An overview of mobile applications (apps) to support the coronavirus disease 2019 response in India

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Background & objectives: The potential benefits of mobile health (mHealth) initiatives to manage the coronavirus disease 2019 (COVID-19) pandemic have been explored. The Government of India, State governments, and healthcare organizations have developed various mobile apps for the containment of COVID-19. This study was aimed to systematically review COVID-19 related mobile apps and highlight gaps to inform the development of future mHealth initiatives.

Methods: Google Play and the Apple app stores were searched using the terms ‘COVID-19’, ‘coronavirus’, ‘pandemic’, and ‘epidemic’ in the first week of April 2020. A list of COVID-19-specific functions was compiled based on the review of the selected apps, the literature on epidemic surveillance, and national and international media reports. The World Health Organization guideline on Digital Health Interventions was used to classify the app functions under the categories of the general public, health workers, health system managers, and data services.

Results: The search yielded 346 potential COVID-19 apps, of which 50 met the inclusion criteria. Dissemination of untargeted COVID-19-related information on preventative strategies and monitoring the movements of quarantined individuals was the function of 27 (54%) and 19 (32%) apps, respectively. Eight (16%) apps had a contact tracing and hotspot identification function.

Interpretation & conclusions: Our study highlights the current emphasis on the development of self-testing, quarantine monitoring, and contact tracing apps. India’s response to COVID-19 can be strengthened by developing comprehensive mHealth solutions for frontline healthcare workers, rapid response teams and public health authorities. Among this unprecedented global health emergency, the Governments must ensure the necessary but least intrusive measures for disease surveillance.

Key words Contact tracing - COVID-19 - India - mobile apps - mobile health - privacy - telemedicine
on January 30, 2020. As of May 5, 2020, there were a total of 46,433 active cases and 1568 deaths. The Government of India imposed a nationwide lockdown on March 24, 2020, and rapidly expanded its testing, contact tracing, and home quarantine efforts. However, an unprecedented flurry of misinformation and fake news leading to panic-driven migration, hysteric buying of masks, medicines, essential household commodities and peddling of unproven treatments.

Digital technology innovations are known to present the possibility of improving the efficacy of the health system response to an epidemic. The Ebola and Zika virus epidemics have shown the utility of mobile health (mHealth) applications (apps) for improving access to testing, contact tracing, supporting frontline healthcare workers, and raising public awareness. Recent evidence underscores the potential of mHealth initiatives for the provision of mental health services to support the patients and healthcare providers in dealing with the psychological impact of the COVID-19 pandemic. Contact tracing apps have been a crucial component of COVID-19 response in countries such as China, South Korea, Singapore, the United Kingdom, and Israel. However, owing to the collection of users’ identifiers and data related to location and Bluetooth interactions, privacy experts have raised concerns over the use of these apps.

The Government of India, launched ‘Aarogya Setu’ mobile app for the containment of COVID-19, through contact tracing and information dissemination. Further, various State governments and healthcare organizations have developed apps for lockdown enforcement, generating awareness and monitoring of quarantined individuals in India. The present study was aimed to identify and systematically review COVID-19-related mobile apps in India. Another objective was to describe the functions of the apps, map those against the WHO guidelines on Digital Health Interventions and highlight gaps to inform the development of future mHealth initiatives.

Material & Methods

The Google Play and the Apple app stores were searched using the terms ‘COVID-19’, ‘coronavirus’, ‘pandemic’, and ‘epidemic’, individually. In addition, a free-text search was run for COVID-19-related apps using the phrase ‘COVID-19 mobile apps in India’. The search was conducted in the first week of April 2020 and updated on May 3, 2020. The preliminary screening of the apps was based on the app titles and full description. The games, apps without English or Hindi language user interface, and apps on infectious disease without a specific focus on COVID-19 were excluded.

A list of COVID-19 specific functions was compiled based on the review of the selected apps, the literature on epidemic surveillance, and national and international media reports. The WHO guideline on Digital Health Interventions was used to classify the app functions under the categories of the clients (general public), health workers, health system managers and data services. Information related to name, developer, target user group and COVID-19-specific function was abstracted from the selected apps. Frequencies and percentages were used to summarize the information abstracted from the apps.

Results

A total of 346 potential COVID-19 apps were identified, of which 50 met our inclusion criteria. All the apps selected were free to download, with no in-app purchase options/requirements. State health/municipal departments were the launching agencies for 41 (82%) of the existing COVID-19 apps in India. Private/non-government developers and the Government of India launched seven (14%) and two (4%) apps, respectively. Figure 2 provides information about the target users of the apps. Two-thirds of the

![Fig. 1. Screening process flowchart.](http://www.ijmr.org.in/articles/2020/151/5/images/IndianJMedRes_2020_151_5_468_284753_sm5.pdf)
apps (n=34) were developed for the general public, 19 (38%) for quarantined individuals or foreign travellers currently residing in the Indian States, and two (4%) for caregivers. One (2%) app each was designed for tested individuals, police officials, and researchers, respectively.

The Table lists the functions of the selected COVID-19 apps and maps these against the WHO guideline recommendations on digital health interventions for health systems strengthening. Dissemination of untargeted COVID-related information on preventative strategies was the function of 27 (54%) apps. Nineteen (38%) apps were developed to monitor the movements of quarantined individuals. On-demand information services through chatbots or telephonic helplines were available only in 19 (38%) apps. Fifteen apps (30%) provided users with a self-risk assessment function based on a set of screening questions related to their symptoms, occupations, travel history, and contact history. Information on the availability of COVID-19 testing facilities was available in six (12%) apps. Four (8%) apps had a provision for booking teleconsultation or testing appointments. The availability of an electronic pass for movement during the lockdown was the only health workforce-specific function available in four (8%) apps. In terms of the data for health managers and policy decisions, nine (18%) apps provide aggregation and visualization of the State governments’ data related to confirmed cases and deaths. Eight (16%) apps had a contact tracing and hotspot identification function.

Discussion

It was found that governments, including the Union government and 22 State and Union Territories, invested in the development of mobile apps to deal with this crisis. While there were differences in the State-specific information in the apps developed by different States, the system architecture and many of the functionalities, including self-testing, quarantine monitoring and contact tracing, were common between these State-level apps. The Ministry of Electronics and Information Technology, Government of India, has taken proactive measures to promote the installation and usage of the Aarogya Setu app, which is currently available in 11 Indian languages. The penetration of the app is critical to the success of the technology-enabled contact tracing. Evidence suggests that 70 per cent of the population should have the app installed for the digital contact tracing efforts to be effective. The current technological plurality in the absence of robust data exchange mechanisms and Centre-State coordination, can be detrimental for technology-assisted contact tracing in a heterogeneous country like India, especially once the lockdown ends and free movement of people starts. Overcoming this challenge requires the State and the Union Government to ensure the mass installation of a single contact tracing app collaboratively. In contrast, the State-specific apps would still be a vital medium of providing context-specific information and supporting local health systems.

The review of the app functionalities revealed that information dissemination regarding the preventative measures was the primary function of the majority of the existing apps in India. The apps reviewed in this study did not have specific strategies to deal with the infodemic. Only two apps, had a fake news control segment. Several apps had a provision related to teleconsultations. The Ministry of Health and Family Welfare, Government of India, has formally recognized remote consultation through recent Telemedicine practice guidelines. With the growing number of COVID-19 cases, there is an urgent need to create integrated teleconsultation options within these apps to assure quality healthcare services, including those with pre-existing conditions. Another notable finding was that the majority of the apps did not have functionalities to assist the hospitals or healthcare workers. In contrast, frontline hospital workers were using mobile apps to compile clinical notes and track the use of protective equipment and ventilator in the United States.

In terms of privacy, all the contact tracing and quarantine monitoring apps reviewed in this study collected user data such as name, phone number, real-time location, and Bluetooth interactions with other app users. While the collection of the location
| WHO recommendations | COVID-19 related functions | n (%) |
|---------------------|---------------------------|-------|
| **Clients**         |                           |       |
| Targeted client communication | Availability of testing services and protective equipment for high-risk population | 6 (12.0) |
| Untargeted client communication | Preventive measures and demystification | 27 (54.0) |
| Client to client communication | Community forums for patients and family members | 0 (0.0) |
| Personal health tracking | Symptom tracker | 6 (12.0) |
| | Self-risk assessment | 15 (30.0) |
| | Quarantine monitoring | 19 (38.0) |
| Citizen based reporting | User feedback on services | 2 (4.0) |
| On-demand information services to clients | Information provision through chatbots or helpline | 19 (38.0) |
| Client financial transactions | Manage out of pocket payment by service users | 0 (0.0) |
| **Health workers**  |                           |       |
| Client identification and registration | Enrol user for health services/clinical care | 0 (0.0) |
| Client health records | Longitudinal tracking of user’s health status | 0 (0.0) |
| Health worker decision support | Job-aid for frontline health workers | 0 (0.0) |
| Telemedicine | Teleconsultation and testing appointments | 4 (8.0) |
| Health worker communication | Provider to provider communication | 1 (2.0) |
| Referral coordination | Manage referrals between points of service within the health sector | 0 (0.0) |
| Health worker activity planning and scheduling | Electronic pass for the movement of the health workers during the lockdown | 4 (8.0) |
| Health worker training | Train new and existing healthcare staff | 0 (0.0) |
| Prescription and medication management | - | - |
| Laboratory and diagnostics imaging management | Testing for COVID-19 | 0 (0.0) |
| **Health system managers** |                           |       |
| Human resource management | Human resource monitoring for hospital staff | 0 (0.0) |
| | Participation/volunteer recruitment | 1 (2.0) |
| Supply chain management | Monitor stock levels of health commodities | 0 (0.0) |
| Public health event notification | Notification of confirmed cases | 14 (28.0) |
| | Contact tracing | 8 (16.0) |
| | Hotspot identification | 8 (16.0) |
| Civil registration and vital statistic | Notification of deaths | 13 (26.0) |
| Health financing | Accepting donations from contributors | 4 (8.0) |
| Equipment and asset management | Monitor status of beds and ventilators | 0 (0.0) |
| Facility and asset management | Priority checklists for facility management | 0 (0.0) |
| **Data services**   |                           |       |
| Data collection, management, and use | Data storage, aggregation and visualization | 9 (18.0) |
| | Prediction on future trends of disease | 0 (0.0) |
| Data coding | - | - |
| Location mapping | Map location of health facilities | 9 (18.0) |
| | Location data recording or Bluetooth handshakes | 19 (38.0) |
| Data exchange and interoperability | Data exchange across systems | - |
data is essential for mapping hotspots of disease transmission, privacy experts are concerned about this data being a hazard for an individual’s privacy and national security. The collection of location data in South Korea and China has sparked global concerns related to privacy and potential mala fide use of the data. To counter this, countries like Singapore and Argentina are using tracking apps that only collect Bluetooth interaction data to preserve user privacy. To ensure transparency, Singapore and Israel have shared their app source code with researchers for an independent audit. In the absence of a data protection law in India, the Central and State governments need to address these privacy-related concerns to garner public trust that would ensure the deployment of these apps at scale.

This study had a limitation that the user feedback on these apps was not assessed. Despite this limitation, this study has important implications for informing the development of future COVID-19 mHealth initiatives in India. These apps are a medium of disseminating disease-related awareness and knowledge at the population level. In a hysteric environment and a severe shortage of testing facilities, the self-risk assessment function available in the apps may help spot the patients at risk for COVID-19.

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| App Name                  | State                          | Target User Group               | COVID-19 related app functionalities                                                                                                                                                                                                 |
|--------------------------|-------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Aarogya Setu**         | Multiple States, developed by Government of India | General public                  | Preventive measures and demystification, Self-risk assessment, Information provision through chatbots or helpline, Electronic pass for the movement of the health workers, Contact tracing, Accepting donations from contributors, Location data recording or Bluetooth handshakes |
| **COVID-19 Quarantine Monitor Tamil Nadu (official)** | Tamil Nadu                   | Quarantined individuals          | Symptom tracker, Quarantine monitoring, Location data recording or Bluetooth handshakes                                                                                                                                                   |
| **MP COVID RESPONSE APP** | Madhya Pradesh; General public; Hospitals; Government authorities | General public                  | Preventive measures and demystification, Hotspot identification, Data storage, aggregation, and visualization                                                                                                                                  |
| **COVA Punjab**          | Punjab                        | General public                  | Availability of testing services and protective equipment for high-risk population, Preventive measures and demystification, Self-risk assessment, Information provision through chatbots or helpline, Notification of confirmed cases, Notification of deaths, Data storage, aggregation, and visualization, Map location of health facilities |
| **GoK - Direct Kerala**  | Kerala                        | General public                  | Preventive measures and demystification                                                                                                                                                                                                    |
| **Quarantine Watch**     | Karnataka                     | Quarantined individuals          | Quarantine monitoring, Information provision through chatbots or helpline, Location data recording or Bluetooth handshakes                                                                                                                                 |
| **Test Yourself Goa**    | Goa                           | General public                  | Availability of testing services and protective equipment for high-risk population, Map location of health facilities                                                                                                                                 |
| **Jaano**                | Multiple States               | General public                  | Availability of testing services and protective equipment for high-risk population, Map location of health facilities                                                                                                                                 |
| **Corona Watch**         | Karnataka                     | General public                  | Preventive measures and demystification; Information provision through chatbots or helpline; Contact tracing; Hotspot identification; Data storage; aggregation; and visualization; Map location of health facilities; Location data recording or Bluetooth handshakes |
| **COVID19 Feedback**     | Multiple States, developed by Government of India | Tested individuals              | User feedback on services                                                                                                                                                                                                                   |
| **Mahakavach**           | Maharashtra                   | Quarantined individuals          | Quarantine monitoring; Contact tracing; Hotspot identification; Location data recording or Bluetooth handshakes                                                                                                                                 |
| **CoBuddy - Covid19 Tool** | Multiple States               | General public; Quarantined individuals | Preventive measures and demystification; Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                 |
| **GCC - Corona Monitoring** | Tamil Nadu                  | Quarantined individuals          | Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                                                   |
| **KSP Clear Pass Checker** | Karnataka                    | Police officials                | Electronic pass for the movement of the health workers                                                                                                                                                                                      |
| **CG Covid-19 ePass**    | Chhattisgarh                  | General public                  | Preventive measures and demystification; Electronic pass for the movement of the health workers                                                                                                                                               |
| **Test Yourself Puducherry** | Puducherry                   | General public                  | Availability of testing services and protective equipment for high-risk population; Self-risk assessment; Information provision through chatbots or helpline                                                                                                                                 |

Contd...
| App Name                           | State       | Target User Group | COVID-19 related app functionalities                                                                                                                                                                                                 |
|-----------------------------------|-------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COVID-19 West Bengal Government   | West Bengal | Quarantined individuals | Symptom tracker; Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                                   |
| West Bengal Emergency Fund        | West Bengal | General public    | Accepting donations from contributors                                                                                                                                                                                                     |
| Kavach                           | Chhattisgarh | General public    | Preventive measures and demystification; Self-risk assessment; Notification of confirmed cases; Contact tracing; Hotspot identification; Notification of deaths; Data storage; aggregation; and visualization; Location data recording or Bluetooth handshakes |
| SMC COVID-19 Tracker             | Gujarat     | Quarantined individuals | Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                                                   |
| Niramaya                         | Madhya Pradesh | General public | Preventive measures and demystification; Self-risk assessment; Information provision through chatbots or helpline; Teleconsultation and testing appointments; Notification of confirmed cases; Notification of deaths |
| Uttarakhand CV 19 Tracking System | Uttarakhand | General public    | Self-risk assessment; Information provision through chatbots or helpline                                                                                                                                                                   |
| nCOVID-19 Nagaland - Visitors App | Nagaland     | Quarantined individuals | Preventive measures and demystification; Self-risk assessment; Quarantine monitoring; Information provision through chatbots or helpline; Location data recording or Bluetooth handshakes |
| Corona Mukt Himachal Prades      | Himachal Prades | Quarantined individuals | Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                                                   |
| UP Self- Quarantine App          | Uttar Pradesh | Quarantined individuals | Quarantine monitoring; Location data recording or Bluetooth handshakes                                                                                                                                                                   |
| Trackmetric-An initiative by Morigaon Police; Assam | Assam | General public    | Preventive measures and demystification; Information provision through chatbots or helpline; Contact tracing; Hotspot identification; Data storage; aggregation; and visualization; Map location of health facilities; Location data recording or Bluetooth |
| COVID-19 Odisha                  | Odisha      | General public    | Preventive measures and demystification; Self-risk assessment; Notification of confirmed cases; Contact tracing; Hotspot identification; Notification of deaths; Location data recording or Bluetooth handshakes |
| RajCovidInfo                     | Rajasthan   | General public    | Preventive measures and demystification; Notification of confirmed cases; Notification of deaths; Data storage; aggregation; and visualization                                                                                                                                                   |
| T COVID’19                       | Telangana   | General public    | Availability of testing services and protective equipment for high-risk population; Preventive measures and demystification; Self-risk assessment; Information provision through chatbots or helpline; Teleconsultation and testing appointments; Notification of confirmed cases; Notification of deaths; Data storage; aggregation; and visualization; Map location of health facilities |
| COPE Odisha                      | Odisha      | General public; Quarantined individuals | Preventive measures and demystification; Symptom tracker; Self-risk assessment; Quarantine monitoring; Contact tracing; Hotspot identification; Location data recording or Bluetooth handshakes |
| Covid Locator                    | Goa         | General public; Quarantined individuals | Quarantine monitoring; Contact tracing; Hotspot identification; Location data recording or Bluetooth handshakes                                                                                                                                 |

Contd...
| App Name                  | State                  | Target User Group                      | COVID-19 related app functionalities                                                                 |
|--------------------------|------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------|
| COVID CARE               | Arunachal Pradesh      | General public; Quarantined individuals | Symptom tracker; Quarantine monitoring; Contact tracing; Hotspot identification; Location data recording or Bluetooth handshakes |
| Corona-Care              | Multiple States        | Quarantined individuals                | Symptom tracker; Self-risk assessment; Quarantine monitoring; Information provision through chatbots or helpline; Teleconsultation and testing appointments; Location data recording or Bluetooth handshakes |
| CoronaFACTS             | Multiple States        | General public                         | Preventive measures and demystification; Notification of confirmed cases; Notification of deaths; Data storage; aggregation; and visualization |
| COVID-19!                | Multiple states        | General public                         | Preventive measures and demystification; Notification of confirmed cases; Notification of deaths; Data storage; aggregation; and visualization |
| BMC Combat Covid19       | Maharashtra            | Quarantined individuals                | Quarantine monitoring; Information provision through chatbots or helpline; Data storage; aggregation; and visualization; Location data recording or Bluetooth handshakes |
| COVID-19 Care Tamil Nadu - (Official) | Tamil Nadu        | General public; Quarantined individuals | Preventive measures and demystification; Self-risk assessment; Quarantine monitoring; Notification of confirmed cases; Hotspot identification; Notification of deaths; Accepting donations from contributors |
| T COVID’19               | Telangana              | General public                         | Availability of testing services and protective equipment for high-risk population; Preventive measures and demystification; Information provision through chatbots or helpline; Teleconsultation and testing appointments; Notification of confirmed cases; Accepting donations from contributors; Map location of health facilities |
| Haryana Sahayak          | Haryana                | General public                         | Preventive measures and demystification; Self-risk assessment; Notification of confirmed cases; Notification of deaths; Map location of health facilities |
| Trackmetic - (Niramoy) by Morigaon Police; Assam | Assam                 | General public                         | Preventive measures and demystification; Information provision through chatbots or helpline |
| NMC COVID-19             | Maharashtra            | General public                         | Preventive measures and demystification; Information provision through chatbots or helpline; Map location of health facilities |
| Sahaaya Setuve          | Karnataka              | General public                         | User feedback on services; Participation/volunteer recruitment |
| House Quarantine AP Police | Andhra Pradesh       | Quarantined individuals                | Preventive measures and demystification; Quarantine monitoring |
| Ayush Kavach            | Uttar Pradesh          | General public                         | Preventive measures and demystification; Information provision through chatbots or helpline |
| Telangana Covid19 Tracker | Telangana            | Quarantined individuals                | Quarantine monitoring |
| RajCop Citizen           | Rajasthan              | General public                         | Electronic pass for the movement of the health workers |
| Fight Covid              | Maharashtra            | Quarantined individuals                | Quarantine monitoring |
| Odisha COVID Dashboard   | Odisha                 | General public                         | Preventive measures and demystification; Self-risk assessment; Notification of confirmed cases; Notification of deaths; Map location of health facilities |

Contd...
| App Name      | State            | Target User Group                  | COVID-19 related app functionalities                                                                 |
|---------------|------------------|------------------------------------|-------------------------------------------------------------------------------------------------------|
| COVID19Connect| Multiple States  | General public; Researchers        | Preventive measures and demystification; Information provision through chatbots or helpline; Provider to provider communication; Notification of confirmed cases; Notification of deaths; Map location of health facilities |
| WashKaro      | Multiple States  | General public                     | Preventive measures and demystification; Symptom tracker; Information provision through chatbots or helpline; Notification of confirmed cases; Notification of deaths |