

# Technological solutions for screening and geolocation of COVID-19 infected people: A country comparison approach

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## ABSTRACT

**Introduction:** As the COVID-19 pandemic spreads around the world, governments are seeking solutions to mitigate contagion. These initiatives use technology to control the movement of infected people, particularly from mobile phone monitoring. This manuscript intends in the first stage to carry out a brief overview of these initiatives at the global level. After that, it aims to identify the main challenges posed by these apps in monitoring the individual's health data and explore good practices that may prove fundamental for the uptake of these solutions on a large-scale.

**Material and Methods:** This study employs a qualitative methodology to perform a review on technological solutions for screening and geolocation of COVID-19 infected people. Five countries have been selected considering the different approaches in the implementation of these technological solutions. Four fundamental principles for the evaluation of these solutions such as consent, proportionality, transparency, and security were considered. Through this approach, it has become feasible to identify and discuss the challenges and best practices in the implementation of these solutions.

**Results:** Although these applications publicly assume that they guarantee people's fundamental rights this information becomes insufficient. It is necessary to evaluate these solutions specifically considering fundamental principles such as consent, proportionality, transparency, and security. The existence of an independent body authority that can audit these solutions is relevant, besides the voluntary adherence to these applications.

**Conclusion:** The way these solutions are implemented and imposed in these countries is quite different. The absence of mechanisms to measure how data is stored and processed raise concerns among people. Accordingly, the large-scale adoption of these tools requires that people's fundamental rights be duly considered from a multidimensional perspective.

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## INTRODUCTION

The health sciences sector is one of the main focuses of technological evolution to offer technological solutions to increase the quality of life of citizens and bring health services closer to the population. Science and technology have been important elements in promoting the health and treatment of diseases. In recent years, the area of mobile health research (mHealth) has been constantly expanding. The mHealth concept encompasses the use of mobile computing and communications technologies in health care and public health [1, 2]. Mobile health applications serve a heterogeneous audience (e.g.,

physicians, nurses, patients, family members) and a wide variety of purposes that include the most diverse areas of health and disease management [3]. It is estimated that information and communication technologies and telemedicine can contribute to improving the efficiency of health services and improve citizens' quality of life, leading to more sustainable health systems [4].

The greatest advantages of using mobile devices for health are associated with the characteristics of these resources. They are personal, portable, have sensors, and are connected to the Internet [5]. Furthermore, Sannino et al. [6] state that they are intelligent

because they have processing capacity. In this way, they can be adaptable and change their behavior according to the usage pattern of users. They can serve users both in daily life and during hospitalization or rehabilitation.

mHealth has gained prominence in the field of health care interoperability. It is seen as a factor that can blur the distinction between traditional health care provision and self-administration [7]. Furthermore, it has contributed to ensuring that health records are not dispersed and can be accessed by the user [8]. However, mHealth poses challenges in the legal framework, particularly regarding the privacy of personal data, its access by the service provider and/or other users, and its sharing with other applications [9-11].

The current context motivated by the COVID-19 pandemic suggests that the use of mobile technology can support diagnosis and reduce the rate of contagion of the disease. Several mHealth initiatives have emerged in the local context promoted by the national government. In countries like China and South Korea, this approach has promoted the reduction and control of the risks of contagion [12, 13]. However, in several countries, especially in Europe, these solutions are viewed with some mistrust by governments and populations and often seen as contrary to the principles of freedom of the populations because they can expose citizens' personal data. In this sense, this short communication aims to provide an overview of several technological solutions that have promoted the control of COVID-19 and, after that, it intends to identify a set of challenges and good practices that enable its large-scale adoption.

## MATERIAL AND METHODS

Governments worldwide have promoted mHealth applications for screening and geolocation of COVID-19 infected people to mitigate their spread. These applications stand out for controlling the movement of infected people by monitoring their location based on mobile phone information. It was from Asian countries that the first examples of these applications arrived, but they have meanwhile spread and been adopted by other governments. An attempt was made to summarize these initiatives given their specifications and geographical coverage, including examples from Asia and Europe. In this sense, a qualitative approach was followed in which five case studies with different approaches are identified in the implementation of technological solutions for diagnosis and control of those infected with COVID-19. In the first stage, a summary description of the solutions adopted in each country is made. Afterward, a set of principles and specific criteria are identified to evaluate these solutions. Finally, a comparative evaluation of these solutions is

performed.

### China

In China, where the outbreak of COVID-19 was initiated, there was a tight control with the citizens to prevent the spread of the infection. Each person has a QR code that is read through the cell phone's camera. The system assigns colors to citizens according to their travel patterns in recent weeks and their state of health. Three colors are assigned: (i) green indicates that the citizen does not need to isolate himself/herself; (ii) yellow indicates that the citizen needs to isolate himself/herself for one week; and (iii) red indicates that the citizen must isolate himself/herself for two weeks. According to the color code, entry into certain public places is forbidden to those who are yellow and red [14]. Moreover, other non-integrated technological solutions have been adopted to avoid contagion, such as artificial intelligence helmets to measure temperature and recognition drones to alert people for not wearing masks in public [15].

### South Korea

South Korea was also among the first countries to adopt mHealth solutions to control the spread of the virus. A government app is adopted that lets every citizen know if they have been close to a confirmed case of COVID-19. If so, the user receives a notification and he/she will have to contact the health authorities to perform a test of COVID-19 and should be in quarantine for 15 days. Quarantine compliance is mandatory and verified by the geolocation of each person [16].

### Singapore

Singapore government advises citizens to adopt TraceTogether. Unlike the two previous examples, adherence to the application is voluntary. This was the first government app to use Bluetooth technology to track contacts of infected people. Therefore, the application does not collect data about the individual's GPS location. It anonymizes and encrypts the data and keeps these records for 25 days. Only three items are recorded in the app: (i) the mobile number, identification details, and random anonymized user [17].

### Poland

Poland was the first country in Europe to use a mobile phone application that enables police authorities to monitor the location of citizens. The application developed by TakeTask applies exclusively to persons diagnosed with COVID-19 or who have been in contact with infected persons. It is used by the police to detect possible breaches of quarantine. Police authorities contact all individuals registered with the application daily to request their

geolocation. Besides the location data, the user is asked to take a selfie, and each person has 20 minutes to check it [18]. At this stage, Poland does not yet have a contact tracing application, but efforts are being made to implement it in the short term. Additionally, it has already been established that membership is voluntary.

**Germany**

The Coronavirus-Datenspende app was developed by Tryveand Robert Koch-Institutwith the support of government authorities. The objective of this application is to restrict the spread rate of COVID-19. This requires a smartphone and a fitness bracelet or smartwatch to recognize the symptoms of a virus infection. This information is useful to detect the virus at an early stage and prevent its geographical spread. This approach offers greater reliability in virus infection indicators, as sensor data are more reliable than manually entering disease symptoms into the smartphone [19].

**RESULTS**

The large-scale adoption of technology for screening and geolocation of COVID-19 infected people assumes that these applications consider people’s fundamental rights. It is necessary to evaluate these technological solutions according to fundamental principles such as consent, proportionality, transparency, and security. Table 1 summarizes the criteria that should be implemented by applications and raises some questions that should be considered.

Furthermore, it is also essential that adherence to these applications is voluntary. Each government, together with the health authorities, must inform the population about the advantages of adopting these platforms. Equally important is to ensure that there is an independent agency that can audit the registration and processing of personal data, as advocated by Kotz et al. [20] as a way to increase the safety of mHealth technology and ensure the protection of personal health information.

Finally, the implemented solutions in each country are evaluated and compared (Table 2) according to previously established criteria.

The following scale was adopted; Y: implemented; N: not implemented; P: partially implemented; and n/a: information not available. The different approaches followed in the implementation of the solutions in each country lead to different levels of performance for each criterion. Explicit consent is only possible in voluntary adoption solutions. Only the technological solution implemented in Germany uses open-source technologies and open standards. Only in this solution, the security of data transmission can be audited.

**Table 1: Benchmark for mHealth solutions evaluation in the fight against COVID-19**

Principle	Criteria	Questions
Consent	Explicit Consent (EC)	Is there explicit consent to the processing of personal data?
	Sensitive Data (SD)	Is there specific permission, where necessary, for the processing of sensitive personal data?
	Identifiable Permission (IP)	Is the relationship between the functionality of the application and the requested permission explained?
Proportionality	Personal Data Need (PDN)	Are appropriate and necessary permissions requested for the execution of the application functionalities?
	Data minimization (DM)	Is the minimum amount of personal information required for the operation of the application?
	Data Expiry (DE)	Is an expiry date set for personal data under the temporary measures to combat COVID-19?
Transparency	Policy Inquiry (PI)	Is there a privacy policy that can be consulted by the user?
	Access to Personal Data (APD)	Do users have access to their personal data?
	Access to Third Parties (ATP)	Are users informed about the potential sharing of data with third parties?
Security	Security Measures Information (SMI)	Are users informed about the security measures implemented by the application?
	Data Transfer Security (DTS)	Is the data transfer in the application performed securely?
	Open Source and Open Data (OSOD)	Is the application code open and are open standards used?

**Table 2: Comparative evaluation of solutions implemented in each country**

Criteria	China	South Korea	Singapore	Poland	Germany
EC	N	N	Y	Y	Y
SD	N	N	n/a	N	P
IP	P	P	Y	P	P
PDN	n/a	n/a	Y	n/a	Y
DM	n/a	n/a	Y	N	Y
DE	N	N	Y	n/a	Y
PI	Y	Y	Y	Y	Y
APD	P	Y	Y	N	P
ATP	N	Y	Y	n/a	n/a
SMI	n/a	Y	Y	n/a	Y
DTS	n/a	n/a	n/a	n/a	Y
OSOD	N	N	N	N	Y

## DISCUSSION

Human Rights Watch (HRW) has considered that tracking and geolocation applications used in several countries to fight the propagation of COVID-19 pose serious risks to human rights by compromising the right to privacy and other fundamental rights [21]. In the study conducted by Van Kolschooten and Ruijter it is confirmed this view by indicating that these applications can serve as grounds for unnecessary and disproportionate citizen surveillance and control measures [22]. In this sense, public health policies should guarantee citizens' rights and freedoms.

Governments claim that these measures are temporary until the pandemic is under control and a vaccine is available. However, these justifications are viewed with some suspicion by citizens. As HRW argues, these measures in some countries could be made permanent in an expanded surveillance regime [21]. Apart from the right to privacy, other rights may be compromised, such as the right to movement, expression, and association [23]. These freedoms may be at risk if these applications are used to identify undesirable behavior, to signal unadvisable routes or destinations, or to detract in advance from groupings of personnel. In this sense, increased state digital surveillance powers threaten the rights and freedoms and citizens that may degrade confidence in public authorities.

Another risk factor pointed out by HRW is the scope of these programs that may not protect the entire population [21]. Several groups may be marginalized, such as migrant workers, refugees, and the homeless. These groups typically do not have access to the Internet and mobile technology and would, therefore, be inhibited from using these applications. This would put their health and livelihoods at risk. In the same vein, the UN [24] refers to the heterogeneity of the impact of COVID-19 on the population. Its impact

is greatest in countries with low levels of economic development and the most disadvantaged classes. The digitalization of the economy has been accelerated by COVID-19 which has resulted in people being heavily dependent on technologies to access health services and work [25]. Access to technology is unequivocally uneven for the entire population, with people on lower incomes being those most exposed to the transmission of the virus [26].

The role that technology can play in combating the spread of COVID-19 and its effects does not seem to be under discussion. Indeed, technology can be a relevant element in achieving social goals and ensuring health protection. As it is indicated by Elavarasanand Pugazhendhi, the functions of self-diagnosis and symptom control can be important in mitigating the spread of the disease and supporting the mental stabilization of users [27]. However, what is under discussion are the conditions of security in the production, access and use of the information processed, stored, and transmitted by the adoption of these platforms.

## CONCLUSION

Several mHealth applications have emerged internationally in response to the challenges of controlling the COVID-19 pandemic. These applications have the fundamental objective of mitigating the spread of the pandemic among the population. For this purpose, we can essentially find mobile applications that aim to identify sources of contagion through the geolocation of devices and Bluetooth, and applications that aim to control compliance with quarantine measures imposed by governments. In some countries (e.g. China, South Korea, Poland) these applications are mandatory for use by the population, while in other countries (e.g. Singapore, Germany) adherence to these solutions is voluntary.

These applications have raised a great debate in the community about the risks posed to human rights, such as the right to privacy, movement, expression, and association. The mandatory adherence to these applications and the absence of mechanisms to measure how data is stored and processed feed these concerns. This form of access and control of personal data can undermine confidence in public authorities and democratic systems. In this sense, it is argued that the large-scale adoption of these tools requires that people's fundamental rights be duly considered from a multidimensional perspective, considering consent, proportionality, transparency, and security. Furthermore, it is essential that adherence to these platforms is voluntary and that an independent body responsible for auditing the personal data stored and processed by the applications is established.

This study contains some limitations that need to be registered. COVID-19 pandemic is an unpredictable and fast evolving event, and the authors only had available data in a limited set of countries at the time of preparing the manuscript. The authors only discussed the relevance of technology for screening and geolocation of COVID-19 infected people and to mitigate their spread. However, technologies can and have been used for other health services during the pandemic, including conducting telehealth consultation sessions, distribute key disease control guidelines, symptom assessment and tracking, social media support group, etc. Another relevant issue is that the discussion of health data privacy greatly depends on the purpose of data use and the likelihood of privacy invasion as related to the adoption of specific data collection/storage/linkage protocols. Without knowing how contact tracing data is

collected and used, it would be difficult to assess the risk to data privacy.

## AUTHOR'S CONTRIBUTION

The author agree on this final form of the manuscript, and attested that all authors contributed in the final draft of the manuscript.

## CONFLICTS OF INTEREST

The author declare no conflicts of interest regarding the publication of this study.

## FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

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