A map point on the role of the telemedicine and e-Health in the digital contact tracing during the COVID-19 pandemic

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Abstract: In public health, independently by the technology use, contact tracing (CT) is the process of identifying people who may have met an infected person and subsequent collection of further information on these contacts. The differences between the potential methods of carrying out CT in 2003, during the SARS epidemic, and the current one SARS-CoV-2 are considerable. During the previous pandemic, current mobile technologies were not available (in particular the smartphone as we know it today). The role of the mobile technology—and therefore of the mobile Health (mHealth)—was and is basic during this pandemic for the digital contact tracing (DCT). The review, starting from the introduction of contact tracing performed manually, faced the potentialities and the technologies used for DCT based on dedicated APPs, interrogating on the state of development and on the aspects affecting the effectiveness of the DCT. From this review, various phases of the dissemination of medical knowledge around these Apps emerged. In a first phase, the novelty was high as well as the consequent difficulty on the part of epidemiology to set a concrete approach on them. Subsequently, scientific knowledge has spread, publications have increased and even the great IT giants have moved in the development of solutions. It was highlighted that hundreds of Apps have been/ proposed and/or are under development in the World according to different approaches in terms of the (I) technologies, (II) protocols (Bluetooth and Global Positioning System), (III) centralized governmental choice. The review in a first part extracted some important experiences in this Area captured during the first period; In a second part extracted some important outcomes from research of the next phases. The review ends pointing out the reasons for success/failure of the DCT and the lessons for the future for the epidemiologist.

Keywords: Digital contact tracing (DCT); mhealth; COVID-19; digital health

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Introduction

The COVID-19 pandemic has allowed unprecedented development of telemedicine systems (1). Furthermore, it was possible to explore specifically new boundaries of mHealth and electronic health (eHealth) (2). Among the new directions/boundaries of development of mhealth we find one focused on epidemiology. It consists of technological support to the sector of Contact Tracing with App-based digital technologies and specially designed algorithms and informative systems. This technological support is usually called digital contact tracing (DCT). Before the COVID-19 pandemic, the need to tackle this issue of epidemiology from a technological point of view was never really felt. In the case of the COVID-19 pandemic, the rapidity and ease of spreading of the SARS-Cov-2 virus infection together with the need to implement the consequent social distancing have been a push for

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inventiveness in this sector. Some countries pushed towards DCT during the emergency phase of the pandemic. Other countries decided to push towards DCT during the restart phases, taking into account that the telemedicine experiences successful in the first emergency phase could be repeated in the subsequent phases (3). Other countries have found these technologies useful at all stages of the pandemic. The objective of this review, from a general point of view, is to focus on the DCT and face the technological evolution that has taken place in the telemedicine field as regards the support for this sector. In detail the review deals with:

(I) A necessary description of contact tracing (CT) and its phases from a merely epidemiological point of view;
(II) A map point (analysis of the status) regarding some relevant experiences of DCT;
(III) An analysis of the problems affecting the effectiveness of DCT.

The "manual" contact tracing

We recently heard a lot about CT associated with digital technologies. So much to make us believe in the belief that CT is one whole with digital technologies. However, this is not the case. CT was born in epidemiology as an activity done with paper, pencil, diary, questionnaires and paper maps by health workers and workers of other sectors of the state who went door to door to reconstruct the contacts of infected subjects, often called positive subjects.

In public health, independently by the technology use, CT is the process of identifying people ("contacts") who may have met an infected person and subsequent collection of further information on these contacts. By tracing the contacts of infected individuals, checking if they are infected, treating the infected and tracing their contacts in turn, public health action aims to reduce contagion and therefore infections in the population. The infectious diseases for which CT is commonly performed are numerous, ranging from tuberculosis to EBOLA. CT has been applied to the SARS-Cov epidemic and is currently applied to COVID-19 (that is, the disease associated with the SARS-Cov-2 virus). We find the exact definition of CT starting from the guidelines of the World Health Organization (WHO) (4).

"Contact tracing is defined as the identification and follow-up of persons who may have come into contact with an infected person".

CT (4) is divided into three essential activities: (I) contact identification (CI); (II) contact listing (CL) (III) and contact follow-up (CF).

- ❖ CI is an essential part of the epidemiological investigation and is carried out according to standard procedures concerning this discipline starting from cases that can be identified as suspect, probable or confirmed. The CI is of course also carried out starting from the cases of death attributable to the investigated epidemiological factor.
- ❖ CL concerns all people who have had significant exposure (falling into the category described above). They should therefore be listed according to standard procedures. Particular care must be taken to identify each contact listed and provide it with information relating to its contact status and the correct indications to follow.
- ❖ CF is a declared intensive CT-related activity that involves numerous professionals (from epidemiology, public health, law enforcement, the community, government bodies, medicine and safety at work, volunteering, and other figures) which takes time for interviews in which attempts are made to reduce identification errors and assignment of status by direct interview. CT is often confused with this activity.

The SARS-CoV-2 versus the SARS-CoV: The new mobile technology potential pushes the manual contact tracing in the digital direction

The substantial difference between the potential methods of carrying out CT in 2003 during the SARS epidemic and the current one SARS-CoV-2 are considerable. During the previous pandemic, current mobile technologies were not available and in particular the smartphone as we know it today was not available. Indeed (5) only in 2008 we gradually witnessed the development of mobile technologies as we know them today; thanks to the smartphone, which has, compared to previous mobile technologies, peculiar characteristics. In general, the smartphone (*Figure 1*) as we know it today differs from the mobile phone due to the simultaneous presence of the following features:

- ❖ The increased memory, a higher calculation capacity, a much more advanced data connection capacity due to the presence of dedicated operating systems;
- ❖ A great potential for the production and the management of multimedia content such as taking

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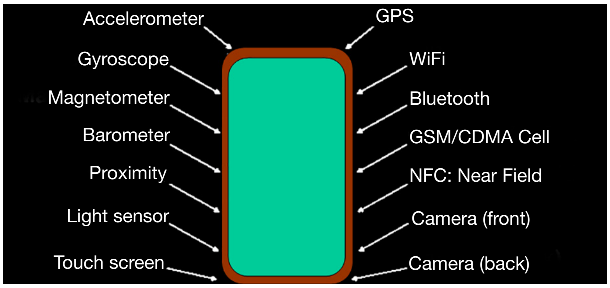

Figure 1 The smartphone potentialities in brief.

high resolution photos, producing video clips;
- ❖ The ability to easily install free and/or paid features and/or applications (Apps);
- ❖ The provision of a high resolution touch screen;
- ❖ The possibility of using/operating a virtual keyboard to interact with the various device functions (from the address book to the notepad), with the web, with the various installed applications and with the so-called social networks;
- ❖ Integration with sensors such as accelerometers, gyroscopes, magnetometers, thermometers and even in the most advanced models: photoelectric sensors, depth laser sensors, Hall effect sensors, proximity sensors, barometers;
- ❖ The possibility of wireless, WiFi or Bluetooth tethering to devices such as other smartphones or mobile phones, laptops or desktop computers;
- ❖ Availability of GPS sensors.

Many of such functionalities can be useful for the DCT.

Why the DCT can be useful

Ferretti *et al.* (6) explored in the first phases of the pandemic the feasibility of protecting the population (that is, achieving transmission below the basic reproduction number) using isolation coupled with classical CT by questionnaires versus algorithmic instantaneous contact tracing assisted by a mobile phone application. The authors concluded that although SARS-CoV-2 is spreading too fast to be contained by manual contact tracing, it could be controlled if this process was faster, more efficient, and increased in scale. A CT APP that builds a memory of proximity contacts and immediately notifies contacts of positive cases can achieve epidemic control if used by enough people. By targeting recommendations to only those at risk, epidemics could be contained without resorting to mass quarantines (“lockdowns”) that are harmful to society. Therefore according to these authors the DCT could be useful to control the COVID-19 epidemic. Similarly to manual CT, described before, in the DCT, 3 phases can be identified:

- ❖ The digital contact identification (DCI);
- ❖ The digital contact listing (DCL);
- ❖ The digital contact follow-up (DCF).

Updatings sources for DCT experiences in the first phases: the difficulties

Since the outbreak of the pandemics, the world has shown, starting from Asian countries, an intense development and use of DCT with different approaches in terms of technology use and invasiveness in the sphere of individual privacy. Since the outbreak of the pandemic, numerous APPs have been developed for the DCT.

The first period of the pandemic (up to June 2020) was characterized by difficulties in finding usable documentation due to the novelty of the intervention.

During the first period the news/updating we had could be found more:

(I) Through the datasheets available in the App stores;
(II) Through the news/updating on the Web;
(III) Through the Blog sites/discussion sites.

To a lesser extent, we have news through:

(I) Public documentation, which in some cases has been made available, as in the case of the public white paper provided online by the designers of the App for DCT “Private Kit: safe Path” (7) in USA or as in the case of the Web link by Italian APP for DCT Immuni (8);
(II) Scientific publications; which in the first period of pandemic (“App contact tracing COVID-19”) up to 15 June 2020, reported 8 works (6,9-15).

Mobile-Technologies and approaches used for App based DCT

In general, CT APPs are based on two main approaches (*Figure 2*).

- ❖ The first approach is based on GPS to accurately track both positive and possible contacts taking into account the high precision that GPS systems can present. With Geo-Tracking via GPS (10,11), it is identified if the paths of two individuals have crossed.
- ❖ The second approach uses Bluetooth also in the

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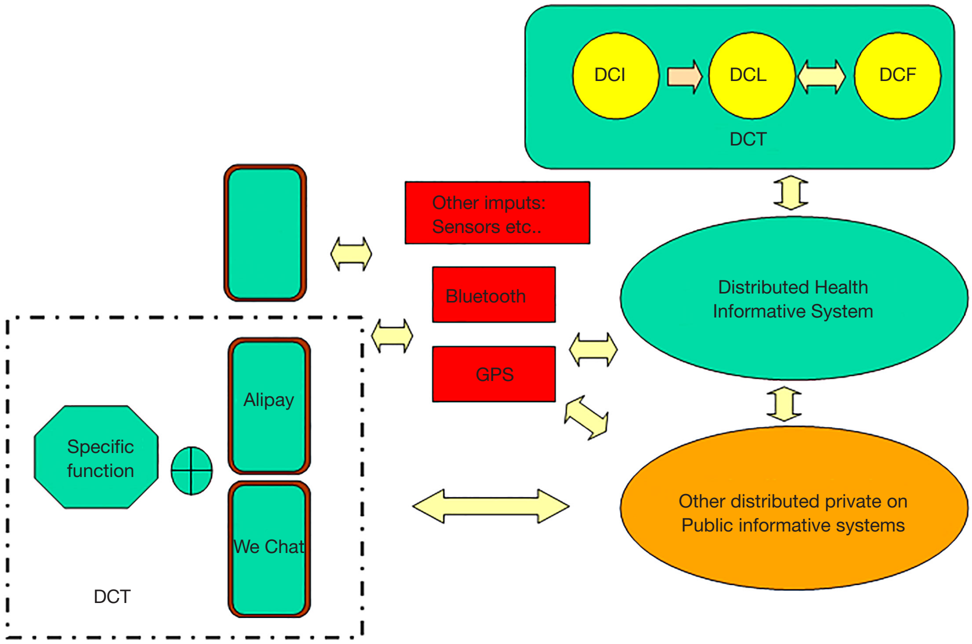

Figure 2 The App/App architectures for DCT. DCT, digital contact tracing.

recent low energy (BLE) version introduced in 2011 (13,14). This technology allows, at a distance ranging from 1–2 meters to tens of meters, to record the presence of another device and estimate its distance based on the signal strength. Some studies report that the second approach can allow excellent respect for privacy and specific developed protocols are today available in this direction such as, for example, the Decentralized Privacy-Preserving Proximity Tracing (DP-3T) (16) (elaboration directly in the smartphone) and the Pan-European Privacy-Preserving Proximity Tracing (Pepp-pt) (elaboration in a central server) (17).

Furthermore, of course, additional systems can also be used. For example, accelerometers (or other inertial sensors) can be used to report contemporary events that can help (such as two people travelling on a bus) or sources from other networks and/or distributed databases. In some cases no specific Apps have been developed, as in China, where a very peculiar and innovative informatic approach has been employed. A Chinese peculiarity is the great use of WeChat (used pervasively by citizens like our WhatsApp offering countless functions suitable for daily use) and AliPay (the Alibaba payment system) as these two platforms have conquered the habits of the population. The Chinese government decided to develop functions attached to these two Apps and to use therefore also data provided by the correlated network/data sources to activate DCT (15). This was applied during the assignment of a Health code.

In general in some cases we have witnessed the birth of government APPs while in other cases we have not, on the basis also of the political organization.

The initial use of DCT: the Asian experience

It is basic as Map point (analysis of status) of DCT the Asian experience of Chine, Singapore and North Korea, the first nations to face the DCT. As it has been introduced before, the strategy of the Chinese government was to not create an additional App, but to integrate a tool with two popular APPs. In this way the government can trace/monitor the pandemic by WeChat and Alipay to the tool. The tool created specifically by the Chinese government for the control of infection is the system called Health Code. Health Code, automatically assigns people one of the three color codes (green, yellow and red) in relation to their state of exposure to the pandemic.

Starting from China, APPs for DCT were spreading in Asian countries. Singapore used a Broadcasting model, for the DCT. The system was centralized on servers of

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the National Center for Infectious Diseases (18). The App, prepared by the government is relatively simple and functional. The subjects in the DCL could be monitored using the position of their phone.

South Korea also used digital APPs for DCT. The Corona 100 App, for example, crosses the user's geolocation data (GPS) with those provided by the government. Using the GPS the Corona 100 App (18,19), give you an alter by an SMS when you approach within 100 m of a probably suspected positive subject.

Following the experience of Asian countries, other solutions have been developed, a detailed examination of which is naturally impossible.

Towards DCT in USA and Italy: between nationally and not nationally centralized Apps

Following the experience of Asian countries, other solutions have been developed, a detailed examination of which is naturally impossible. The United States has also acted with technological innovation to deal with the epidemic. It was not decided here to spread a governmental APP here in consideration to the Federal organization. Some of these efforts have been dedicated to the assessment of solutions that overcome the privacy problems experienced by the Apps used in the Asian world. Among the many experiences we report, as a not exhaustive example, a first experience of the Massachusetts Institute of Technology (MIT) related to the creation of the App "Private Kite: Safe paths" and to the publication of the White paper (7,20). This App has been available in a prototype version since March 17 on the Google play (20,21) and App Store stores. The experience of design of this APP had a great resonance in the World, also outside the USA as it is possible to see, navigating the Web. The APP uses both GPS and BT. This App allows you to monitor movements in respect of privacy; and allows you to rebuild the network of contacts of those who have become infected with COVID-19. Users can download information about the encrypted positives' positions so that they can self-determine their likely exposure to COVID-19. The App can do this without collecting user information in an external cloud prevents government surveillance. After this experience the MIT faced a second important experience in the study of protocols for DCT and proposed the BT based protocol private automated contact tracing (PACT) (22). The protocol has been designed for identifying people at risk of infecting COVID-19, by using the Bluetooth signals that our cell phones send each other. Privacy is a solid rock value in the protocol so the system can notify individuals of potential contacts without revealing any private information to other individuals, the government, health care providers, or cell service providers. In Italy, it was decided to use a governmental APP, the non-compulsory immune App (23) was launched after a selection at the government level of among 319 participants (24). The APP, which works via BLE, using the Dp-3T protocol, was designed by Bending Spoons and is available for download from June 1st on iOS and Android. The App operates in respect of users' privacy. The Immuni App can be freely downloaded, no one is obliged to install it, but the download is only on a voluntary basis. It is based on a DCT system that uses BLE technology, to detect the proximity between two smartphones in the order of one meter. In this way, the APP keeps on the device of each citizen a list of anonymous identification codes of all the other devices to which it has been close within a certain period. If a citizen is positive, with a mapping code can automatically upload the alphanumeric strings sent from his or her APP to other smartphones to a cloud server. The server in turn sends these strings to all the APPs in circulation and it is the individual smartphones that calculate the risk of exposure to infection for each identifier on the basis of parameters such as physical proximity and time, generating a list of users more risk to which you can send a notification on your smartphone. Therefore, the server never has knowledge of the meetings between users.

Ongoing initiatives of DCT in the word: the moving of the Giants

In the second wave of the 2020 as it is easy to verify on the sites of the two giants Apple and Google in USA moved to support the DCT, these multinationals are launching a complete solution that includes programming interfaces (API) and technologies at the operating system level to facilitate the activation of CT, the Google & Apple' exposure notifications API (G&A-EN-API). The initiative was relevant in consideration of the fact that almost all use the iOS and Android operating systems that rest respectively on Apple and Google for technologies and virtual App stores made available (Apple store and Play store). It is evident that the App for DCT based on the G&A-EN-API will have a better integration with the Android and iOS operating systems.

Many countries in different parts of the world moved to the creation of APPs for DCT, with a different approach

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towards privacy. Making a list of these APPs is impossible as there is an update hour by hour: only at the selection of the Italian national App were proposed 319 Apps!

The situation of publication on DCT now

We can identify 3 waves of the spread of the pandemic. In the first wave as we have previously described the 'documentation and information on DCT were mainly accessible through resources other than those of the scientific literature.

In the second half and now in the first weeks of the third quarter we have seen an adequate production of scientific literature.

A search with (COVID-19) AND (Digital contact tracing) reports a number of publications. We focalized ourselves on the reviews (including overviews) and found 19 contributions (25-43). Two independent experts evaluated them with a grid of scores on the quality of the publication (Quality, impact of the research, relevance, completeness) (min 1 max 5). We set an average score of 3 on assessment as the acceptance limit in our review.

All studies were found to be of great value.

Table 1 (arranged into three parts) resumes the focus of each one of this studies, ranging from technological features, impact, management of DCT up the concerns for the privacy issues. The reader can find synthetically the main finds and the conclusions of these studies.

Conclusions and final considerations

The COVID-19 pandemic is characterized by a strong union between the use of mobile technologies and social distancing. This strong union led compared to previous epidemics to the possibility of carrying out CT activities (4) digitally using APP for DCT. It has been shown in (6) that DCT has the potential to slow down the spread of the pandemic. Many countries are exiting from the emergency phase, the so-called first phase of the pandemic. DCT will be also especially important in the post-emergency phases to avoid a resurgence of the pandemic and many nations, such as in Italy have decided to intensify the use of DCT right at this stage.

For DCT to succeed, however, it is necessary (*Figure 3*):

(I) A great sense of responsibility for the citizens. In most countries, registration of positive cases to DCT systems takes place on an exclusively voluntary basis for obvious privacy reasons.

(II) That DCT system reaches a great uptake in terms of installation of the Apps for DCT by all citizens. A low diffusion will not make the system effective.
- ❖ (connected to point 2) Overcoming the problem of the "digital divide" which concerns some categories of subjects. In particular, as is known, the elderly are less familiar with mobile technologies, essential for DCT and have still remained with the old cell phone;
- ❖ (connected to point 2) Overcoming the problem of the "digital divide" which concerns some areas that have been affected by the world pandemic.

(III) Another important problem is that of training the operators (not only health) involved in the DCT. This training must be carried out respecting social distance, for example, through specially prepared distance learning courses (DLC) (44).

Lesson learned for the epidemiologists

DCT was a real novelty for this pandemic and for pandemics in general. There is no doubt that at the beginning there were difficulties in accessing scientific medical knowledge relating to these applications and therefore, in patches, a generalized difficulty in setting up an epidemiological strategy based on them by the epidemiologist. It was then seen that two different macro-approaches based on these Apps have been consolidated, one on Bluetooth and the other on Global Positioning systems with a different approach to privacy. There is no doubt that in some cases the DCT could be fundamental as in the case of:
- ❖ Super-diffusion events (matches, concerts and more);
- ❖ Situations in which it is difficult to remember the contacts that have taken place.

In fact, in these cases the map of the contact tracing with analogue (manual) techniques is impractical!

Furthermore, numerous studies starting from that of Ferretti (6) have also highlighted through modelling the advantages of an (automatic) DCT compared to a mere (manual) CT.

However, it is evident from evidence in the field (45), such as, for example, in Italy, that the familiarity with this type of App (strategic tool) has been low and the consequent perception by the citizen of the usefulness of the DCT reduced.

The consequence of all this is a citizen's removal from

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Table 1 Outcome of the review

Ref	Title	Focus
(25)	Storeng *et al.* The Smartphone Pandemic: How Big Tech and public health…	The analysis extends such critiques by considering what the digital response to COVID-19 reveals about tech corporations' growing power to influence public health agendas. They discuss how they promote technical solutions to public health challenges that are politically seductive, but that have uncertain effectiveness and societal implications that warrant critical scrutiny.
(26)	Bernardo *et al.* Collaborating in the Time of COVID-19: The Scope and Scale of Innovative…	Over 60 projects rooted in collaboration are categorized into five main themes: knowledge dissemination, data propagation, crowdsourcing, artificial intelligence, and hardware design and development. They highlight the numerous ways that citizens, industry professionals, researchers, and academics have come together worldwide to consolidate information and produce products to combat the COVID-19 pandemic (including the DCT).
(27)	Anglemyer *et al.* Digital contact tracing technologies in epidemics: a rapid review. Cochrane Database Syst Rev	The effectiveness of digital solutions is largely unproven as there are very few published data in real-world outbreak settings. Modelling studies provide low-certainty evidence of a reduction in secondary cases if digital contact tracing is used together with other public health measures such as self-isolation. Cohort studies provide very low-certainty evidence that digital contact tracing may produce more reliable counts of contacts and reduce time to complete contact tracing. Digital solutions may have equity implications for at-risk populations with poor internet access and poor access to digital technology.
(28)	Elkhodr *et al.* Technology, Privacy, and User Opinions of COVID-19…	This article highlighted the fact that COVID-19 contact tracing apps are still facing many obstacles toward their widespread and public acceptance. The main challenges are related to the technical, usability, and privacy issues or to the requirements reported by some users.
(29)	e Souza *et al.* Digital Tech…a protocol for a systematic review	A protocol for a systematic review of the digital technologies for monitoring infected people, identifying contacts and tracking transmission chains in the corona virus disease 2019 pandemic.
(30)	Jaca *et al.* Cochrane corner: digital contact tracing technologies in epidemics	The aticle summarize findings from a rapid Cochrane review that included cohort and modelling studies to assess the benefits and harms of digital solutions for identifying contacts of confirmed positive cases of an infectious disease. The review included 12 studies, which assessed digital contact tracing for the following infectious diseases: Ebola, tuberculosis, pertussis and coronavirus disease 2019 (COVID-19).
(31)	Simmhan *et al.* GoCoronaGo: Privacy Respecting Contact Tracing for COVID-19 Management.	The article offers a detailed overview of the app (in the title), backend platform and analytics, and the authors' early experiences with deploying the app to over 1000 users within the Indian Institute of Science campus in Bangalore. They also highlight research opportunities and open challenges for digital contact tracing and analytics over temporal networks constructed from them.
(32)	Khatib *et al.* Navigating the risks of flying during COVID-19: a review for safe air travel	In-flight transmission of SARS-CoV-2 is a real risk, which may be minimized by combining mitigation strategies and infection prevention measures including mandatory masking onboard, minimizing unmasked time while eating, turning on gasper airflow in-flight, frequent hand sanitizing, disinfecting high touch surfaces, promoting distancing while boarding and deplaning, limiting onboard passenger movement, implementing effective pre-flight screening measures and enhancing contact tracing capability.
(33)	Golinelli *et al.* Adoption of Digital Technologies in Health Care During the COVID-19 Pandemic	In particular, within the reviewed articles, the authors identified numerous suggestions on the use of artificial intelligence (AI)-powered tools for the diagnosis and screening of COVID-19. Digital technologies are also useful for prevention and surveillance measures, such as contact-tracing apps and monitoring of internet searches and social media usage. Fewer scientific contributions address the use of digital technologies for lifestyle empowerment or patient engagement.

Table 1 (*continued*)

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Table 1 (*continued*)

Ref	Title	Focus
(34)	Wirth *et al.* Citizen-Centered Mobile Health Apps Collecting Individual-Level Spatial Data for Infectious Disease Management: Scoping Review	The aim is to inform the current discussions and to support the development of solutions providing an optimal balance between privacy protection and pandemic control. To this end, they present a systematic analysis of existing literature on citizen-centered surveillance solutions collecting individual-level spatial data. They identified four different use cases, which focused on individual surveillance and public health (most common: digital contact tracing). They found that the solutions described were highly specialized, with 89% (24/27) of the articles covering one use case only. Moreover, they identified eight different technologies used for collecting spatial data (most common: GPS receivers) and five different diseases covered (most common: COVID-19). Finally, they also identified six different data protection measures
(35)	Skoll *et al.* COVID-19 testing and infection surveillance: Is a combined digital contact-tracing	This review explored the role of technology-augmented contact-based surveillance in tracking the outbreak in select countries in comparison to the current U.S. approach. It evaluated barriers in the U.S. to implementing similar technologies, focusing on privacy concerns and a lack of unified testing and tracing strategy. Finally, it explored strategies for rapidly scaling testing in a cost-effective manner.
(36)	Baumgart DC. Digital advantage in the COVID-19 response: perspective from Canada's largest integrated digitalized healthcare system	The article shows that the rapid launch of online screening and triage tools to guide testing and isolation, online result sharing, infected patient and contact tracing including a smartphone exposure tracking application (ABTraceTogether), electronic best practice alerts and decision support tools, test and treatment order sets for standardized COVID-19 management, continuous access to population level real-time data to inform healthcare provider, public health and government decisions have become key factors in the management of a global crisis in Alberta.
(37)	Whitelaw *et al.* Applications of digital technology in COVID-19…	This Viewpoint provides a framework for the application of digital technologies in pandemic management and response, highlighting ways in which successful countries have adopted these technologies for pandemic planning, surveillance, testing, contact tracing, quarantine, and health care.
(38)	Budd *et al.* Digital technologies in the public-health response to COVID-19	This Review aims to capture the breadth of digital innovations for the public-health response to COVID-19 worldwide and their limitations, and barriers to their implementation, including legal, ethical and privacy barriers, as well as organizational and workforce barriers. The future of public health is likely to become increasingly digital, and we review the need for the alignment of international strategies for the regulation, evaluation and use of digital technologies to strengthen pandemic management, and future preparedness for COVID-19 and other infectious diseases.
(39)	García-Iglesias *et al.* Digital surveillance tools for contact tracking of infected persons by SARS-CoV-2	The results showed that some countries are implementing digital tools for contact tracking through mobile apps that allow user data to be shared via the device's GPS and/or Bluetooth. The terms on the privacy and confidentiality of the population data are, in some cases, questionable. The authors concluded that the use of digital surveillance tools to track contacts of people infected with an infectious disease, such as SARS-CoV-2, can be key to reducing the number of people infected and reducing the spread of the virus.
(40)	Caetano *et al.* Challenges and opportunities for telehealth during the COVID-19 pandemic:ideas on spaces and initiatives in the Brazilian contex	The article discusses telehealth's contribution to the fight against COVID-19 and the recent initiatives triggered in Brazil as opportunities for the consolidation of telemedicine and improvement of the Brazilian Unified National Health System. The authors conclude that telehealth offers capabilities for remote screening, care and treatment, and assists monitoring, surveillance, detection, prevention, and mitigation of the impacts on healthcare indirectly related to COVID-19. The initiatives triggered in this process can reshape the future space of telemedicine in health services in the territory.

Table 1 (*continued*)

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Table 1 (*continued*)

Ref	Title	Focus
(41)	Ye *et al.* Using Information Technology to Manage the COVID-19 Pandemic: Development of a Technical Framework Based on Practical Experience in China	Based on the framework, the authors review specific health information technology practices for managing the outbreak in China, describe the highlights of their application in detail, and discuss critical issues to consider when using health information technology. Technologies employed include mobile and web-based services such as Internet hospitals and Wechat, big data analyses (including digital contact tracing through QR codes or epidemic prediction), cloud computing, Internet of things, Artificial Intelligence (including the use of drones, robots, and intelligent diagnoses), 5G telemedicine, and clinical information systems to facilitate clinical management for COVID-19. The authors show that practical experience in China shows that health information technologies play a pivotal role in responding to the COVID-19 epidemic.
(42)	Bassi *et al.* An overview of mobile applications (apps) to support the coronavirus disease 2019 response in India	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. The authors conclude that their 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.
(43)	Ekong *et al.* COVID-19 Mobile Positioning Data Contact Tracing and Patient Privacy Regulations:	The contribute shows that despite the potential of digital contact tracing, it always conflicts with patient data privacy regulations. The authors found that Nigeria's response complies with the NDPR, and that it is possible to leverage call detail records to complement current strategies within the NDPR. The authors conclude that the (I) study shows that mobile position data contact tracing is important for epidemic control as long as it conforms to relevant data privacy regulations; (II) the implementation guidelines will limit data misuse.

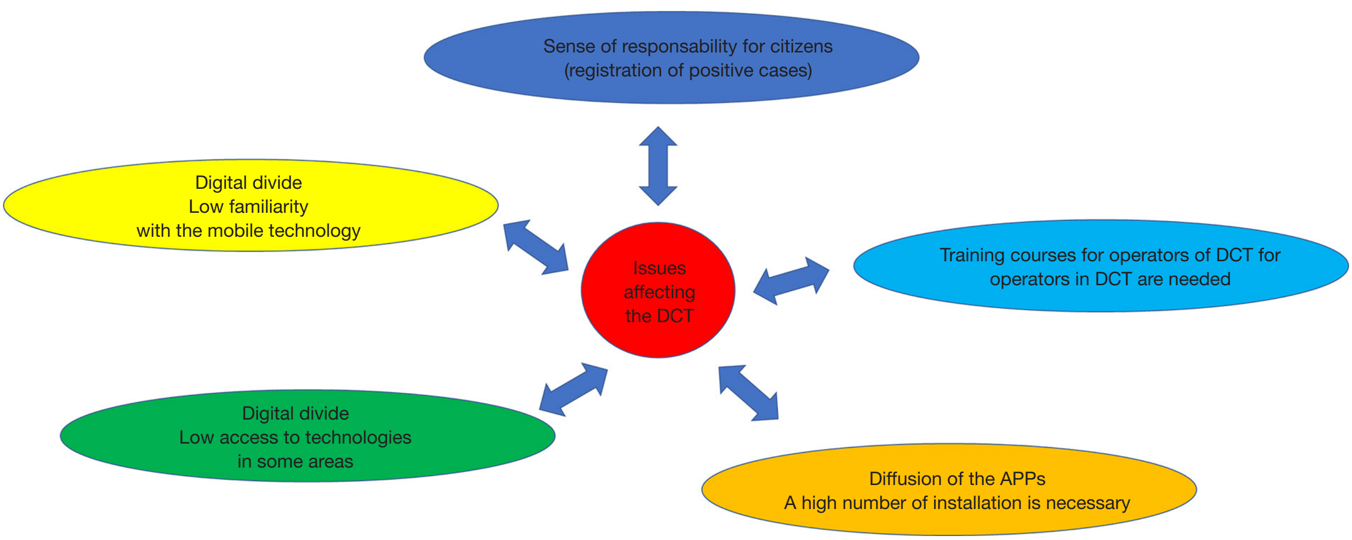

Figure 3 Aspects affecting a successful diffusion of the DCT. DCT, digital contact tracing.

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the DCT with the natural negative consequences for the epidemiologist who must monitor an epidemic.

At this point the stakeholder must help the epidemiologist for the future so that the experience is not lost and the weaknesses of the start-up process are treasured.

With reference to the national situation, a working group which also includes the authors of this study developed and submitted a national survey specifically with this objective.

From the survey, currently being analysed, it is expected to have concrete answers that will help the stakeholders and consequently the epidemiologist to get the pulse of the situation and concrete suggestions for the future.

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