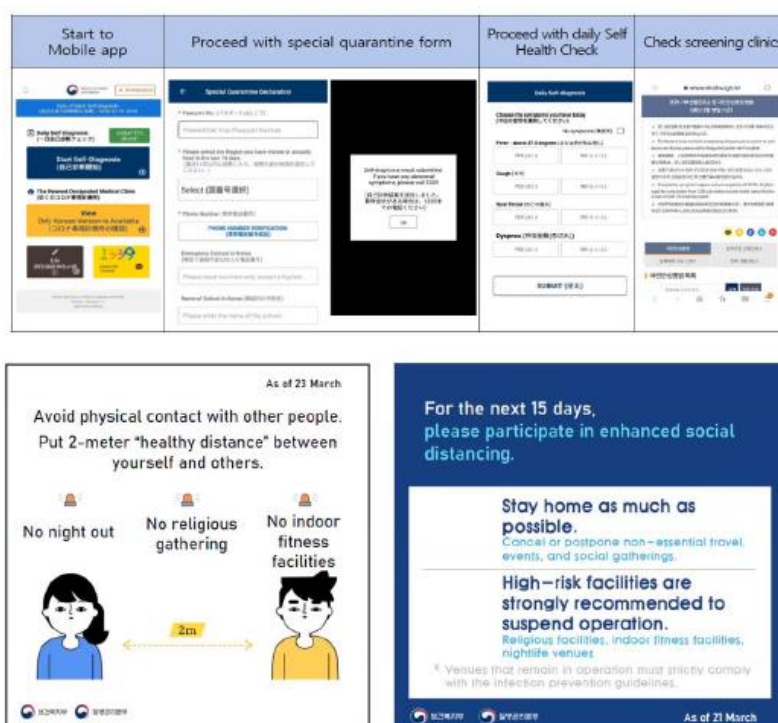


FIGURE 4: SELF-DIAGNOSIS MOBILE APPLICATION FOR COVID-19

The Korean Government has developed a smart quarantine information system as well, which helps them to conduct real time, in-depth epidemiological investigations based on the contact

²² Pg. 31, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

tracing data. Figure 5 summarizes the workflow of the smart quarantine information system using roaming data²³.

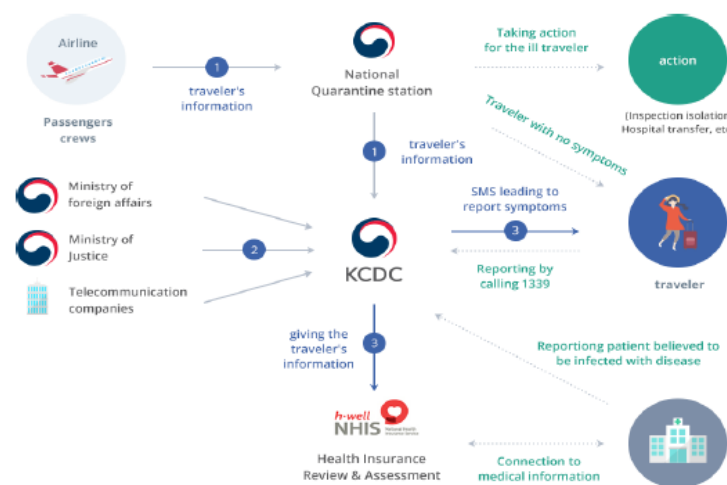


FIGURE 5: SNAPSHOT OF A SMART QUARANTINE INFORMATION SYSTEM

Similarly, in Singapore, the Government has been quite successful in controlling the COVID-19 spread and a range of ICT applications contributed to this success. More specifically, Singapore's COVID-19 contact tracing effort helped to develop an in-depth mapping of any newly discovered patient within the first 24 hours of the detection, using a mixture of ICTs and around 100 contact tracers²⁴. Singapore Government's TraceTogether application is available for any phone set with a Singapore mobile number and Bluetooth capability. Using this application, government agencies can detect whether the phone owners have been in close contact (less than five meters) with a COVID-19 patient²⁵.

In addition to the individual level, businesses are also required to use a tracing mechanism to ensure greater safety for the community from COVID-19. In New Zealand, all businesses were required to display their official NZ COVID Tracer QR code posters near the entrances of their businesses. This QR code communication for businesses was mandatory for the country alert levels 2 and 3.²⁶ The Ministry of Health and Medical Services of Fiji implemented a nationwide eHealth system (Surveillance Outbreak Response Management and Analysis System or SORMAS) that enabled early COVID-19 detection using real-time digital surveillance. Beyond the urban centers, SORMAS worked with the peripheral healthcare infrastructures in Fiji too²⁷.

The NCOVI application of Viet Nam²⁸ and MorChana application of Thailand²⁹ are other successful ICT interventions for COVID-19 contact tracing in the region. Taiwan Province of China

²³ Pg. 42, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

²⁴ <https://knowledge.wharton.upenn.edu/article/singapore-south-korea-taiwan-used-technology-combat-covid-19/>

²⁵ <https://www.tracetoegether.gov.sg/>

²⁶ <https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-novel-coronavirus-resources-and-tools/nz-covid-tracer-app/nz-covid-tracer-qr-codes>

²⁷ https://sormasorg.helmholtz-hzi.de/About_SORMAS.html

²⁸ <https://apps.apple.com/vn/app/ncovi/id1501934178>

²⁹

https://apps.apple.com/th/app/allthaialert/id1505185420?branch_match_id=719443404369189740&utm_source=10april&utm_campaign=10april&utm_medium=marketing

is one of the other most successful regions in combatting the COVID-19 pandemic. The Government here used the collated databases of immigration and national insurance to create a unified big data platform for contact tracing, quarantine management, and other analytics. This system enabled the Government to issue real-time warning to any targeted population group about any potential infected individual³⁰.

ICTs and COVID-19 Treatment

Automation in healthcare received a great push with the COVID-19 pandemic and China, has been the leader in this effort. One of the major hospitals in Wuhan, the Wuchang Hospital, was completely transformed into an IoT enabled smart space to provide better treatment for the patient without compromising the safety of the healthcare workers. In this case, China Mobile and a robotics company, Cloud Minds closely collaborated to introduce robots and primary service providers. During the time of admission in this hospital, the patients used 5G enabled thermometer and smart wearables like rings and bracelets, which sent real time updates about every patient to the main hospital information system. Besides this hospital, Cloud Minds installed 100 robots in other hospitals within China for carrying food and medicine for the COVID-19 patients.

Aside from the physical automation, ICTs have been instrumental behind the rapid research and development process of humanity, fueling the race towards finding a cure for this paradigm-shifting global health crisis. The Korean health sector, comprising public-private-academia affiliated stakeholders, is using AI for the development COVID-19 medications. The use of artificial intelligence is assisting the entire R&D process to reduce time necessary for this work. Different Korean companies are using AI supported deep learning algorithms to predict the numerous interaction outcomes between the proposed drugs and viral proteins. A Korean AI-driven drug-discovery start-up is using bioinformatics and pharmacogenomics to treat COVID-19 more effectively. In Figure 6, we can see the repurposing of medication done by a Korean company using AI-driven analyses to combat COVID-19.

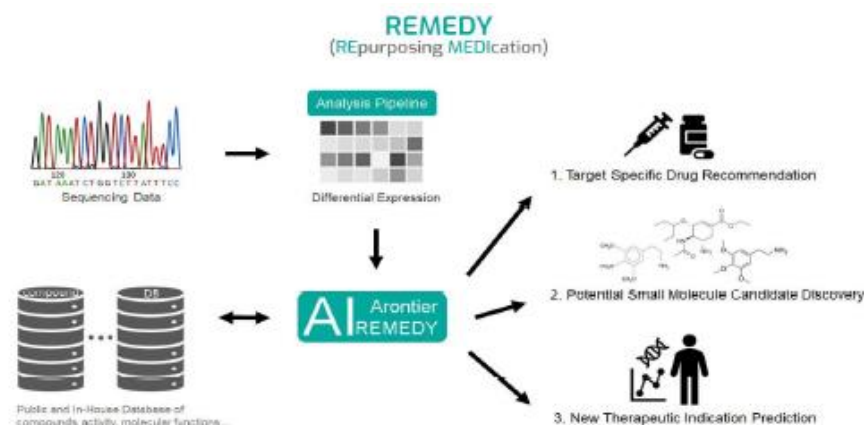


FIGURE 6: AI-DRIVEN ANALYSIS FOR COVID TREATMENT

³⁰ <https://knowledge.wharton.upenn.edu/article/singapore-south-korea-taiwan-used-technology-combat-covid-19/>

Key Take-Away Messages

- *A robust ICT infrastructure is important for the success of any country's fight against COVID-19*
- *Interoperability between different healthcare systems within a country is crucial, backed up by friendly ICT policies*
- *Repurposing low-tech interventions to combat COVID-19 is necessary in the case of resource scarcity*
- *Inter-governmental coordination is required for any COVID-19 tracking/tracing initiative to succeed in the long term*

Communication with the Communities (CwC) on COVID-19: ICT Applications and Innovations

One of the most important tasks for any government in the COVID-19 pandemic is to communicate about the disease to its population. As the threat of the Coronavirus increased with time in different parts of the world, people have sought information on Covid-19 related parameters: the daily infection rate or positive case rate, daily death rate, total number of death in a certain area/country/region, total number of available ICU seats, address of the COVID-19 treating medical facilities, etc. We have observed the use of ICTs by different public and private entities to communicate such information and more for the public. According to United Nations Division of Economic and Social Affairs (UNDESA), by early April 2020, around 86 per cent (167 in total) countries of the world have developed some forms of public information portal to communicate about COVID-19³¹. In many instances, such communications have been quite successful, and were effective in communicating the messages to the target audience. However, we have found some significant disconnections between information providers and the intended recipients or communities as well.

Big Data and Data Analytics

The most common ICT-based interventions, adopted by both the affluent and the developing countries alike have provided some form of online/offline dashboards on COVID-19 outbreaks. The Singapore Government is providing a network visualization of confirmed cases through its dashboard. It also has provisions for online donation from the citizens³².

³¹ <https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-61-covid-19-embracing-digital-government-during-the-pandemic-and-beyond/>

³² <http://sil-asia.org/asias-ict-tools-against-covid19/>

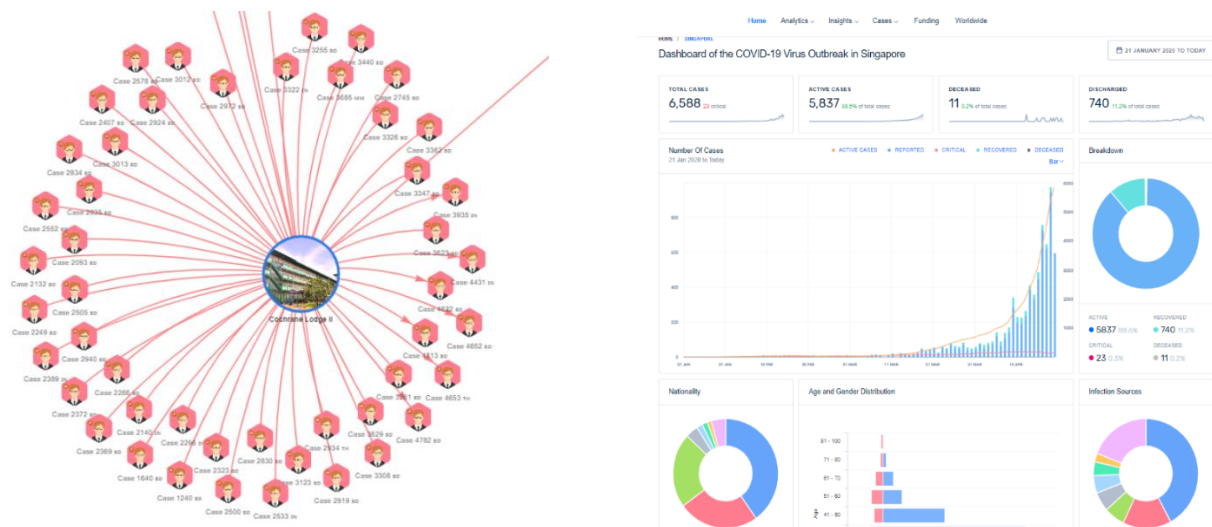


FIGURE 7: THE USE OF BIG DATA TO COMBAT COVID-19

In Malaysia, in addition to some common statistics, the Kitajagakita website facilitates solicitation for funding projects with the goal of helping people directly affected by the COVID-19 related lockdown³³. The dashboard created by the Viet Nam Government provides updated aggregated information about case reports and recoveries per locality. Moreover, it provides the option for its users to ask questions online and to report fake news³⁴. In Hong Kong, China, users have access to in-depth information about the spread of COVID-19. This dashboard publishes a building-by-building map, reflecting the actual number of cases in each address of the entire city³⁵.

Mask Information Service

The Korean Government, alongside its partnership with private companies, presented another effective ICT application for facemask distribution. In order to avoid hoarding of essential masks and to avoid any sort of confusion related to its supply information, Mask Information Service was introduced online and through mobile platforms, with active collaborations from around 150 web and app services. All these services are providing real time information on the availability of masks in the government approved pharmacies, marts, and post offices. The government also regulated the number of masks any individual can purchase within a certain period. Furthermore, the option for proxy purchasing is also available to accommodate the physically unable and under-age population. Figure 8 elaborates the workflow diagram of the Korean Mask Information System³⁶.

³³ <http://sil-asia.org/asias-ict-tools-against-covid19/>

³⁴ <http://sil-asia.org/asias-ict-tools-against-covid19/>

³⁵ <https://academiccommons.columbia.edu/doi/10.7916/d8-hbbh-e863>

³⁶ Pg. 56, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

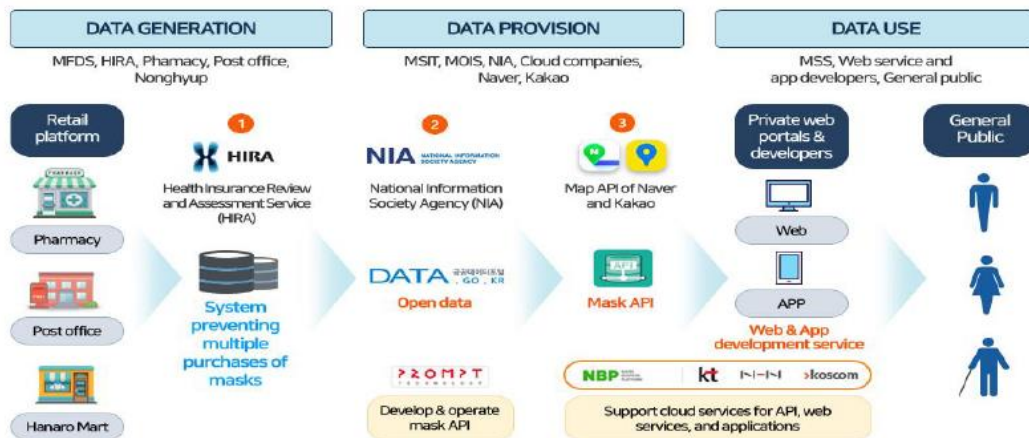


FIGURE 8: SNAPSHOT OF A MASK INFORMATION SYSTEM

Low-Tech ICT Solutions

In India, a voice-based community media platform (Mobile Vaani) has become very popular for supporting the hard-to-reach communities with low literacy and poor internet connectivity. It provides audio modules on COVID-19 related awareness building, fake news detection, etc., and gives its users option for giving feedback. Mobile Vaani programs can work in both smart and non-smart phones, thus ensuring a bigger reach of affected population (more than two million people) across ten states in India³⁷. Additionally, we have observed the use of web portals to manage mobility during nationwide lockdowns due to COVID. In Albania, the citizens are allowed to apply for permission to go outside their homes for some pre-defined and important reasons. In order to obtain the permission, all Albanians are required to access the e-Albania portal, and can only venture out after receiving real-time validation, sent to them via email/SMS³⁸.

Simpler ICT based solutions are also available in Central Asian countries. In Uzbekistan, a popular messaging service - Telegram is being used to raise awareness and distribute official notification related to COVID-19. This Telegram channel, "Koronavirusinfouz", has around 1.5 million followers in Uzbekistan. In both Kyrgyzstan and Kazakhstan, governments are using social media, online outlets, and 24/7 call centers to communicate information about COVID easily and without much cost for the citizens.³⁹

³⁷ The Coronavirus (COVID-19) Response ICT Case Repository, Mobile Vaani

³⁸ The Coronavirus (COVID-19) Response ICT Case Repository, Albania

³⁹ <https://www.voanews.com/science-health/coronavirus-outbreak/after-late-start-central-asia-takes-covid-19>

Key Take-Away Messages

- *The majority of ICT innovations and applications are focused on communication with the communities*
- *The Republic of Korea, Singapore, China are some of the global leaders for successfully utilizing big data and AI for CwC during COVID*
- *Most of the CwC ICT applications are not interactive and need to ensure more transparency and people's participation*

Local Entrepreneurships, COVID-19, and ICTs

According to the International Labor Organization (ILO), approximately 436 million enterprises around the world are facing severe disruption due to COVID-19 and many of these businesses are closing for good⁴⁰. Within the Asia-Pacific region, we are observing severe disruptions in the traditional supply-chain systems of almost all the businesses, both local and international. Amid such a grim situation, we have also witnessed some business innovations or enablers, facilitated by different Asia-Pacific governments and/or private stakeholders. Many of these options are low-tech ICT solutions with higher level of effectiveness, at times simply providing the interface to connect people or the information critical for running micro, small, and medium enterprises (MSMEs).

In Brunei Darussalam, during the pre-COVID time, people in general were not used to managing their daily shopping and smaller commercial activities online. Now, the Government wants to change this for good and is encouraging e-commerce based solutions for local MSMEs. At present, the directory website eKadaiBrunei.Bn is working as a nationally reachable, online platform, which connects general consumers, local businesses, and logistics and delivery services⁴¹.

⁴⁰ https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_743036/lang--en/index.htm

⁴¹ <http://www.ekadaibrunei.bn/>

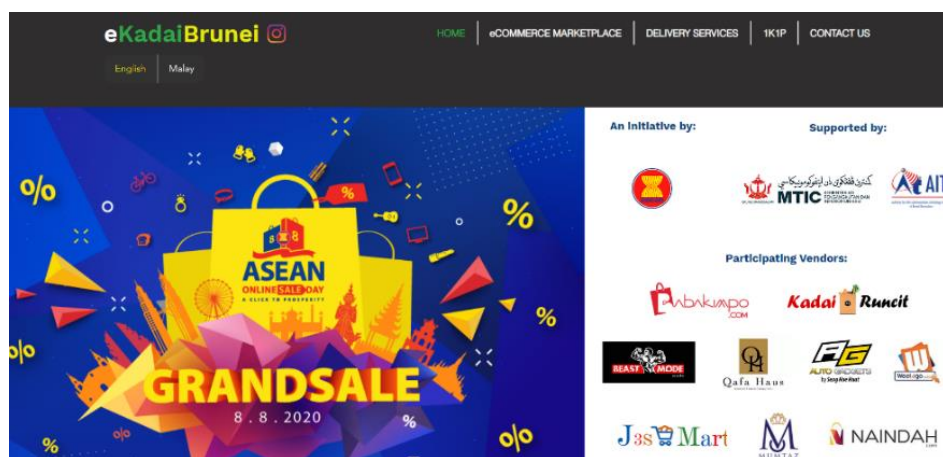


FIGURE 9: THE OFFICIAL E-COMMERCE PLATFORM TO HELP LOCAL ENTREPRENEURS IN BRUNEI

Similarly, in Indonesia, RegoPantes (meaning fair price) is functioning as an online marketplace for rural farmers in this time of COVID, facilitating direct connections between the agro-producers and communities of customers, thus keeping the value-chain alive⁴². In Bangladesh, in addition to the rapid rise in online shopping (primarily in the urban areas), the Government also implemented a mobile phone based shopping service, especially for the communities under strict lockdown. Under the “ekShop” service, anyone within a government-assigned lockdown zone can call “3333” to a national call center and convey their shopping wish list (from a set of pre-selected options). According to the citizens’ demands and based on the geolocation of the callers, a group of local volunteers acquires the goods, and ensures on-time delivery to the respective addresses. The exchanges of purchased items and money are done after taking all the required safety measures⁴³.

Besides enabling the online and mobile-based platforms for connecting suppliers-buyers, maintaining value chains, and accommodating daily shopping options for the people under government imposed lockdown, we have observed other relatively simpler yet effective ICT applications in Asia Pacific, which supports mobility of people to maintain economic productivity legally and without worsening the pandemic situation. In Kazakhstan, the Government has launched a free online service (AgroRuqsat). This web based citizen service can issue valid mobility permits for its farmers, so that these people can legally have access to their agro-productions without violating the official social distancing and isolation directives. The interested agricultural workers who need to be in the field for food production and sales, request for their mobility each time they need to go out at AgroRuqsat. Moreover, usually between a few minutes to 24 hours, an official response is communicated to the applicant individuals⁴⁴. On June 1, 2020, after the COVID-19 infection level decreased, the Kazakhstan Government stopped the operation of AgroRuqsat⁴⁵.

The COVID crisis and the consequent social distancing requirements have also created new entrepreneurial opportunities for many. In Senegal, a women-led e-payment platform PayDunya, got huge boost in their business after the regional governments started enforcing social distancing and mobility restrictions for the general population. According to Ms. Youma Dieng Fall, the

⁴² The Coronavirus (COVID-19) Response ICT Case Repository, Indonesia

⁴³ The Coronavirus (COVID-19) Response ICT Case Repository, Bangladesh

⁴⁴ The Coronavirus (COVID-19) Response ICT Case Repository, Kazakhstan

⁴⁵ <https://ruksat.akimvko.gov.kz/>

founder of PayDunya, the majority of her new clientele are from MSMEs in agricultural and pharmaceutical sectors.⁴⁶

With the goal of revitalizing the economy, the Chamber of Commerce and Industry in Uzbekistan has partnered with United Nations Development Programme to support small and medium enterprises. Jointly, they launched the "Business Clinic" program that offers free advisory services for entrepreneurs facing financial problems during the COVID crisis. This support from the business clinic can be accessed by any entrepreneur in Uzbekistan using a hotline (dialing 1094), through a Telegram channel (https://t.me/biznes_klinika), and via accessing a website (www.businessinfo.uz)⁴⁸. In Vanuatu, in order to ensure the continuity of citizen services, the Office of the Government Chief Information Officer provided VPN access to the public officials to connect themselves from home⁴⁹.

Key Take-Away Messages

- *SME industries are severely affected by COVID-19 related shut down of businesses across Asia and the Pacific*
- *Governments are enabling online and mobile-based platforms for connecting suppliers and maintaining value chains*
- *Governments are subsidizing electronic and mobile commerce services to enforce social distancing and physical lockdown to curb the spread of COVID-19*

Education, ICTs, and COVID-19

The COVID-19 pandemic severely affected the education sector globally. According to UNESCO, worldwide around 1.05 billion students are now out of their educational institutions due to respective government imposed shutdowns⁵⁰. The educators and students alike in many of the regions are now forced to adopt education services using ICT-enabled teaching and learning platforms. These ICT-dependent classes and related educational activities are done in real time, through asynchronous modes or through a hybrid combination of both along with limited in-person interactions.

Our research shows that there are some common challenges shared by majority of the educational institutions around the world. These include the abrupt disruption of effective, face-to-face education delivery, lack of effective educational content for online adaptations, scarcity of educators with sufficient trainings to facilitate online education, absence of proper educational

⁴⁶ <https://tinyurl.com/yyyykkpc>

⁴⁷ <https://www.uz.undp.org/content/uzbekistan/en/home/presscenter/pressreleases/2020/05/helping-uzbekistans-small-businesses-outlast-the-quarantine.html>

⁴⁸ <https://www.uz.undp.org/content/uzbekistan/en/home/presscenter/pressreleases/2020/05/helping-uzbekistans-small-businesses-outlast-the-quarantine.html>

⁴⁹ <https://publicadministration.un.org/en/Themes/Digital-Government/Good-Practices-for-Digital-Government>

⁵⁰ UNESCO (<https://en.unesco.org/covid19/educationresponse/globalcoalition>)

and ICT policies, etc. Overall, the digital divide has become a major factor in the provision of education⁵¹. Furthermore, the challenges faced in the education sector differ based on the varying levels and types of education. Experts mentioned that ICT integration and implementation processes are relatively easier at the tertiary level, with more experienced students and educators, when it comes to technology adaptation. The availability of online/ICT-based courses is also higher at this level. In comparison, at the other levels of traditional educations, countries are required to manage access, availability, and affordability of education content and learning options for a greater number of student communities, who are younger along with a diverse range of educational needs and aspirations. The situation becomes more challenging for regions with resource constraints. Thereby, policymakers and community leaders are required to make hard choices to prioritize resource allocations. Unfortunately, in many cases, the education sector suffers from scarcity of funding, as we have witnessed during this present pandemic⁵².

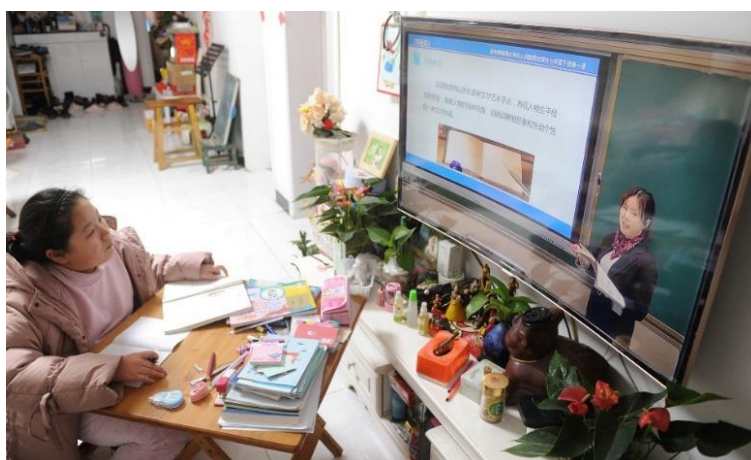


FIGURE 10: A STUDENT ATTENDING AN ONLINE CLASS IN CHINA⁵³

Irrespective of these numerous challenges, the governments of Asia-Pacific region are coming up with ICT-centric solutions for education. In many cases, these are low-tech but more sustainable options. For example, in Sri Lanka the TV media (both terrestrial and satellite) are used to provide education services. These over-the-air education programs are broadcasted through the state-owned TV stations as well as through the private TV channels freely. Such programs include live interactive teaching and feedback sessions. In addition, the Information and Communication Technology Agency of Sri Lanka (ICTA) is offering a collaborative management platform to ensure better communication between the government and the participating schools⁵⁴. Similarly, in Pakistan, the government is providing technology enabled academic learning for the schools closed for COVID-19 using the existing distance education program, Developments in Literacy (DIL)⁵⁵. Even with such efforts, the majority of the students in South Asia are not receiving much education at all, mainly due to poor ICT infrastructure, lower household income, fewer

⁵¹ <https://www.crpe.org/thelens/digital-divide-among-students-during-covid-19-who-has-access-who-doesnt>

⁵² <https://www.worldbank.org/en/topic/edutech/brief/edtech-covid-19>

⁵³ <https://www.weforum.org/agenda/2020/03/3-ways-coronavirus-is-reshaping-education-and-what-changes-might-be-here-to-stay/>

⁵⁴ The Coronavirus (COVID-19) Response ICT Case Repository, Sri Lanka

⁵⁵ The Coronavirus (COVID-19) Response ICT Case Repository, Pakistan

trained teachers, and shortage of effective educational content⁵⁶. Similarly in Turkey, the Ministry of National Education used its online social education platform (Educational Informatics Network or EBA) for providing remote classes for primary, secondary and high schools, using a dedicated TV channel⁵⁷.

In China, by the end of March, approximately 180 million schoolchildren were staying home due to the COVID-19 related school closure. All of these students were receiving education through remotely used educational technologies⁵⁸. Within ASEAN, only Malaysia, Brunei Darussalam, and Singapore have the internet services available for more than 80 per cent of their population. This coverage is around 60 per cent for Thailand, Cambodia, and Indonesia, and only 40 per cent for Myanmar and Viet Nam. According to experts, beyond just connectivity, the quality of network, its availability, and affordability are also very important to ensure a good learning environment⁵⁹.

Key Take-Away Messages

- *AP region's students, primarily at the primary and secondary levels, are severely affected by global shutdown*
- *Education using ICT platforms is worsening the digital divide in developing countries*
- *Non-traditional modes in addition to the high-tech options are being used to deliver education*

Online threats, infodemic, and responses

The overall number of threats from online or other forms of digital communications, transactions, and access have increased manifold during the current pandemic, as more people are forced to use different ICT platforms and services. By April 2020, UN Women have predicted the global internet use to be increased by 50 per cent to 70 per cent. Consequently, physical threats, sexual harassments, trolling, phishing, telephone scams, etc. are all on the rise⁶⁰. For the general population, such threats are mainly coming from entities with ill motives. Hence, comprehensive policies and efforts need to be in place to address such online and ICT related threats, especially in present times. The government of the Republic of Korea, along with its private sector partners, introduced an official scam alert system of this country is constantly updated and can reach out to all the citizens to inform about the latest cases of scams and how to cope with these challenges.

⁵⁶ <https://economictimes.indiatimes.com/news/international/world-news/22-million-children-from-south-asia-missed-out-on-early-childhood-education-due-to-covid-19-unicef/articleshow/77111511.cms?from=mdr>

⁵⁷ <http://www.eba.gov.tr/>

⁵⁸ <https://www.worldbank.org/en/topic/edutech/brief/edtech-covid-19>

⁵⁹ <https://blogs.worldbank.org/education/covid-19-east-asia-how-regions-higher-education-systems-are-addressing-crisis-adapt>

⁶⁰ <https://www.unwomen.org/en/digital-library/publications/2020/04/brief-online-and-ict-facilitated-violence-against-women-and-girls-during-covid-19>

The government also improved its overall response time against any telecom fraud, thus creating a safer environment of its ICT users⁶¹.

At the government level, some of the Asia-Pacific region's countries are deemed as the most successful ones in their responses against COVID-19 infodemic. For example, the Singapore government has used its "Protection from Online Falsehoods and Manipulation Act (POFMA)" against several entities accused of spreading fake news on COVID-19. The government compelled platforms like Google, Facebook, Twitter to comply with POFMA to avoid any large-scale spread of misinformation. Different government ministries worked together on a set of consistent and viable advisories on COVID, and those messages were disseminated through different social media platforms as well as the digital display panels situated in residential areas⁶².

The Chinese government has been very strict in applying the law against anyone spreading rumors on COVID-19. It constantly reminded the Chinese citizens about the legal repercussion they would face in the event of sharing and/or creating false news on COVID-19. The Chinese population was actively encouraged for championing the real discoveries about this novel virus. It was reported that the Chinese teachers also wrote to their students, urging them to be kind to their peers who lost their parents. These teachers furthermore requested the students to abstain from creating panic or spreading rumors about the Coronavirus⁶³.

For Government of the Republic of Korea, correctional actions came in the shapes of advisories from different health experts, which were mainly used for debunking rumors. The Korean government and the media set the benchmark of cross-country referencing to address fake news too. At least around 10 countries' news and social media trends were analyzed to highlight the commonalities among the prevalent COVID-19 related fake news across the different parts of the world.⁶⁴

When it comes to managing the privacy of the citizens' data, some Asia-Pacific countries prefer higher levels of oversight. For example, China has been in the forefront of state-of-the-art ICT applications for combating COVID-19. However, a major part of its digital installations and services heavily depends on mass surveillance and mobile tracking of its citizens, in order to obtain smartphone location data, travel and credit card histories, body temperature, facial recognitions, etc. Such oversights are helping China to successfully contain the Corona virus⁶⁵.

Studies have shown that women and girls are relatively more vulnerable than men are during this pandemic, due to online and ICT-centered violence against them. In Pakistan, Digital Rights Foundation (DRF), a local social organization on human rights and digital activism, has been operating a helpline to assist and counsel the victims of cybercrime and harassments. At the start, this helpline was operating through email. Since May 2020, DRF has been using a toll-free number and since June, this helpline is operating 24/7 due to its huge demand⁶⁶.

⁶¹ Pg. 63, <https://www.mk.co.kr/news/society/view/2020/01/80017/>

⁶² <https://www.cnbc.com/2020/04/08/singapore-law-minister-on-tackling-fake-news-during-coronavirus-pandemic.html>

⁶³ <https://www.nytimes.com/2020/03/17/technology/china-schools-coronavirus.html>

⁶⁴ https://www.koreatimes.co.kr/www/nation/2020/08/356_294917.html

⁶⁵ <https://www.globaltimes.cn/content/1188548.shtml>

⁶⁶ <https://digitalrightsfoundation.pk/cyber-harassment-helpline/>



FIGURE 11: CYBER HARASSMENT HELPLINE DURING COVID-19 SHUTDOWN IN PAKISTAN⁶⁷

Aside from creating an unprecedented global health crisis, COVID-19 initiated a worldwide infodemic, a deluge of fake news across regions. Such proliferation of false information has caused large-scale public panic and confusion among general population. Xenophobia and racism are on the rise. False remedies and fake medicines' market are thriving all over the world. All these are very much prominent in the Asia-Pacific region as well.

Key Take-Away Messages

- *Cyber harassments are on the rise in Asia and the Pacific, especially in regions with limited resources*
- *Developed countries in Asia and the Pacific have introduced digital safety nets for its citizens, backed up by dynamic ICT policies*
- *Wide-scale training to raise awareness about and action against online threats and infodemic is needed across Asia-Pacific*

ICT Infrastructure, Innovations, & Newer Applications

One common factor present among all the successful countries in the Asia-Pacific region against COVID-19 is their ability to effectively harness the true potential of ICT innovations and platforms amid this unprecedented global health crisis. The Republic of Korea, China, Taiwan Province of China, Viet Nam, Hong Kong, China - all these governments are working very closely with their tech-companies as well to fend-off COVID-19 from their borders. Firstly, all the examples mentioned here more or less enjoy high quality internet backbone and other state-of-the-art digital communication infrastructure. These facilities enabled them to easily manage the sudden increase in net access due to countrywide lockdowns. Secondly, more specifically in the cases of China and the Republic of Korea, experts are using big data, machine learning techniques, and

⁶⁷ <https://digitalrightsfoundation.pk/june-2020-drf-launches-digital-50-50-e-magazine/>

AI for identifying new compounds or already existing drugs, which could be repurposed for new treatment. With faster machines and new algorithms, the race towards finding a cure for COVID-19 is also going strong for these nations.

Another major part in fighting against the Coronavirus is efficiently managing numerous variables of health data, coming from individual patients as well as from other institutional sources and different platforms. Ensuring interoperability of Electronic Health Records (EHR) paved the way for seamless transition and transfer of sensitive health information from one health service provider to the other, and at times across different countries, regions, and continents. Experts highlighted this notion of interoperability as the key to better functionality, cooperation, and scale⁶⁸. At the peak of COVID-19 outbreak in any part of the world, we have witnessed significant shortages of respiratory ventilators, ICU beds, PPEs, masks, hand gloves, face shields etc. Due to the breakdown of global supply chain, different governments are exploring other less exposed and less conventional ways to make these in order to remedy the shortages of medical supplies. Consequently, some of the countries are actively using 3D printing to mass produce ventilators, masks, gloves, protective classes, and face shields, bypassing the traditional production and supply routes⁶⁹.

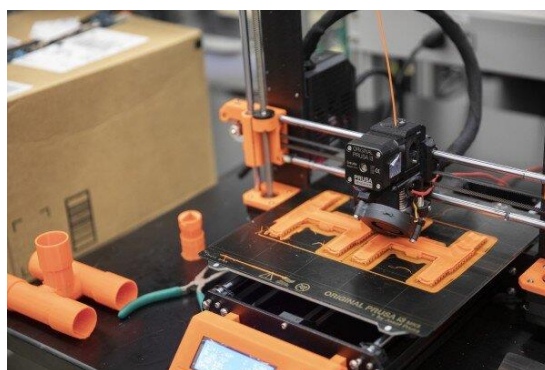


FIGURE 12: 3D PRINTING OF VENTILATORS⁷⁰

In the “Healthcare” section, we elaborated on the ICT initiatives and innovations for combating COVID-19 from the Republic of Korea. Another country championing ICT with a plethora of applied innovations, in the backdrop of a nationwide 5G network, a relatively novel infrastructure for communication and accessing information is China. The Chinese government used positioning technologies to pinpoint the riskiest areas to guarantee effective humanitarian assistance. A Chinese company, BeiDou, helped the government to track patients. Moreover, based on their provided data, the government could decide on the places where makeshift COVID-19 hospitals needed to be built. BeiDou-enabled drones were also in use for monitoring congested population centers, enforcing social distancing, and communicating important public announcements without initiating personal contacts⁷¹. The Chinese government worked with Alibaba and Tencent to develop a color-coded health-rating app in order to track millions of its citizens daily. Based on people’s travel and medical histories, Alibaba’s algorithm assigned color to every app user, and that color would decide whether a person needs to be in quarantine or not⁷².

⁶⁸ <https://itif.org/publications/2020/05/26/building-global-framework-digital-health-services-era-covid-19>

⁶⁹ <https://fortune.com/2020/03/28/coronavirus-3d-print-masks-ventilator/>

⁷⁰ <https://medicalxpress.com/news/2020-04-d-printed-ventilator-covid-pandemic.html>

⁷¹ <https://www.geospatialworld.net/article/the-sino-approach-use-of-technology-to-combat-covid-19/>

⁷² <https://www.japantimes.co.jp/news/2020/03/24/asia-pacific/china-green-light-alipay-app/>

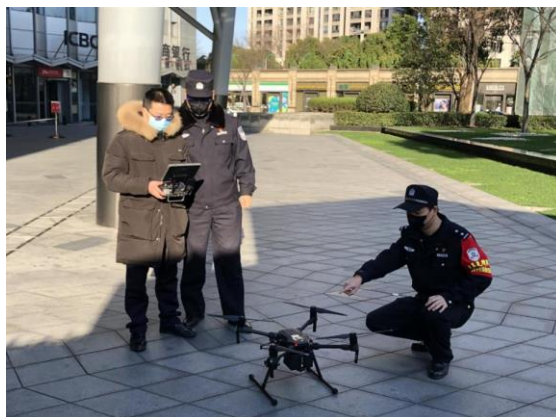


FIGURE 13: USE OF DRONE FOR CITIZEN ENGAGEMENT DURING COVID-19 SHUTDOWN IN CHINA⁷³

In other parts of the Asia-Pacific region with limited ICT infrastructure, there are efforts in place to combat COVID-19 using innovative measures. A Bangladeshi innovator is using a 3D printer to develop face shields for doctors and nurses who treat COVID-19 patients, working in sync with BRAC (the no. 1 NGO in the world⁷⁴) to mass produce his product⁷⁵.

Key Take-Away Messages

- *Countries with better ICT infrastructure performed significantly better*
- *Efficiently managing numerous variables of health data played a crucial role behind the success of the Republic of Korea, Singapore, China, etc.*
- *Innovations related to 3D printing and big data analysis helped developing countries within the Asia-Pacific region as well*

⁷³ <https://www.shine.cn/news/metro/2002222591/>

⁷⁴ <https://www.brac.net/latest-news/item/1269-brac-ranked-1-ngo-in-the-world-for-the-fifth-consecutive-year>

⁷⁵ [https://blogs.worldbank.org/endpovertyinsouthasia/bangladeshs-unlikely-inventor-creates-face-shields-tackle-coronavirus#:~:text=In%20these%20unprecedented%20times%2C%20SM,coronavirus%20\(COVID%2D19\).](https://blogs.worldbank.org/endpovertyinsouthasia/bangladeshs-unlikely-inventor-creates-face-shields-tackle-coronavirus#:~:text=In%20these%20unprecedented%20times%2C%20SM,coronavirus%20(COVID%2D19).)

Policy Recommendations

The countries within the Asia-Pacific region, similar to other places in today's world, are combating the global pandemic using their own resources, policies, and solutions. ICTs, in many cases have emerged as a major factor behind the success of many of such initiatives against COVID-19. Numerous challenges also emerged during this shared struggle of humanity, especially when it comes to introducing inclusive, effective, and equitable solutions using ICTs, which need to be available, accessible, and affordable for the mass and not only of the fortunate few. The 4 AI-framework assisted in analyzing the overall effectiveness, challenges, and emerging opportunities of ICT applications for combating COVID-19. It furthermore helped to analyze the level of inclusivity, interoperability, inter-governmental co-operations, and robustness of relevant ICT infrastructures and applications. These recommendations are also in accordance with the key findings and analyses from the United Nation's High-level Panel on Digital Cooperation and UN ESCAP's Inclusive broadband connectivity through the Asia-Pacific Information Superhighway initiative.

Pre-requisites for successful policy formulation and implementation processes during the age of COVID-19

Key Recommendations

- *Formulation and application of inclusive ICT policies to enable robust applications and innovations*
- *SDGs need to be taken into consideration for long-term, anti-COVID strategies*
- *Increased investment in local ICT and healthcare R&D infrastructure*
- *Establishment of joint ventures with technologically advanced countries who performed well during the first COVID-19 wave*

Depending on the relevance, any successful policy (to enable ICT application or innovation for addressing any aspect of this crisis) need to be an inclusive one, and should not exclude any particular groups or nations or socio-economic strata out of the loop, should not create any digital divide, segregation over race or gender, or any other kinds of discriminations.

The road towards achieving the SDGs took a significant hit due to this pandemic. Any new policy introduced need to ensure necessary compliance to facilitate the fulfilment of SDGs. Absence of trust for any government's action or policies can severely hinder the successful adaptation of any policies or regulations. The Republic of Korea's overall anti-COVID ICT policies and implementation processes aptly highlighted the importance of constituencies' trust towards their policymakers' actions.

In order to successfully fight off COVID-19 impacts (due to the first wave and the incoming ones) or any other upcoming global pandemic, any country's (within its own abilities) policy should be to increase the allocations on local R&D and human resource development. Governments,

(especially the ones with struggling or emerging economies) furthermore need to initiate or to strengthen the existing joint R&D ventures with strategic partners. These partners can be other governments, industry stakeholders, development agencies and/or academia.

Establish Robust ICT Infrastructures

Key Recommendations

- *National internet backbones need to prioritize their services for any anti-COVID initiatives*
- *Governments need to lower or exempt taxes for the private broadband and mobile internet services*
- *Use of Universal Service Funds for emergency ICT capacity enhancement at the local as well as national levels*
- *Asia Pacific countries with limited connectivity should collaborate with their neighbors and invest on new, shared infrastructure*

Ensuring a stable and robust ICT infrastructure is critically important for the success of any country's fight against COVID-19. In the immediate or short term, the existing ICT infrastructure of a country, primarily the national internet backbone needs to prioritize its services for any anti-COVID initiatives. The allocated bandwidth for internet service providers need to be increased given that globally, more people are depending on such lifelines for communications, access to information and education, and also to continue working from homes. Governments may consider lowering or exempting taxes for the private broadband and mobile internet service providers to incentivize seamless services for their populations.

If within a country, the national telecom regulator has the provision for Universal Service Fund or something similar (to mainly encourage the deployment of telecom/internet services in commercially less-lucrative parts of any country), it should be channeled towards emergency capacity enhancement of related ICT infrastructure at the local as well as national levels. In addition, collaboration and coordination with the more traditional but widely available technologies (e.g., Over the Air TV channels, FM and AM radio stations, Satellite TV stations, etc.) is imperative to guarantee greater reachability to any population.

As a mid to long term strategy (six to 24 months), Asia-Pacific countries with limited connectivity should explore ways to enhance their internet/telecom service capabilities by partnering with their neighbors to develop or invest in new, shared infrastructure. This is more important for landlocked countries within this region.

Enable Synergy between Healthcare Systems, Policies, and ICTs

Key Recommendations

- *Invest on healthcare specific R&D, System Development, and ICT infrastructure*
- *Use both high end (AI, IoT based) and low end (traditional broadcasting, non-smart phone based) solutions for COVID-19 tracking*
- *Establishment of inter-government co-operation to ensure the long-term effectiveness of COVID-19 tracking*

Taking into consideration the many Asia-Pacific countries' less affluent socio-economic state, policies need to be in place for any country to address the challenges its healthcare system is facing. Increase in funding and proper utilization of it critically important. So far, the key trends of health interventions against COVID-19 indicates the crucial roles ICTs play (especially from the examples of the Republic of Korea, China, Singapore, Taiwan Province of China) for saving the infected or exposed population. Special focus needs to be placed on ensuring technological synergy. Such actions can help developing interoperable systems for COVID case testing, tracking and treatment. As a mid to long term strategy, in addition to the external cooperation, Asia-Pacific countries with emerging economies need to put efforts to develop their own health specific AI, IoT, and ICT solutions. Inter-governmental and inter-industry level co-operations will be more effective.

Reliance on both high and low-tech interventions for COVID-19 tracking

The Korean government demonstrated that the uses of state-of-the-art ICT applications using AI and IoT is quite effective for COVID-19 rapid testing. However, such capabilities of ICT innovation, development, and quick deployment are only possible for countries with superior technological infrastructure, ample funding, correct policies, and trained human resources. For the relatively low-tech and lesser effective COVID test solutions, many of these pre-conditions are not critically important.

In the context of the Asia-Pacific region in general, we observed that the awareness about higher-end ICT solutions for COVID-19 testing is high among the concerned stakeholders. However, for the majority, the availability, accessibility, and affordability of such solutions and applications are still very low. Such interventions are also not inclusive in terms of socio-economic backgrounds, have limited interoperability with the traditional health technological infrastructures, and we have not found any inter-governmental initiative for transferring or coordinating such technological applications. On the contrary, the low-tech informational solutions using ICTs have better chances of being inclusive. We found replications of such applications across different countries as well, inspired by the success in China, the Philippines, etc.

Need for an inclusive tracking system and inter-government co-operation

The experiences of Asia Pacific countries demonstrated that the primary pre-conditions behind the success of any COVID-19 tracing/tracking mechanism are: the people (for whom this tracing/tracking is being conducted) need to be well aware about this initiative; and such tracking system is widely available, affordable, and accessible among the mass. An effective viral infection tracking mechanism also needs to be inclusive across gender, race, and other socio-economic strata. For its success, a robust infrastructure as well as a sustainable supply-chain of testing materials and human resources are necessary. These elements need to be able to function across different types of health infrastructure.

In order for the COVID-19 tracking/tracing initiative to succeed, inter-governmental coordination is an imperative, and we have observed that efforts implemented by Governments in the Republic of Korea, Taiwan Province of China, Singapore, and China have demonstrated superior success in comparison with the rest of the world's performance in tracing COVID-19 infected population. The Asia-Pacific countries with higher concentration of expat professionals (e.g., Republic of Korea, Malaysia, Singapore, etc.) are now closely coordinating with the countries from where these foreign workers originated. In order to ensure safer travels and transitions to the host countries, pre and post- (international) travel standardized COVID-19 tests are being organized for these migrant workers.

In terms of COVID-19 treatment, for the greater good of the humanity in general, a long-term and truly inclusive inter-governmental co-ordination is going to be crucial. Effective cooperation at that level can ensure the development of a set of treatments or health interventions, which are universally applicable, affordable, and accessible.

Facilitate Transparent and Continuous Communication with Communities (CWC)

Key Take-Away Messages

- *Communication with Communities, irrespective of the types of ICT options being used, needs to be transparent, inclusive, and trustworthy*
- *Governments need to involve the community members in the decision-making and design phases of any COVID related communication materials*

Perhaps the highest number of ICT innovations and applications, both at the individual and organizational levels, belong to this domain of interventions. General population around the world are in need of effective and trustworthy sources of information on this current pandemic. Moreover, in order to address this need, the majority of the governments of the world alongside their development organizations are offering a range of applications, based on different digital as well as analog platforms. Developing informational dashboards has truly become a global

phenomenon. Within the Asia-Pacific region, we have witnessed ICT based CwC initiatives which are affordable (overwhelmingly free of charge), accessible, and to some extent available. For a large number of populations who are still on the wrong side of the digital divide, we also have reasons to be hopeful, due to low-tech solution like Graam Vaani. More of such technologically hybrid and inclusive solutions are needed to guarantee a long term, sustainable and effective communication network with the communities in Asia and the Pacific.

We have furthermore witnessed some innovative and relatively low-tech solutions within CwC: the mask information service introduced and applied by the Korean Government. This service is ICT-centered and a true example of an affordable, accessible, and available intervention. Other Asia-Pacific countries, especially the densely populated ones can be inspired by such solutions and can easily replicate or customize this according to their particular mask distribution situation and socio-economic contexts.

This paper's observations revealed that the majority of the ICT applications designed and deployed during this global health crisis are dedicated towards informing about the pandemic to the public. In order to ensure immediate as well as long-term success in CwC, governments and tech companies are required to be transparent about the development and functional processes of their applied innovations with the people. Such acts contribute to enhancing confidence among the population about the ongoing healthcare initiatives and other anti-COVID measures taken by the authorities.

In addition to providing transparency in its services, it is important for any CwC initiatives to involve the people of the communities in the decision-making and design phases of any COVID related communication materials.

Provide Education for All in New Normal

Key Recommendations

- *Asia Pacific countries with lower mobile phone and internet penetration need to design and deliver education content using traditional ICT and other non-traditional means (e.g., memory cards, broadcasting TVs, community radio stations, etc.).*
- *The cost of net access needs to be decreased and if possible subsidized for education related services and stakeholders*
- *Prioritizing investment to train teachers for the "New Normal" ways of teaching*

Education is one of the worst affected sectors globally due to this COVID-19 pandemic. The closure of schools, colleges, universities, or any other types of education institutions have severely affected the learning process of students across continents. All the service industries related to education are also suffering considerably. Amid such a backdrop, Asia and the Pacific is witnessing two very distinct scenarios, each with challenges as well as opportunities.

At one hand, we observed the relatively smooth transition to digitized education for the Republic of Korea, China, Singapore, Taiwan Province of China, etc. It is mainly due to these countries'

improved digital infrastructure and higher level of connectivity, in harmony with appropriate education policies, and well-trained human resources to make the most out of such transitions. On the other hand, there are other countries in the Asia-Pacific region with relatively lower broadband and phone penetrations, and low income per household, in which the situation has got worse due to the current economic crisis. These countries are now facing a significant dilemma. The respective governments are compelled to physically close educational institutions due to the pandemic, but have the constitutional commitments for providing education to their citizens. The efforts of using hybrid solutions involving traditional broadcasting, mobile network, and asynchronous/synchronous online teaching are in place, but facing severe challenges.

As short term solutions, for Asia Pacific countries with relatively lower mobile phone and internet penetrations, education contents need to be designed and developed in digital platforms, with the goal of disseminating those via the existing internet infrastructure and through non-traditional, offline networks as well (e.g., memory cards, broadcasting TVs, community radio stations, etc.).

Access to the internet, where available, needs to be cheaper or free for the students, whose learning process and cycles have been severely hampered by COVID related shutdowns. The ICT service providers need to offer free access to the educational sites recommended by the corresponding governments, to make accessing digitized educational content easier for the students with limited financial means. As a mid to long term policy goal, strategies and provisions for teacher training are needed, which would enable new corps of educators with capability to provide education digitally, online or offline, and who are trained to educate students amid the emerging socio-technological challenges, digital divides, and repeated COVID-19 waves.

Use ICTs as Enablers for Local Entrepreneurships

Key Recommendations

- *Economic revitalization needs to be a priority for every Asia Pacific country, using ICTs as enablers*
- *Governments need to consistently support the electronic and mobile commerce infrastructure for local entrepreneurs and facilitate the inclusion of newcomers in such platforms.*
- *In the long-term, large scale inter-governmental co-operations are needed to boost ICT-centered regional MSME ventures*

COVID-19 pandemic has adversely affected the traditional economic activities, especially for the MSMEs. All over the Asia Pacific region, there is a push for going online to somewhat maintain the existing clientele, and to explore new ways to generate revenue. Many Asia-Pacific countries are still struggling with awareness-building among the relevant stakeholders about the online-based commercial opportunities. Lack of trust to ICT based impersonal platforms, along with relatively lower levels of availability, accessibility, and affordability of choices have made things complicated for businesses within the Asia Pacific emerging and developing economies. Hence we are observing the trend of government sponsored business platforms being promoted for networking and doing business during the time of global shutdown and economic depression. We

also witnessed the rise of social media-based, (mainly Facebook) home-based, and MSME services in many parts of South and South-East Asia, which makes the most out of the available, inclusive and interoperable platforms and do not require higher-end infrastructure to operate. In addition, there had been no large scale, inter-governmental cooperation within Asia and the Pacific to boost ICT-centered regional MSME ventures.

Combat New Types of Infodemic and Online Threats

Key Recommendations

- *Rapid dissemination of COVID-19 related fake news needs to be stopped, and debunked using locally acceptable and intelligible health communications*
- *Helplines, using hybrid and traditional low-tech options need to be considered alongside latest, online based ICT solutions*

With the increasing trend of digitization and the global push for the fourth industrial revolution, we are also witnessing a steady rise of cybercrimes and rapid proliferation of fake news, on both organizational and personal levels. In addition to the current pandemic, we are combating the COVID-19 infodemic everywhere, irrespective of a wide range of socio-economic progresses and levels of ICT infrastructure. Fake news related to COVID-19 are creating confusion among general populations and are hindering the successful dissemination of valuable healthcare messages. For most countries in Asia and the Pacific, government policies against such acts are dated, inadequate, and at times oppressive. A few exceptions, i.e., China, the Republic of Korea, Singapore, etc. are providing truly inclusive solutions while addressing such threats and infodemic. For the rest, we have observed locally organized efforts (similar to DRF in Pakistan) to address some pressing needs (alarmingly increased violence against women, both online and offline). However, not many people or communities are aware of such initiatives, which need to be more available, affordable, accessible, inclusive, and interoperable.

One of the most effective ways to fight the COVID pandemic is contact tracing, by applying higher level of surveillance over almost all the people. This helps to gather data about any individual on her/his daily mobility, work habits, socializing practices etc. However, such practices raised the concerns of privacy breach and further exploitation of private data by the governments or other implementing agencies. While ensuring greater security against COVID-19 is important, this should not come at the price of compromising any citizen's sensitive information. Hence, strict and transparent policies need to be in place to manage any COVID-19 related efforts that need access to personal user data. Online violence (especially against women, children, and people from minority groups) is alarmingly on the rise during the worldwide shutdowns with a significant number of people are forced to be confined at their homes and can only work or study via online. Establishment of 24/7 helplines, backed up by strict laws are needed to address this type of crimes.

APCICT

The Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) is a regional institute of the Economic and Social Commission for Asia and the Pacific (ESCAP). APCICT aims to strengthen the efforts of the member countries of ESCAP to use ICT in their socioeconomic development through human and institutional capacity-building. APCICT's work is focused on three pillars:

1. Training – To enhance the ICT knowledge and skills of policymakers and ICT professionals, and strengthen the capacity of ICT trainers and ICT training institutions;
2. Research – To undertake analytical studies related to human resource development in ICTs; and
3. Advisory – To provide advisory services on human resource development programmes to ESCAP member and associate members.

APCICT is located at Incheon, Republic of Korea.

<http://www.unapcict.org>

ESCAP

ESCAP is the regional development arm of the United Nations and serves as the main economic and social development centre for the United Nations in Asia and the Pacific. Its mandate is to foster cooperation between its 53 members and 9 associate members. ESCAP provides the strategic link between global and country-level programmes and issues. It supports Governments of countries in the region in consolidating regional positions and advocates regional approaches to meeting the region's unique