**COVID-19 Mobile Apps: A Systematic Review of the Literature**

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**ABSTRACT**

**Background:** Contact tracing could also be a widely adopted television used to identify, assess and handle folks that are exposed to novel infectious diseases. mobile apps employing a digital technology system, called "proximity tracking", are used as a television to manage the COVID-19 pandemic.

**Objective**: the target of this review is to seem at the use of Mobile apps for contact tracing to manage the worldwide COVID-19 pandemic.

**Method**: Searches of various electronic databases, like PubMed, PubMed Central, Google Scholar, and Google were performed using the search items 'mobile app,' 'tracing' and 'COVID-19'. The search was done between 18 and 31 May 2020.

**Findings:** the invention revealed that a complete of 15 countries within the world developed and actively used 17 mobile apps for contact tracing to regulate the COVID-19 pandemic during the chosen time-frame. China and Malaysia were using only two apps. Three of the 17 apps were protected by the country's data protection laws. The results indicated that the mobile app was used to monitor self-isolating individuals, to identify persons not wearing masks, whether or not that they had close contact with an infected person, the precise time and place of encounter and confers a possible risk of infection.

**Conclusions:**Contact tracking has been revealed to be an important public health approach to fight the pandemic and other new infectious diseases. However, caution is required to generalize the usability of apps, especially in LMICs, and to deal with concerns about data anonymity, data privacy and usage, and data rights.

Keywords: COVID-19 pandemic, mobile app, contact tracing, prevention, data privacy.

1. **INTRODUCTION**

The emerging zoonotic virus infection, known as COVID-19 is affecting people all over the world causing major health crisis.With more than 5,550,000 of people worldwide, claiming the lives of more than 350,000 people across the world, COVID-19 has spread, overwhelming, and that each and every part of the world, either directly or indirectly. It is a practical option to control the spread of the infection, the antiretroviral (arv) treatment and a vaccine, but it has been in the research and development time.In light of the pandemic, as countries around the world, which is implemented by the firm to the public health and welfare measures, including the lockdown of the border, is a national recommendation for the use of the home, and many of the second order, with the goal of reducing the spread of the virus. Of the instrument, in order to ease the lockdown, the power of the surveillance technology is designed to remain in place in order to maintain the consistency of the decline of the new positive cases of COVID-19, in .In some of the countries that have already experienced the second wave of the corona virus to in some cases. As an alternative to the locking mechanism of action, and the researchers have, therefore, proposed the creation of an app-based, contact-tracing, that the disease is under control.

According to the World Health Organization (WHO) air quality guidelines, the member states are required to have a monitoring system in place, and in order to achieve a critical and evidence-based data as part of their COVID-19 response, but keep clarity, and in the personal life of the community. Digital technology, combined with artificial intelligence, and it may prove to be a welcome addition to the overall health of the worker, in the form of a real time reporting, data collection, and data analysis .Contact tracing is a widely used system for follow-up. It is used in the identification, evaluation, and treatment of individuals who may have been exposed to the disease, or have been in contact with a person exposed to the disease. Early recognition and reporting of can prove to be useful in order to break the chain of the virus. In a digital technological system, which is known as ' call tracking is gaining popularity all over the world, and is now a widely used control system for the COVID-19.

it is highly recommended that you use, in order to track down a mobile app for control of this disease. In order to mitigate the spread of the infection, it is of the utmost importance, and to all the people who came into close contact with a COVID-19 diagnosed individual.Call tracking is to estimate whether the two devices, such as smartphones, in the heart has been turned on, and the spread of the virus from an infected person to an uninfected person. A person will have in order to be notified when it is exposed to, and to take the necessary actions to be taken by the officers of health, In a recent study conducted in the uk, 74% of respondents said they definitely or probably will download and install it to a contact-tracing app.Because the vast majority of people with an interest in the use of the app, and it's for a smartphone, even in low - and middle-income countries (lmics), the right to use your app, that could be a potential

1. **METHODOLOGY**

Academic databases, search engines, such as PubMed, PubMed Central, Google Scholar, and Google, are used to collect information on the use of a mobile app to track COVID-

19. The following search terms were used alone or in combination, in a mobile app's 'find' and 'COVID-19'. The reference lists of the retrieved articles were examined, and, on the basis of the relevant evidence. The search was performed up to May 31, 2020.

**Results and Discussion:**

The search revealed a total of 15 countries around the world have developed and are actively using 17 of mobile applications to track, control of the COVID-19 pandemic during a certain period of time (Table 1). In mainland China, Malaysia, and china are the only two apps. Out of the total of 17 apps, three of which were protected by the law on the protection of personal data.

Table 1: Key characteristics of mobile app for COVID-19 tracing by different countries

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name of the app** | **Country** | **Method of data collection and type of data** | **Protected by Data Protection Law** | **Storage Policy** |
| COVIDSafe | Australia | Name, mobile no., postcode and age | Yes | All storage data will be deleted after  the pandemic |
| BeAware | Bahrain | The locations of self-isolating persons are traced and monitored  by electronic bracelet | Not available | Not available |
| Facial recognition technology | China | The monitoring system can detect fever with a difference of 0.3 °C  of accuracy and can identify persons not wearing face masks | Not available | Not available |
| Mobile payment systems (Ali Pay and We Chat) | China | Combine users' data such as location, health and financial data and, then, generate an individual personal infection  risk situation | No | Not available |
| The e-Rouŝka | Czech  Republic | Only identifies the people a person has been in contact with  by tracing the location | Yes | Data is only accessible for the  epidemiological purpose |
| CoronaApp | Columbia | Symptoms, receive preventive advice and locating individuals | Not available | Not available |
| GH COVID-19 Tracker  App | Ghana | Can trace anyone who has come in contact with an infected  person | Not available | Not available |
| VirusRadar | Hungary | If an individual is infected, the app user will be asked to share  the information with the health authorities. | Yes | Stored on the device for 14 days |
| Rakning C-19 | Iceland | Tracks users’ GPS data to collect information about the users’ encounters |  | The data is stored only on the phone and is accessible only to the user. The information is stored for 14 days and  then deleted. |
| AarogayaSetu | India | Tracks location and Bluetooth contact but also assigns color- coded badges indicating infection risk. | No | The information stored is deleted after 30 days in case a person wishes  to opt-out |
| HAMAGEN | Israel | Uses GPS location of the phone to notify the user if s/he happens to cross a COVID19 positive person and provides the  exact time and place of the encounter. | Not available | Not available |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| MyTrace | Malaysia | A community-driven application that assists users to exchange proximity information between each other once the app  detects another device with the installed app |  |  |
| MySejahtera | Malaysia | Personal data as, name, ID number, postcode | No |  |
| NZ Covid Tracer app | New  Zealand | Personal data, a digital diary of different locations that have  been visited |  |  |
| Smittestopp | Norway | Collects user info about the movement pattern of the users, and in case of one them has been in close contact with another user  who is diagnosed with Corona Virus |  | The users’ data is anonymize and data older than 30 days are  deleted continuously |
| Tatamman | Saudi Arabia | The app provides services to identified cases for follow-up and lab test results as well as users who were in contact with  confirmed cases | Not available |  |
| TraceTogether | Singapore | Allows exchange of short-range Bluetooth signals; So, everyone can trace other TraceTogother users and alert them whenever someone comes in contact with COVID-19  patient to take precautions |  | Data is automatically deleted every three weeks if the user is not exposed to a positive  case during |

**COVIDsafe**

Australia is one of the countries that have been impacted by the current COVID-19 pandemic and the negative impact of the crisis-hit sector in the country, such as health, trade, energy, finance, and toerisme.De at present, the reported cases, the (by June 30, 2020) is a 7,834 that the majority of them were between the ages of 20 and 29 years old. A total of 104 of the virus, with the vast majority of (89-89) years of age, and the country is viewed as a major up-and-coming to the recovery of 7,037 .This app has been launched with effect from the 26th of April, 2020, and any personal information such as your name, phone number, zip code, and age). A unique, encrypted code is generated for it to be created, a confirmation message. It is very sophisticated, and works by using Bluetooth signals directly to the encoded data was in close contact with each other. The laws relating to the protection of personal data, it will still have the protection of this revolutionary new app from the Privacy Amendment to the bill . For the diagnosis of COVID-19, direct communication, either verbally, are recorded and then uploaded to the COVIDSafe app in the app store on the system. The officers of health, the analysis of the data collected to track and control the virus from spreading. If an element has the same level of data protection, the person who is infected with the information, it will not be published. The user is suggested that you simply uninstall this app, and every one the stored data are going to be destroyed only the pandemic will end. The Data of the patients and their contacts, which are stored in a secure system, and it will be removed at the end of the pandemic, which, unfortunately, is to take a look at from a distance, and therefore it is of great interest. However, the erasure of the personal data, the storage system can be provided on request

**BeAware**

Bahrain is a developing country, which is not as protected from epidemics as its neighbors in the Arabian Peninsula . The first two cases were registered on 24 February 2020 and the first death case on 16 March 2020. The curve continued to rise gradually and till 11 April the reported cases were low, and later, it started rising in a big way, and the peak of the evidence was recorded on 13 June. And up-to-date (30 June 2020), Bahrain has recorded 26,239 cases and 84 deaths . The Kingdom of Bahrain authorities have developed the BeAware app. It tracks COVID-19 patients using a wearable electronic bracelet and alerts the government of any suspicious activity, and tracks movement via Bluetooth with GPS. People in self-isolation are advised to set their location. For surveillance, the health ministry requests photographs that show users' faces and bracelets. The monitoring center is alerted if the wearer moves 15 meters away from their phone. Violations are punished with fines and/or jail terms. Removing or tampering with the bracelet is considered a violation. Users need to charge their devices and ensure that the location and internet connection is on.

**Facial Recognition Technology**

China is the first country to report COVID-19 cases, the pandemic that has contributed to huge adverse effects globally. The first case in Wuhan was published in late December 2019 . Later, the cases began to rise until they reached their peak by 3 February 2020, while the death rate continued to rise from 11 January onwards . The Chinese government imposed high measures of quarantine and social distancing in the affected areas resulting in a significant reduction in both confirmed cases and deaths after April 17 and total confirmed cases and deaths as of June 30 at 85,227 and 4,648 , respectively . China has revamped existing digital surveillance systems to cover COVID-19 contact tracing. The system can detect fever with an accuracy of 0.3°C and can identify persons not wearing face-masks. The highly sophisticated facial recognition technology has been developed by Sense Time and Megwi, high-tech Chinese firms specializing in this area. Sense Time has developed temperature detection software. The enforcement of these gadgets to control the spread of COVID-19 has been promoted and supported by the Chinese government. The government considers this as an approach that will allow COVID-19 infected people to resume healthy life with complete surveillance . Mobile payment systems that include touchless money transfers and mobile wallets are popular digital payment apps in China, these apps combine users' data such as location, health and financial details and, then, create an individual personal infection risk situation. It operates in collaboration with government agencies, which then determine the conditions for users to access transportation, shops, and other public places. However, private technology companies involved in data collection and a reluctance to share information locally have hindered the government's ability to limit the spread of COVID-19 to earlier stages of the outbreak. Ant Financial, a sister concern of the technology giant, Alibaba. Ant Financial has leveraged the Alipay Health Code, which puts the public at risk for COVID-19 in color-coded categories based on aggregated and self-reported data. This then determines their freedom of movement, including the freedom to travel. The green band allows unrestricted travel, and the yellow recommends a one-week quarantine, and the red enforces a two-week quarantine

**e-Rouŝka**

The first three cases of COVID-19 in the Czech Republic were recorded on 1 March 2020, taking the number of cases since then to 9226, with 319 deaths. To slow the spread of the virus, a project within the COVID19CZ initiative (a joint venture of Czech technology companies and IT enthusiasts to fight COVID-19) was created and operates under the auspices of the Ministry of Health of the Czech Republic . The project was named "The e-Rauska" (e-facemask) and aimed to help hygienists identify people at high risk of infection by easy and adequate identification. Archived data is available to hygienists only for epidemiological purposes. The app helps in distinguishing exposed people from healthy individuals and identifying negligible contact with infected people (more than 15 minutes for a distance of less than 2m. It is believed to facilitate the gradual release of national quarantines and reduce the impact of the pandemic on society and the economy.

**Coronaapp**

In Colombia, the epidemic followed an exponential trend as the first case was reported back on 6 March 2020, where the most affected age group is 60 years. Currently (30 June), total confirmed cases are 91,769, and deaths 3,106, and the peak of the pandemic has not yet been identified on the country's curve as cases continue to rise . The government-approved CoronaApp-Colombia app allows users with provisions to register friends and family, and may report health information, including symptoms, receive preventive advice, and obtain updated information about the virus. is also able to find where the cases are located in the map . Officials removed the contact tracing feature after experiencing glitches and adopted the contact tracing technology of Apple and Google.

**GH covid-19**

Ghana recorded its first COVID-19 case on 12 March and as of 28 May 2020, Ghana has 7,768 positive cases with 35 deaths On 12th April 2020, Ministry of Communications and Health launched a mobile app for contact tracing, mentioned as "GH COVID-19 Tracker App". Ghana collected 4,786 with a test positivity rate of three .18 with enhanced contact tracing and get in touch with tracing assistance . The app works by identifying suspected cases alongside testing and tracking the contacts of confirmed positive cases of COVID-19. The app works through a mobile network platform and should detect the places a private has visited recently and inform if a private must self-quarantine after exposure. Collection and availability of knowledge through the App Ghana's COVID-19 . has been a crucial aid within the fight against

**virus radar**

The first case of COVID-19 was registered on 4th March 2020. As of 29 May 2020, Hungary has recorded 3,841 confirmed cases of COVID-19 with 517 deaths. The Ministry of Innovation and Technology on May 13 announced a politician COVID-19 tracker app named "VirusRadar". Developed by NextSense, the app used the company's contact tracing technology and was donated to authorities as support against the COVID-19 fight . The app uses Bluetooth technology and measures the space between phones while exchanging encrypted, anonymize data with other app users. The collected information is stored on the device for 14 to 2 weeks. If a person is infected, the app user will be asked to share the knowledge with the health authorities. Collected data is stored on a secure server managed by health authorities and neither location is tracked nor personal information is disclosed

**Ranking C-19**

Iceland began the corona virus fight on 28 February 2020 with its first reported case. As of May 27, a total of 1,315 COVID-19 positive cases and ten deaths have been reported. Racking C-19 was launched in early April and tracks users' GPS data to collect information about their encounters and allow investigators to locate exposed individuals. It has the most significant penetration rate of all contact trackers worldwide, with around 40% of citizens using the app. The country has managed to flatten the curve, and the numbers have been stagnant for several weeks. The last recorded COVID-19 end was on April 19, and the country has not taken drastic social measures like the rest of the world. It mostly focused on a mix of social distancing, the "bubble strategy" of dividing workplaces, and schools not interacting with each other in separate units. The success has been attributed to aggressive testing, tracing and isolation by the government. Once installed, the app runs in the background and saves the phone's location several times in an hour. The data is stored only on the phone and is accessible only to the user. This information is stored for two weeks and then deleted.

**Arogya Setu**

As of 31 May 2020, there have been 89,995 confirmed cases of COVID-19 and 5164 deaths in India. On 2 April 2020, India relased its mobile traciking app as "Aarogya Setu", which aims to facilitate efforts to limit the spread of the virus in India. As of May 26, the app has over 114 million users, more than any other contact tracing app in the world and is available in 12 languages across Android, iOS and KaiOS platforms. Aarogya Setu, unlike other similar apps, is a massive all-in-one undertaking that not only tracks location and Bluetooth connectivity but also offers colour-coded badges indicating the risk of infection.

India is that the only democratic country within the world which has made the covid-19 app mandatory for its citizens. However, the country lacks a national data privacy law, and thus there is ambiguity as to who can access the data from the app. There are concerns about blurring the line between voluntary and mandatory, between preserving privacy and moving forward. The app pioneers new data-driven flattening of curves using "syndromic mapping". So far, the app has reached over 900,000 users and has been useful in advising quarantine, testing or precaution. The overall COVID-19 positive rate is around 4.65% and of those who were instructed to get tested, 24% have been found positive for the COVID-19 infection. The app has identified around 3,500 hotspots across India using a "syndromic mapping" approach and these estimated hotspots were confirmed as actual hotspots in 17-25 days.

**hamgen**

As of 30 May 2020, Israel has 16,809 confirmed COVID-19 cases and 281 deaths. Developed by the Ministry of Health (MOH), the contact tracing app named "HamGen" was launched on 22 March 2020. The app uses a phone's GPS location to inform the user if he/she has come across a COVID-19 positive person. and provides accurate time, and encounter location. The user is then able to review, confirm or reject the notification manually. Cross-referencing of GPS history is done with MOH's epidemiological data and is stored only on the user's phone and is not accessible to any third parties. The control system of the App is voluntary and provides absolute discretion to the user.

**my sejhtera**

As of the end of January 2020, the number of COVID-19 patients in Malaysia is increasing rapidly. As a result, Malaysia has the highest number of cases in Southeast Asia at the time. Three main tracing apps were developed by various government body to contain the spread of COVID-19. The first is MyTrace, a community-driven application that helps users exchange proximity information between each other once the app detects another device with the app installed. Therefore, MyTrace is able to identify users who were close to infected individuals. It was developed through an internal collaboration between eight government agencies, the International Islamic University Malaysia and Google. The other is MySejahtera, which allows users to conduct a self-assessment and monitor progress, as well as provide any immediate intervention to the MOH if required. The third one is Gerak Malaysia, which lets users obtain travel permission while on the move control command. Additionally, it allows the MOH to trace the movement of users and contacts of potential patients. However, this app collects a lot of personal data like name, ID number, postcode, which raises concerns regarding data privacy and usage.

**NZ covid tracer app**

New Zealand is one of the countries that controlled the pandemic and is getting promising results so far. The country recorded the first COVID-19 case and death (28 February and 29 March 2020 respectively). Since the new COVID-19 pandemic, contact tracing is a top priority, aimed at identifying and isolating people who have been in contact with an infectious case, in order to prevent transmission from contact to others. Tracing was mainly done by medical, health and public health workers who specialize in infectious disease control. In addition, the MOH in New Zealand has launched the NZ Covid Tracer App on 19 May 2020 as a part of its contact tracing strategy. The app requires setting up an account that includes personal data. During registration, the user is required to create a digital diary of the various places they have visited. If the User is identified as a close contact with a COVID-19 case, the National Close Contact Service will contact the User to provide necessary advice and arrangements. Additionally, they will collect further information about users' social circle to find out if anyone may be at risk of the virus.

**smithestopp**

Since the first case of COVID-19 was detected in Norway in February 2020, public health officials have advised on well-known infection control measures, such as hand hygiene, sneezing and coughing habits, for those with COVID-19 symptoms. Isolating individuals should be avoided. Unnecessary travel, work from home if possible and contact tracing of confirmed cases. To limit the the spread of the virus, health officials have developed Smittestopp, an application supported on the Apple and Google Play stores. Smittestopp collects virtual data about users' movement patterns, and if one of them is in close contact with another user who has been diagnosed with COVID-19, the app provides advice on how to limit transmission. does. will provide one piece. Users' data is anonymous and data that is more than a month old is constantly deleted.

**Tataman**

In Saudi Arabia, the epidemic recorded a high rate so far, as the first case was reported on 2 March 2020, and the first death occurred on 24 March. Since these dates, the number of cases has been increasing, as the country is still going to peak, and the total cases recorded till 30 June 2020 are 186,436 and 1599 deaths. MOH has launched an app named "Tatman" as part of its qualitative initiative to contain the spread of COVID-19. According to the MOH, the app is aimed at those in self-isolation or quarantine to provide containment and enhance their recovery processes respectively.This application provides solutions for follow-up and laboratory test results, as well as identification for users who have been in contact with confirmed cases. In addition, all citizens coming back from abroad must wear a bracelet linked to an equivalent app.

**trace together**

Singapore's first COVID-19 cases were identified in early March 2020. So the government began implementing public health measures to control the spread and flatten the curve.The Government on 20 March 2020 launched the Trace Together application in its efforts to combat and reduce the extent of COVID-19 through community-driven contact tracing. This mobile app was developed by Government Technology Agency in collaboration with MOH. The application allows the exchange of Bluetooth signals over short distances; Hence, everyone can trace other TraceTogother users and alert them to take precautions whenever a person comes in contact with a COVID-19 patient. The application only requests a registered phone number, and no further information is collected. Additionally, if the user does not come in contact with any positive case during this period, the data is automatically deleted every 21 days.

1. **MODELING AND ANALYSIS**

**Benefits of those apps**

Many countries of the world have so far developed and launched applications with the aim of controlling the spread of COVID-19. the most strength of the apps is its 'innovation-impact', which helps health officials to watch and diagnose infected persons. consistent with Amnesty International, Bahrain's 'Beware Bahrain', Kuwait's 'Shlonik' and Norway's 'Smitstop' apps are found to be the "most dangerous mass surveillance tools" and compromise users' privacy because the apps are "actively live or doing near-live tracking. Tracing users' locations by repeatedly uploading GPS coordinates to a central server. This recent coronavirus infection has affected an outsized population globally, hence a universal mobile application system are often developed which can include all critical facilities to detect, monitor and send alerts and connectivity with health authorities and officialdom in order that they will take immediate measures. Control the spread of infection. Apples available and epidemics this is often the primary review of its kind to match and contrast their applicability in controlling

**Privacy, security concerns and challenges**

The applications mostly supported Apple and Google Play stores and were created in the spoken languages in the countries as well as English. However, this strategy has raised concern regards the data anonymizing, data privacy and usage, particularly the involvement of Google and Apple who could have access to the database which imply the question whether are the data rights being safeguarded, as well as lacking policy that will give privacy considerations when designing contact tracing apps .The use of a mobile application for tracing CoronaVirus infected patients might provide false info and some instances using the app can be difficult. It should be noted that this form of the mobile app is not a substitute for treatment or necessary follow-up. Maintenance of this system can be difficult as it would require backup systems in case of problems with the transmission. It’s unlikely that the users are at risk even in case of transmission issues as senders are usually notified. The systems require to meet data protection guidelines and also privacy and confidentiality requirements.

Moreover, the applications are installed voluntarily. Therefore it doesn’t ensure full public engagement. Till now, there's no scientific evidence that correlates the effectiveness of mobile applications and COVID-19 contact tracing. Moreover, there is no available data regards the number or percentage of people who have installed the app and are using it regularly. Additionally, the mobile applications are a continuous work that is in progress and updated periodically. Hence, the gathered knowledge might always change, which will affect data analysis. The search was not systematic. Not all databases have been searched. No previously tested or valid instrument was used to evaluate the apps.

1. **CONCLUSION**

The review reveals that the use of mobile technology is helping the health authorities to monitor and diagnose the infected individuals and thus controlling the infection to spread. The COVID-19 pandemic affected the health facilities’ responses even in developed countries with proven and state of the art modern healthcare systems . With proper utilization of these mobile contract tracing apps, it would be possible to control, detect the clusters and predict next waves during this current pandemic and future disease outbreaks. However, strong caution is warranted to generalize the usability of apps, especially in the LMICs, and to address the concerns regarding data anonymize, data privacy and usage, and data rights.

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