



# The Methods and Challenges of Managing a Smart Health Program during the COVID-19 Pandemic in Thailand

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*Received:* 01/16/2023; *Accepted:* 05/19/2023; *Published:* 07/18/2023

**Abstract:** A smart health city creates a healthy environment. Since the end of 2019, the coronavirus pandemic has increased the number of sick patients around the world, and many government services have been enacted to treat patients with distance therapy. Therefore, many countries are using smart health technology as one tool to address coronavirus. In this article, we present how cities can implement and manage smart health technology in response to the coronavirus. In addition, we present the challenges in implementing smart health technology as a tool for solving the coronavirus problem. We found that the Internet of Things is a concept to drive smart health programs, and governments and municipalities should develop innovative strategies for deploying emerging technologies in health information technology (health IT) to enhance the quality, accuracy, efficiency, and availability of health care while reducing costs. However, some of the challenges of smart health cities are that medical staff must change the work culture by using more technology, the cost of providing accessibility to emerging technologies in aspects of government investment, and equal opportunities to access technology.

**Keywords:** Management, Challenges, COVID-19, Pandemic, Smart Healthy

## Introduction

A healthy city means one that facilitates the creation of a state of happiness among the population in both aspects of physical and mental health; in addition, urban populations are physically and mentally happy in the context of their well-being. Healthy cities are those that continually create and improve the physical and social environment and strengthen the community's resources, enabling people to support each other in the fulfillment of all the functions of life and to achieve their maximum potential (Turnwald and Crum 2018; Ruenpakpoj, Aim-Im-Tham, and Promsaka Na Sakolnakorn 2020). In addition, healthy cities must emphasize the need to address inequality in health and urban poverty; the needs of vulnerable groups; participatory governance; planning and healthy urban design; and the social, economic, and environmental determinants of health (Kickbusch and Behrendt 2013). In addition, as healthy cities become important to urban development around the world, they aim to create a health-supportive environment, to achieve a good quality of life, to provide basic sanitation and hygiene needs, and to supply access to health care. In addition, healthy cities foster health and well-being through governance, empowerment, and

participation, creating urban places for equity and community prosperity and investing in people for a peaceful planet (WHO 2018).

Many cities in the world face major challenges in creating healthier urban environments, with major obstacles including more pollution, road traffic, and health inequalities (Smith 2019). To create healthy cities, information and communication technologies (ICT) have been widely adopted in the healthcare environment to make healthcare access and delivery easier and more cost-effective (Haluza and Jungwirth 2014; Zeadally et al. 2019). A smart healthy city aims to cover human health, the well-being of the physical, economic, and social environment, and to provide happiness, good health, and well-being for the people. Smart healthy is a concept outside the traditional healthcare system that encourages disease prevention and full well-being in the city (Ruenpakpoj, Aim-Im-Tham, and Promsaka Na Sakolnakorn 2020), by increasing the technology and data for governments to manage citizens' health proactively, thereby changing the way health care is delivered (Jagota 2018).

In addition, the healthcare industry has to adapt to the digital world due to the influence of global change. In particular, the COVID-19 pandemic has been an important turning point driving consumers and organizations to adapt and learn different technologies in order to adhere to medical treatment and comply with social distancing measures. The medical community must be at the forefront of robotics and automation remote operations (telemedicine), including online counseling (video conferencing), the inevitable fight against COVID-19, and so on. With the development of these technologies, the result will be a more effective treatment of diseases. The COVID-19 pandemic has been rapidly spreading and affecting many people around the world and has been the most violent and phenomenal outbreak in recent years. Therefore, many countries are eager to apply new technologies or cutting-edge innovations in medicine to enhance their capabilities and solve the crisis. As mentioned earlier, in this article, we aim to present smart health cities as well as their management and challenges in Thailand during the 2019 coronavirus crisis.

## Smart Healthy Cities

“Healthy cities” refers to the use of innovations and technological resources in urban infrastructure and local services to solve urban health problems based on the principles of primary health care, health promotion, and health for all (Alves 2019). Electronic health (e-health) is the contribution of ICT implementation in the healthcare industry, and the e-health concept helps increase efficiency and reduce medical costs (Mamra et al. 2017). In addition, the convergence of technology creates a vast range of opportunities in the healthcare sector, particularly for those affected by chronic conditions who could access medical information, be constantly connected with a network of formal and informal caregivers, and benefit from clinical monitoring tools (Nollo et al. 2015). With emerging technologies such as artificial intelligence, Generation 5 data networks (5G), and smart cameras, innovative strategies and designs can address healthcare problems. The data also allows city services to respond promptly to urgent health needs and to make decisions to avoid situations of poor health. The

combination of intelligent solutions and real-time data access is proving to be a significant force for healthcare professionals. Patient care will improve, and residents will stay out of hospitals, living healthier lives. In addition, virtual health enables easy access to a doctor for diagnosis, remote monitoring, care coordination, and occupational health (Burton 2020).

The key role for smart technology in smart healthy cities is to provide support and incentives for various stakeholders to collaborate in the provision of integrated care. There are many factors or parts to this role, including the following: data protection and regulatory compliance guidelines in line with technological innovation; leveraging of existing information technology (IT) capabilities and good practices in the IT ecosystem; collaboration in the IT ecosystem to improve usability, data interoperability, standardization of information, and IT competency in the new technologies; involvement of health- and social care professionals and informed citizens in the organizational change and service design; planned interventions and production of services based on health, environmental, and social data; and a multidisciplinary system, involving a wide range of social sectors and actors that have in common the aim of preventing disease and frailty (Nollo et al. 2015).

To create a healthy city, the five most important steps in the implementation process are as follows: (1) Make a city greener, more eco-friendly, and sustainable by using clean energy and/or renewable energy such as solar, wind, and electric transportation. (2) Improve mass transit with energy-efficient public transit, and upgrade mass transit and infrastructure, as well as public transportation, thereby reducing traffic on the roads and the pollution that transportation creates. (3) Invest in digital health to provide people with the opportunity to take active roles in their health care through digital applications by having the option to monitor their health at home with digital monitoring devices, thereby reducing the time spent at the hospital. (4) Implement the Internet of Things (IoT) to encompass the many elements that comprise a smart city; IoT can link all the necessary elements of a smart city through technology into a unique platform, thereby improving efficiency and breaking silo behavior. (5) Monitor air pollution by analyzing it and distributing and sharing that data; this will be a large part of the challenge, but we emphasize that accurate monitoring of air pollution is another key element for a healthy, smart city, and we encourage at the community level the formulation of a plan to implement and manage hundreds of air-quality sensors (Korber 2016).

In addition, a smart healthy city must use IoT as a tool for urban development. Furthermore, to develop a clean and green city concept, we must implement an efficient waste management system, using a circular economy to help with solid waste management. We must develop more green spaces such as public parks, including the development of more areas for exercise in the city. The city must be developed following a friendly design concept, including the development of bike lanes for people to use bikes as their mode of transport in their everyday lives. We must ensure food quality and the safety of agricultural products to supply the city. The city must have medical applications on smartphones for health checks, connected to hospitals to book medical service, and we must develop an online tool that

facilitates the collection and sharing of medical information between residents and hospitals or medical doctors (Ruenpakpoj, Aim-Im-Tham, and Promsaka Na Sakolnakorn 2020). In addition, the use of ICT is a key concept for improving today's health care as it will improve access to quality care and will make the health sector more efficient. This efficiency will include data sharing between patients and health service providers, hospitals, health professionals, and health information networks through the use of electronic health records, telemedicine services, portable patient monitoring devices, operating room scheduling software, robotized surgery, and blue-sky research on the virtual physiological human (ActiveAdvice 2017).

One of the challenges of smart health care is telecommunication because wireless and internet networking technologies are used to provide connectivity in various types of medical devices and sensors (Zeadally and Bello 2021). In addition, healthcare providers with limited finances and resources face challenges in providing ICT systems for potential smart health care, and lack of finances hampers the quality of security system services (Sligo et al. 2017). Numerous studies have shown that the challenges in IT are maintaining people's privacy and security and protecting the database from unauthorized access (Tissaoui and Saidi 2020; Jitsupa, Nilsook, and Piriyaawong 2012; Atiyah and Al-Mejibli 2022). In addition, people cannot access technology due to economic problems, such as the lack of money to buy a smartphone for billions of people around the world. Smartphones remain too expensive for many people in low- and middle-income countries (Woodhouse 2020). With the gap between the people who can benefit from the digital world and people without the internet or modern ICT, people without internet access or smartphones cannot access news, buy products, use online services, or access smart healthcare services.

## **Management of Smart Healthy Cities to Improve the Quality of Life for Citizens**

Smart healthy cities can improve the health and wellness of citizens by increasing the adoption of telemedicine, which allows on-demand specialist resources to expand the scope of their care to underserved populations and communities (Satyam 2019). An integrated healthcare solution can be of great benefit when implemented on a large scale in smart cities. The increase in technology and data will provide more opportunities for governments to manage citizens' health proactively and to change the way health care is delivered. It will integrate stakeholders through a robust, technology-based smart healthcare structure. This technology will enable the provision of affordable, accessible, efficient, quality care to all when they need it, and where they need it. Moreover, a holistic view of a city's health data including disease profiles, disease patterns and trends, or seasonal disease cycles will be available to the government, through which the authorities can plan their healthcare initiatives and programs and allocate funding (Jagota 2018). Thus, in Table 1, we summarize the environmental and development issues for the management of smart healthy technology in cities.

Table 1: The Management of Smart Healthy Cities

<i>Issue</i>	<i>Management</i>
<i>Smart Infrastructure</i>	<ul style="list-style-type: none"> <li>▪ Free Wi-Fi internet access in public places</li> <li>▪ 5G systems enabled</li> <li>▪ Low cost of internet</li> <li>▪ High-speed internet and 5G coverage of both urban and rural areas</li> <li>▪ Transformative power of the Internet of Things (IoT) and its core and complementary technologies for ICT management</li> <li>▪ Municipal management with smart healthy city innovations to create platforms for citizen engagement</li> <li>▪ City to promote environmentally friendly transport systems in the near future</li> </ul>
<i>Smart Institution</i>	<ul style="list-style-type: none"> <li>▪ Building a smart nation and digital government</li> <li>▪ R&amp;D investment (research and development)</li> <li>▪ Local government collaboration with universities</li> <li>▪ Proximity to universities</li> </ul>
<i>Smart People</i>	<ul style="list-style-type: none"> <li>▪ Improved open data/big data initiatives</li> <li>▪ Increased job opportunities</li> <li>▪ A healthy city initiative to create robust economic value</li> <li>▪ Knowledge sharing</li> <li>▪ Training programs and internet training programs targeting older and disadvantaged people to become a necessity in mitigating the digital divide in the community (Kamel Boulos, Tsouros, and Holopainen 2015)</li> </ul>
<i>Urban Environment</i>	<ul style="list-style-type: none"> <li>▪ Design of the urban environment following the clean and green city concept through the growth of trees and valuing, nurturing, and protection of urban forests. This will lead to a low-carbon city with green transport and increasing use of electric vehicles (EV), improvement in waste management. Such a city will be the cleanest, using green energy and a friendly design to improve and renovate downtown areas. It will create a universal, friendly design and a sustainable environment with renovated walkways and roads for everyone. Urban form and city growth will be connected to natural areas to protect their rich biodiversity (Promsaka Na Sakolnakorn 2018).</li> </ul>

<i>Smart Healthy Cities</i>	<ul style="list-style-type: none"><li>▪ Use of ICT as the key concept for improving a city's healthcare systems</li><li>▪ Telehealth innovations in remote healthcare services delivery</li><li>▪ Health intelligence can be characterized as applications of artificial intelligence (AI) to improve health at the population level and at the individual level, using IoT in several disciplines within public health and precision medicine and generating and consuming large amounts of big data on health and the environment (Kamel Boulos, Peng, and VoPham 2019)</li><li>▪ To create mobile applications for promoting public health such as through the disciplines of environmental health, epidemiology, genetics, social and behavioral sciences, and infectious diseases (Kamel Boulos, Peng, and VoPham 2019)</li><li>▪ Adopt applications of the Virtual Reality Geographic Information System (VRGIS) for healthcare systems. In addition, VRGIS technology is a combination of virtual reality (VR) and GIS technologies, integrating three-dimensional GIS (3D GIS) and internet-oriented GIS (Web GIS) (Kamel Boulos et al. 2017)</li></ul>
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Smart health means putting the patient at the heart of the health services design and reimagining models of care to realize personalized health at scale by interconnecting people, the environment, and infrastructure as a unified, intelligent, data-optimized system of care. That is the point at which health becomes smart (Mcbride, n.d.). In addition, during the coronavirus outbreak of 2019 (COVID-19), technology has become a tool for COVID-19 management as it assists in the sharing of knowledge and the use of technology for the control of the virus. For example, developers have created more efficient mobile health applications for COVID-19 such as information about the nearest health centers and essential services. These applications allow for self-symptom checks, the tracking of infected individuals, and government announcements (Davalbhakta et al. 2020). For example, technology can be implemented to support COVID-19 management, such as pulse oximetry sensors, which serve as an indicator of respiratory malfunction and can help in COVID-19 diagnostics and monitoring for a person's oxygen saturation, as well as indirectly monitoring the oxygen saturation of a patient's blood. In addition, body temperature sensors can be used to measure temperature, including skin probes and rectal thermometers (Ennafiri and Mazri 2020). Furthermore, mobile application-based prototype smart home healthcare systems can be used for efficient and effective health monitoring to ensure patients' convenient and independent living while at home. Patients can use the mobile application system to remotely upload or capture essential health symptom information during a pandemic, such as the ongoing

COVID-19 pandemic, for their doctor's assisted diagnosis, especially when patients are observing self-isolation at home or government obligatory quarantine. In addition, the smart healthcare support system measures and records specific health parameters such as weight, pulse, blood pressure, glucose level, and body temperature; this system is also designed to send a reminder to patients on the use of certain medications, with input supplied by the user (Taiwo and Ezugwu 2020).

## Methods

In this study, we used secondary data related to smart health care and/or health cities. We collected data from published research reports, websites, and previously conducted surveys. In addition, we collected data on how to manage the smart health program during the COVID-19 pandemic in Thailand from the news and the internet. We followed the five research steps: identify the research topic, identify the data source, collect data, combine and compare the data, and analyze the data using content and descriptive analysis. One limitation of this study is that we collected all data from secondary sources and used existing data, which is not representative of all phenomena; however, the study's results can help other countries determine and develop smart health cities in the future.

## Results

We divided the results of this study into two phases: managing the smart health program during the COVID-19 pandemic and the challenges in Thailand in managing the smart health program.

### Managing the Smart Health Program during the COVID-19 Pandemic

The IoT comprises technology-enabled linked devices/applications that can be utilized to lower the spread of COVID-19 via early diagnosis, patient monitoring, and the practice of protocols after patient recovery (Nasajpour et al. 2020). In addition, the IoT allows for integrating physical devices that connect to the internet to provide patients' real-time health statuses to doctors. Chronic diseases such as diabetes, heart, blood pressure are prevalent in the world as economic and social problems (Kumar, Kumar, and Shah 2020). The highlight of smart healthy cities is their emerging technologies for improved healthcare services. Governments and municipalities should develop innovative strategies for deploying emerging technologies in health information technology (health IT) in order to advance the quality, accuracy, efficiency, and availability of healthcare delivery while reducing costs (Taiwo and Ezugwu 2020). In addition, IoT-powered smart cities will rely on a growing number of subtechnologies and subsystems (devices, appliances, buildings, vehicles, component services, etc.) that need to be seamlessly interconnected and interfaced with one another in real time (Agbali et al. 2017). For the smart management of health during the

COVID-19 crisis, the government should adopt new working practices using smart technology and the IoT to fight COVID-19:

1. In developing countries such as Thailand, many citizens still do not have a smartphone. Data from the National Statistical Office Thailand (2021) showed that, based on the results of the 2019 Household Information and Communication Technology Survey of the National Statistical Office, Thailand has 56.7 million mobile phone users, accounting for 89.6 percent of the population. Specifically, 86.4 percent of mobile phone users use smartphones, and 12.7 percent use feature phones.

Thus, the government should collaborate with mobile and telecom companies to allow citizens without a smartphone to exchange their non-smart mobile phone for a smartphone. The government should subsidize the mobile phone companies. For example, from 2020 to 2021, the Thai government only gives money to citizens and subsidizes the travel economy, including internal travel, hotel subsidies, and more.

2. Governments should develop smartphone applications for COVID-19. Countries should have only one application for COVID-19 statistics, monitoring, registration for social welfare, checking in at public areas, and discovering [incorrect word choice – please revise] symptoms. It should also offer an anonymous and safe medical application for self-diagnosis and focus on safeguarding access and information for citizens and marginalized groups. The crisis response could offer the capacity for building sustainability to tackle future crises. Thailand has many mobile applications for COVID-19 developed by many government agencies, who tried to force Thai citizens to use all applications. For this issue, why did Thai government agencies not integrate mobile applications during development?

3. Sensors and the application network should be used to avoid COVID-19 disease, including using infrared thermometers for thermal imaging and body temperature measurement. Infrared reflection sensors could also be used for door and window operation, lift operation, power switch operation, water supply in toilets, and heart rate detection via smartwatches. Optical cameras could be used for facial recognition of patients, and smart internet cameras could be used for virtual conferences, meetings, and news broadcasting (Kamel Boulos and Al-Shorbaji 2014).

4. Smart medical devices that use IoT wireless technology are revolutionizing health care. For example, wearables now link patients to doctors and transmit critical medical data in real time from hospital beds and private homes. Mobile equipment is also used at emergency sites and in transport vehicles, and smart monitoring facilitates vaccine delivery and storage by using mobile technology and the IoT to transmit accurate information of conditions throughout the vaccine supply chain (production, transportation, vaccine storage, and delivery to patients).

5. Telemedicine or telehealth technology is an alternative method in the COVID-19 era. The doctor and patient can communicate via an online application or telephone, and patients can receive advice from their doctor via internet systems. In addition, the doctor and patient can communicate via digital cameras for virtual treatment.



6. A case study was conducted in Thailand using smart health and technology as tools for COVID-19 management by creating mobile applications connected to the healthcare database for COVID-19 prevention, as follows:

6.1. Thai Chana mobile application: Thai Chana means “Thailand Wins.” This application is used for people to check in when they have been to a public area, which is useful for COVID-19 disease investigation. It reminds people when an infected person has been in the same area and the period during which the infected person spent time in the public area.

6.2. Mor Chana mobile application: Mor Chana means “Doctor Wins.” It is the second mobile application used in Thailand. People open the application when they go out to public areas, and the application records the locations they visit. If people have been infected with COVID-19, this application will show the timeline and then a health officer will announce to the public, and people who have been to the same place and are at risk for COVID-19 will get tested. However, the Mor Chana mobile application is not popular in Thailand because it uses a lot of mobile battery power, and people feel it is a duplicate of the Thai Chana mobile application.

6.3. Mor Prom mobile application: This application was developed in 2021. Mor Prom means “Doctor Ready.” This mobile application is concerned with the COVID-19 vaccine and is used to promote people to register for the vaccine and make a vaccine appointment, and it collects users’ vaccination history, COVID-19 vaccine certificate, COVID-19 lab certificate, and travel health certificate.

6.4. In 2020, after the Thai government developed the Thai Chana mobile application, many provincial governors also developed provincial mobile applications for local management; however, it has appeared to be unsuccessful, giving people and local residents a higher duty load.

6.5. After July 2021, COVID-19 spread throughout Thailand, and the number of patients increased so that health systems and hospitals could no longer support all patients. Also, many patients just stayed home or went to a COVID-19 quarantine facility that does not have critical medical equipment such as ventilators. To solve this problem, medical associations and volunteer doctors set up telemedicine for consultant and patient self-healing while waiting for a hospital bed.

6.6. The uncertainty of Thai government policies on mobile applications for vaccine registration made citizens uncomfortable or insecure; for example, government units and/or some provinces have announced new mobile applications such as the “Thai Ruam Jai” (“United Thai Heart”) mobile application, and the Thai government also allowed the governor to develop his own provincial mobile application. Also, the Thai government announced its support for that application while the other was still active. Then, the Thai government changed its mind and allowed its people to use the old application (Mor Prom mobile application). In conclusion, many government departments have developed mobile applications, but only a few have been effective in the long term.

6.7. At the end of years 2022 and 2023, Thailand declared COVID-19 to be an endemic, and Thailand returned to an open society and economy. It also welcomed tourists from around the world. However, the Ministry of Public Health is still using mobile applications as tools for fighting COVID-19, especially the Mor Prom mobile application, and the Mor Prom mobile application has also received more development and has become more useful in comparison to 2021. Nowadays, this mobile application can be used for COVID-19 vaccination certificate, ATK (antigen test kit) results, searches for health service units, registration for places that have strict COVID-19 rules, and health certificates.

### *The Challenges in Thailand in Managing the Smart Health Program*

The challenges in Thailand in managing the smart health program during and after the COVID-19 pandemic are as follows:

1. The costs for patients lead to public health inequality because poor people do not have access to the technology they need to address, for example, the cost of mobile health (smart phone, smart watch) and of internet access.
2. Medical technology is set up only in large hospitals, so people in rural areas do not have access to high-quality medical services. Therefore, people in rural areas have to travel to be treated in a large hospital, and in some cases, doctors in rural hospitals send patients to receive treatment in major hospitals because the local hospital cannot treat complicated diseases.
3. Applying technology for doctors and nurses is a basic problem in almost every hospital because doctors and nurses face difficulties in using new technology, so they stick to the old system.
4. Smart remedies that are not smart: smart health care in Thailand can only move forward in terms of using technology to help take care of patients with follow-ups to monitor them, but it is still impossible to conduct big data analysis to increase the efficiency of treatment.
5. Linking databases between hospitals: in Thailand, hospital databases have not been linked together, but the databases in private hospital groups have been connected.
6. Patient safety and cyber security: the regulations for disclosing patient information are also an issue because patient information is confidential and can only be viewed by a licensed physician. Therefore, there must be a high level of security to support and determine the right to access the appropriate data and to prevent patient information leaks.

## **Conclusion**

Smart health cities are meant to improve the physical and social environments and increase the community's resources, enabling people to support each other in the fulfillment of all life functions and achieve their maximum potential (WHO 1997). The emergence of COVID-19 has made technology more important in medical treatment and resulted in a paradigm

shift in medicine and public health, but on the other hand, quite a few people still cannot access technology due to lack of resources, poverty, knowledge, and physical readiness as well as physical potential. In Thailand, various technologies have been developed to solve problems during COVID-19; however, many technologies were developed too hastily, making their design inefficient. Therefore, technology design requires systems and mechanisms that are linked to practical use for each target group in the area. It must be developed to address the needs of those who will actually use it to make technology more equitable for all groups of people in society, and the government has a responsibility to support systems and mechanisms.

The healthcare industry is facing a variety of challenges, including inadequate medical personnel, the number of elderly people is increasing every year, and new diseases are emerging, the consequences of which are higher health costs for people in the country. After the COVID-19 outbreak, Thailand adapted to what is known as the new normal. Medical and public health professionals must be prepared for three key principles: (1) the safety of patients and medical personnel is paramount; (2) the congestion of patients in a medical facility must be reduced, and (3) there must be no disparity in receiving treatment. For example, the model for new medical services was set up at Pattani Province. Patients were simulated, and they were classified into three groups according to traffic lights: (1) green (low risk), (2) yellow (moderate risk), and (3) red (high risk), which were determined based on the need for direct care medical doctors and the risk of COVID-19 infection. Patients did not need to visit a healthcare facility, and patients used the mobile application to consult remotely with a doctor. Medicines and supplies will be delivered to the people at their homes with the help from village volunteers. In addition, Thailand has other technologies, such as facial recognition cameras, to measure temperature and warn people who do not wear masks. Medical service robots are being used at Ramathibodi Hospital to help deliver food and medicine, and they are ready to send equipment to measure the vital signs of the wilder at Mahidol University. Also, the robot Westie (also known as Wastie) collects infectious waste by using a mechanical arm to lift the waste bin to the storage pickup, thus reducing the risk of infection for healthcare professionals (DEPA, n.d.).

To build smart healthy cities, the government should focus on designing and renovating infrastructure as a friendly design, with city development that follows clean and green city concepts to balance modern development and environmental friendliness. For smart infrastructure, cities should collaborate with mobile network operators to develop low-cost, high-speed internet and enable 5G systems to support software and mobile applications for smart healthy cities, with the transformative power of the IoT at its core, along with complementary technologies for ICT management. To implement smart health by using technology during the COVID-19 pandemic, the government should develop only one (or a few) mobile application to monitor COVID-19 disease investigation, to record the locations people have visited, and for vaccine management, as well as using more information to encourage people to use the mobile application. In addition, the government should encourage

people who do not use a smartphone to do so or allow poor people to obtain a smartphone for free or for a low price. Moreover, governments should seriously monitor the labor camps, slums, and prisons for COVID-19 prevention, as well as control businesses such as nightclubs, bars, pubs, and casinos. In these places, many people gather without wearing masks. A case study in Thailand found that the spread of COVID-19 across Thailand in early 2021 occurred via night activities, such as at nightclubs, pubs, buffet restaurants, and illegal casinos (in Thailand, casinos are illegal). It also spread via illegal night entertainment where men paid women for sex. In addition, in May 2021, COVID-19 occurred in prisons around Thailand, and more than 10,000 prisoners were infected.

Finally, the COVID-19 crisis is an important turning point that has driven consumers and organizations. It is important to be open to and learn how to use technology faster. According to social distancing measures, such as remote work, the use of robots and automation (robotics & automation), especially in the healthcare industry, has been at the forefront of the fight against COVID-19. In addition, Thailand is facing the challenge of becoming a fully aging society populated by an increasing number of patients with chronic noncommunicable diseases; however, efficient communication system technology has allowed Thailand to develop smart healthcare for patients. In addition, medical personnel can communicate in real time, more patients' data can be analyzed, more data can be exchanged between medical doctors and the hospital, a more specific medical treatment design has become suitable for personnel and patients, patients receive healthcare services that are able to predict health problems, and patients can participate more through health surveillance via mobile phones with various applications and wearable devices.

## **Informed Consent**

We liaised with all coauthors to confirm agreement with the final statement.

## **Conflict of Interest**

We have no conflict of interest to declare, and this article does not contain any studies with human or animal subjects performed by any of the authors.

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