COVID-19 mobile positioning surveillance and contact tracing, and patient privacy

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Abstract

Background: The coronavirus disease pandemic is the biggest global economic and health challenge of the century. Its effect and impact are still evolving with deaths estimated to reach 40 million if not checked. One effective and complementary strategy to slow the spread and reduce the impact is to trace primary and secondary contacts using technology.

Objective: The objective of this paper is to survey strategies for digital contact tracing for COVID-19 pandemic and to present how using mobile positioning data conforms with Nigeria's data privacy regulations.

Methods: We conducted an exploratory review of current measures for COVID-19 contact tracing globally. We then analyzed how countries are using mobile positioning data technology in handling the COVID 19 pandemic spread. We made recommendations for how Nigeria can adopt this approach in context of Nigeria's Data protection Regulation (NDPR).

Results: Despite the potentials, digital contact tracing always comes in conflict with patient data privacy regulations. We found that Nigeria's response complies with the NDPR, and that it is possible to leverage telecommunications call detail registry (CDR) to complement current strategies within the NDPR regulation.

Conclusions: Our study show that mobile position data contact tracing is important for epidemic control as long as it conforms to relevant data privacy regulation. Implementation guideline will limit data misuse.

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Does COVID-19 mobile positioning data contact tracing conform with patient privacy regulation?

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Abstract

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Keywords: COVID-19; Contact tracing; NDPR; GDPR; HIPPA; Coronavirus; Surveillance; mHealth; eHealth; digital health

Introduction

The coronavirus disease 2019 code-named COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. This infectious respiratory disease was first detected in Wuhan City, China, in December 2019. It was declared a global pandemic by WHO on March 11th, 2020, and has currently infected over two million people globally, killing over 150,000 people. Globally, responses have been swift and in full influenza pandemic control mode [2]. Travel and movement restrictions to curtail spread both within and across cities are in force. Many cities around the world are in lockdown or lock-in mode. Some have issued dusk-to-dawn curfews. In other scenarios, large gatherings have either been banned, or discouraged. Estimates suggest that this pandemic can claim the lives of as many as 40 million people globally [3]. The Spanish flu that

lasted between 1918 and 1920 in some places has been estimated to have cost the lives of between 21million and 50 million people globally [4]. Evidence suggests that influenzas can mainly be spread through large clusters [5]. The WHO Global Influenza preparedness plan are guidelines for influenza and other disease management and control [6]. Nigeria, one of the countries that adopts WHO guidelines have over 493 cases diagnosed as of 17th April 2020, with seventeen mortalities. This is an increase from an index case first reported on February 27th. To better manage the spread, the Nigeria's Federal Government has declared a lockdown in key affected states of Lagos, Ogun, and the Federal Capital Territory. The lockdown was in addition to several mitigating actions by State governments, ranging from a ban on social gatherings to dusk-to-dawn curfews. During the lockdown, schools, markets, churches, mosques, banks, offices, parks, motor parks, and airports remain closed often for 14 days.

The Nigeria Centre for Disease Control (NCDC) reported it is currently conducting contact tracing of over 9000 contacts of confirmed cases in an attempt to effectively contain the spread of the disease, in line with recommended measures for response in a pandemic [7, 8]. These measures include antiviral, vaccine, and non-pharmaceutical measures such as case isolation, household quarantine, school or workplace closure, and travel restrictions. Given the scale of the COVID 19 pandemic, non-pharmaceutical actions appear to be the only practical and logical option in the absence of any known antiviral drug or vaccine. Resources are stretched even in advanced health systems, as seen in Italy, United Kingdom, China, and the United States [9] [10].

NCDC's approach, has been commended for its compliance with WHO guidelines for large scale containment and contact tracing, there remain options that may yet be explored [11]. Given the inadequacy of testing kits, critics believe the figures of confirmed cases may be far lower than the actual numbers in Nigeria and most African countries. This is fueling the speculations of the real catastrophic level pandemic if isolation, containment, quarantine, and contact-tracing mechanisms are not urgently implemented. In a country with an already weak health system occasioned by poor health investment choices, managing such an outbreak will become impossible.

There is, therefore, a need to develop and adopt new strategies, particularly digitally-enabled strategy to facilitate a more extensive, accurate, seamless and timely response in line with the high frequency of new infections among contacts of confirmed cases known as secondary infection rate [12]. Digital solutions adoption in Nigeria has been focused on electronic forms for contact data collection and visualization for follow-up [13]. Digital technologies can do more than field data-collection and outbreak investigation platform. Data about households and general population movement patterns can be extracted through digital technologies [14]. Farrahi et al in their research show that over a nine months period, 72 participants made 1,973,547 Bluetooth interactions representing physical proximity movements (b). The participants equally made 10,992 phone calls and 9,432 SMS records representing communication flow (a) as in Figure 1 [15]. Their findings show that interactions far surpassed communication, and thus movement management is most critical in epidemic control.

Figure 1: Visualization of practical communication and interaction networks [15]

This paper reviews the global evidence practice in the use of mobile positioning data to achieve a more targeted and efficient approach at contact tracing and disease surveillance especially for COVID-19 pandemic. We discuss how this approach is possible within regulatory confines. We also recommend a novel strategy for coordinating agencies to leverage mobile positioning data, and how

to ensure patient privacy is preserved.

Methods

COVID-19 disease pandemic is emerging and only three months old with little scholarly work to justify a systematic search, review and analysis approach. We conducted an exploratory (non-systematic) internet search for technology approaches and responses to the COVID-19 epidemic. Results from global and national agencies responsible for infection prevention and control (IPC) were analyzed to ascertain how they currently use technology. We also reviewed how these use cases fit within the regulatory framework for contact tracing and isolation. Similar internet search methodology was adopted for Nigeria's response and her use of digital tool for contact tracing.

Result

Our search yielded results based on emerging trends and how countries around the world are using digital technologies to respond. We first present global perspectives and respond strategies around the world of how countries are using mobile position data during prior and current pandemics. We then present and Nigeria's approach.

How it works

The GSM Association (GSMA) puts the total number of mobile subscribers at 5 billion unique mobile subscribers and 7 billion connected devices [16]. Nigeria has 184 million active mobile subscriber lines [17]. Mobile telecommunications subscriber communication and movement data was used for Ebola outbreak contact tracing [14]. Many countries are currently using mobile data for a more rapid response to the COVID-19 pandemic [18, 19]. There has been a 90% increase in the number of countries implementing digital tracking measures and a 100% increase in reports of censorship [20]. These approaches range from the use of anonymized aggregate data to monitor the general mobility of people, tracking mobile phones of confirmed cases, to tracking suspected patients and their contacts. In some cases, these approaches were individualized and mandatory while, in others, they were aggregated and anonymized. In all cases, there were collaborations between government, Mobile Network Operators (MNO), and other data controllers such as technology companies and financial services providers. Each mobile subscriber at any time is connected to a segment of the MNO base station tower. For simplicity, we have presented in Figure 2, a cellular tower, and a subscriber. We used letters A and B to illustrate the farthest and shortest distance of the subscriber from the base station tower based on power throughput and internal cell tower position triangulation. The difference between A and B, representing the diameter of a user's device which is a proxy for the user's location is often between 50 and 300 meters, depending on many other factors [14].

Figure 2: Location of a subject with respect to MNO cell tower

Global strategies

Table 1 details some of the strategies governments around the world are adopting to track and isolate COVID-19 patients and their contacts or for lockdown/lock-in enforcement. In the United States, 500 million USD of the 2 trillion USD economic stimulus bill recently signed into law is for the US Centre for Disease Control to launch new surveillance and data-collection system to monitor the spread of COVID-19 [21]. This move is the first for the US as stringent patient data privacy and security regulations have hampered adoption of contact tracing as a countermeasure for epidemic control in the past [22]. Similarly, the state of Massachusetts has announced it is launching what it calls the 'first contact tracing' call center with 1000 virtual assistants to call and trace contacts of COVID-19 positive persons [23].

The EU's recent General Data Protection Regulation (GDPR) is being tested at a large scale. Within the regulation, a patient can decide not to disclose who they have been in contact with or legally resist being traced [24]. At least evidence emerged that Germany, Austria, and Italy are using aggregated telecommunications call details registry (CDR) information to enforce lockdown and stay at home [25]. As this is an evolving challenge, and European countries such as Italy and France are amongst the worst affected, changes to the GDPR regulations are expected and anticipated.

In China, the government worked with telecommunications companies to track and contact people who had traveled through Hubei province during the early days of the disease outbreak. Location data was shared with China's National Health Commission and other agencies, enabling them to retrospectively simulate the location of confirmed cases and their contacts who were then issued warnings via social media [26]. Information has also emerged that the Chinese government may have leveraged its large network of sensors and surveillance cameras supported by Artificial Intelligent facial recognition and recommender system in her response to the COVID-19 outbreak [27]. This success may not be unconnected with the often criticized and loose patient data privacy and security regulation in China.
It was, however, observed that the extent of compliance with international and country-level regulations regarding data privacy considerations in deploying this digital technology varied from country to country.

Table 1; Country strategies for the use of mobile positioning data in COVID-19 response

Country	Strategy planned or adopted
USA [21]	The state of Massachusetts announced the launch of first contact tracing call center to be manned by 1000 virtual assistants [23]. The US federal government announced $500 million package for COVID-19 surveillance to CDC [21].
China [22] [28]	A mandatory smartphone app 'Health code' that leverages mesh network for infected persons contact tracing and notification.
Italy, Germany, and Austria [25]	Telecommunications providers make available call detail registry allow for sharing location data with health authorities to check whether people are remaining at home. The data is aggregated and anonymous, mapping concentrations rather than individuals to respect Europe's privacy laws.
South Korea [29]	The government created a map of cellphone data provided by telecom and credit card companies. The map was made public, so everyone could track their level of exposure.
Israel [19]	The government is using GMS call detail registry (CDR) in addition to patient phone position data to locate contacts and trace their movement patterns.
Iran [30]	Iranian authorities developed a mobile application with government endorsement with self-diagnosis check for COVID-19 disease. It however

	also discretely collects user's location data.
Singapore [18, 21]	Mobile app uses Bluetooth-based mesh network to detect people's proximity to those who have been exposed to coronavirus and warns them to get tested if they come in close contact.

Nigerian strategy

Human travel patterns and mobility can be assessed using available mobile phone data, and its application can be useful in disease epidemiology [31]. Panigutti et al also revealed the adequacy of mobile phone data for tracking infectious disease spread, particularly in heavily populated and highly interconnected communities [31].

Border restrictions, internal travel restrictions, and school closures or total lockdown are reasonable but have minimal impact compared to effective case isolation or quarantine, which have been shown to have a significant impact if properly conducted [2]. This is particularly important in Nigeria's case, where total compliance to these strategies cannot be guaranteed. Therefore, data on case isolation and quarantine should be a significant priority in our setting. More so, data is useful in modeling disease transmission. Specifically, collecting and analyzing data on transmission in different social contexts is highly effective in mapping intervention strategies since the impact of case isolation and quarantine depends on the reduction of contact rates of the index case and other cases while they are ill [2].

More so, in order for the NCDC to effectively conduct the current large-scale contact tracing of over 9000 contacts of confirmed cases, use of digital technology is inevitable. The number of contacts may even be more than this number considering the frequency of new infections. Currently, there are several digital contact data capture solutions including the Surveillance, Outbreak Response Management and Analysis System (SORMAS) in use. These solutions require a field epidemiologist or their representative visiting every contact.

Discussions

Evidence suggest that contact tracing and data protection can go together [32]. Significant progress is being made with current strategies. As promising as they may seem, data privacy concerns remain a major impediment with an overriding need to find a balance between deploying the technology, maintaining data safety and patient privacy. Existing patient privacy regulations are currently being tested. Some countries have attempted to relax existing stringent regulations that protect patient privacy to allow for greater access, others have worked around them. According to [21], many of the new digital technology approaches appear inevitable and legitimate, given the unprecedented high frequency of COVID-19 infection spread. Many countries have now also invoked speedily legislative processes to give legitimacy to their workarounds and deployments.

In Israel for instance, the cabinet has passed an emergency law to use mobile data for tracking people infected with COVID-19, trace their contacts and identify those for quarantine [19]. This law was speedily passed overnight, bypassing parliamentary approval. In the United States, privacy advocates are proposing stringent procedures to keep personal information safe, including deletion, once it's no longer in use to prevent abuse by law enforcement agents [21].

In Nigeria, the National Data Protection Regulation (NDPR) was promulgated in 2019 [33]. Amongst other stipulations, the regulation states the guiding principles for data processing in Section 5. These principles consider data processing unlawful if there is no consent by the individual data subjects (in

this case, the confirmed persons) if it is inaccurate with prejudice to human dignity and not protected against cybercrime as well as stored beyond the reasonably necessary period. However, regardless of these guiding principles, Section 6, part 2.0, subsection 2.2 (e) of the document listed the conditions for lawful data processing and states that;

"processing is necessary for the performance of a task carried out in the public interest or the exercise of official public mandate vested in the controller."

The Data controller, in the case, of mobile positioning data is the MNO who is the entity that determines the purposes for and the manner in which network subscriber phone data is processed or is to be processed. Section 11 of the regulation states that data processing by a third party (in this case a public authority such as the Federal Ministry of Health, NCDC, or anybody engaged in processing the location data such as a technology company) shall be governed by a written contract with the Data Controller. Interestingly, though the NDPR protected the privacy of personal mobile location data, it has nonetheless provided the window for the use of such data in situations of overriding public interest, such as the current COVID-19 outbreak.

Recommendations

Mobile phone location data can be effectively utilized in Nigeria for the COVID-19 response. The government can leverage existing mobile technology resources and infrastructure available in-country by working with MNOs and technology firms to optimize the ongoing contact tracing and surveillance of over 9000 known contacts of confirmed cases. This collaboration should remain guided by the NDPR in order to protect and safeguard individuals' data, prevent a breach of data privacy rights as well as inappropriate use and abuse by law enforcement agencies beyond the period of contact tracing and surveillance.

In practice however, the first step should involve anonymized mobile subscriber data in line with good data governance policy. Where possible, informed consent of confirmed cases should be appropriately sorted once they are diagnosed in the spirit of goodwill. The use of public interest exception should be the last resort. A simplified guideline for these process for adhering to NDPR should be written and made transparently available for data custodians, requesting bodies, data handlers and the patient or contact.

A third-party agreement should also be formally signed between parties interfacing with patient data in any way. A typical use case sensitive to data privacy concerns is the use of information about a visit to public facilities only including public transportation systems, parks, churches, mosques, or malls used by the confirmed cases as described by [34]. The use of CDR has proved to be effective in detecting outbreak clusters and then using other frontline data collection tools for mitigating the impact and containment [14]. A key limitation of using CDR from MNOs as already illustrated in figure 2 is that for basic phone users (2G- second generation), the location will rely on mobile network phone mast location triangulation only. This approach alone has proximity accuracy of between 50 and 300 meters. This accuracy level is not sufficient to confirm persons who have been in contact with a COVID-19 patient as the WHO contact definition prescribes two meters [7]. The use of telecommunication CDR should be complemented with other strategies for effective result.

The immediate action after successful contact trace is communicating the expected course of action to citizens of an infected community cluster. A simple, user-friendly interface using the Unstructured Supplementary Service Data (USSD) technology will help improve information requests and management for low income but literate users. Also, interactive Voice Response (IVR) technology will be suitable and appropriate for local language awareness response for low literate users.

Conclusions

Mobile positioning data can significantly improve the capacity and scope of timely outbreak response and will help governments as well as other responders in Nigeria. When implemented early [15], there are opportunities to leverage positioning data to break the chains of disease transmission in community clusters. It can improve the efficiency of currently used field data-collection and outbreak investigation platforms when used in synergy.

While mobile positioning data can be used within the current regulation, guidelines for data handlers must include measures to curtail misuse and unauthorized access. Future research will be to design and implement models for mobile position contact tracing.

Conflicts of Interest

None

Abbreviations

2G – Second generation of mobile telephony
CDC: US Center for Disease Control
CDR: Call Detail Registry
COVID-19: Coronavirus 2019
GDPR: European General Data Protection Regulation
HIPAA: Health Insurance Portability and Accountability Act
IPC: Infection Prevention and Control
MNO: Mobile Network Operators
NCDC: Nigeria Center for Disease Control
NDPR: Nigeria Data Protection Regulation
NITDA: National Information Technology Development Agency
WHO: World Health Organization

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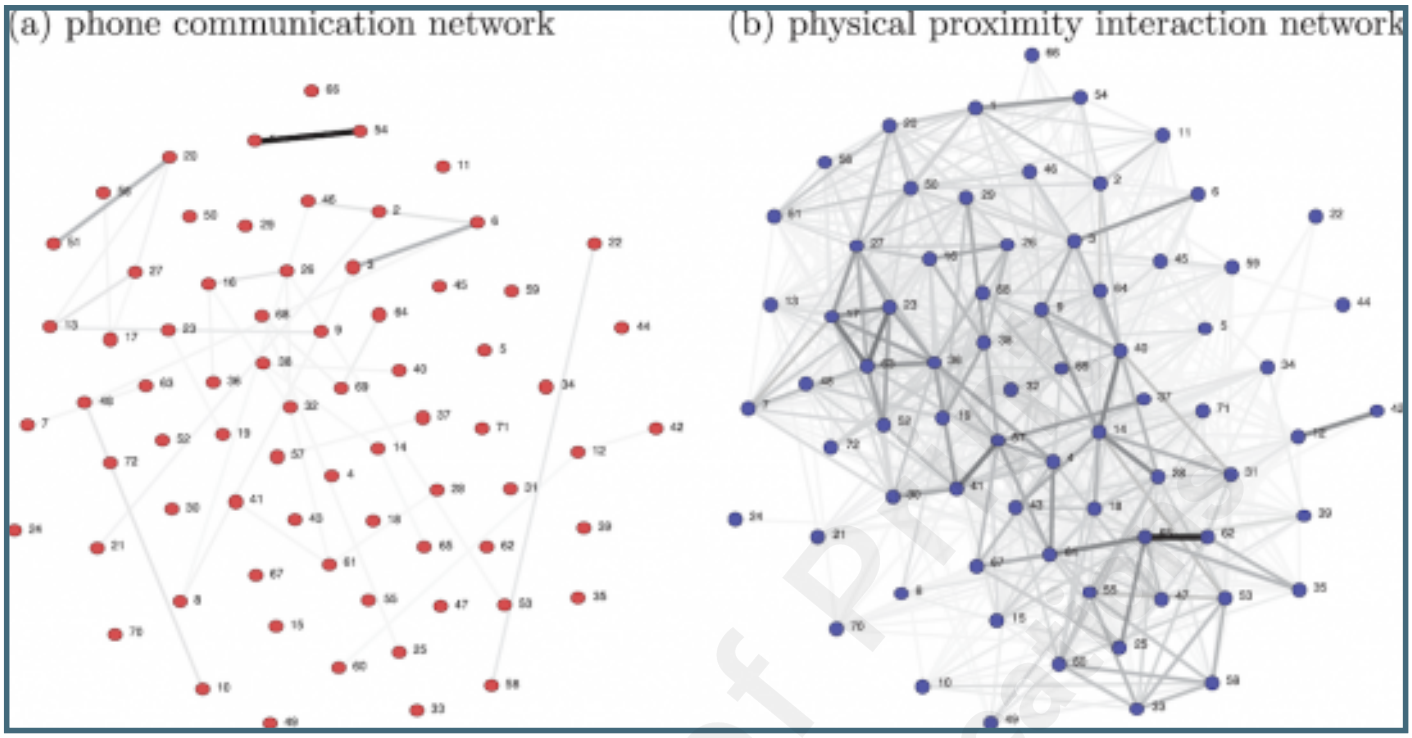
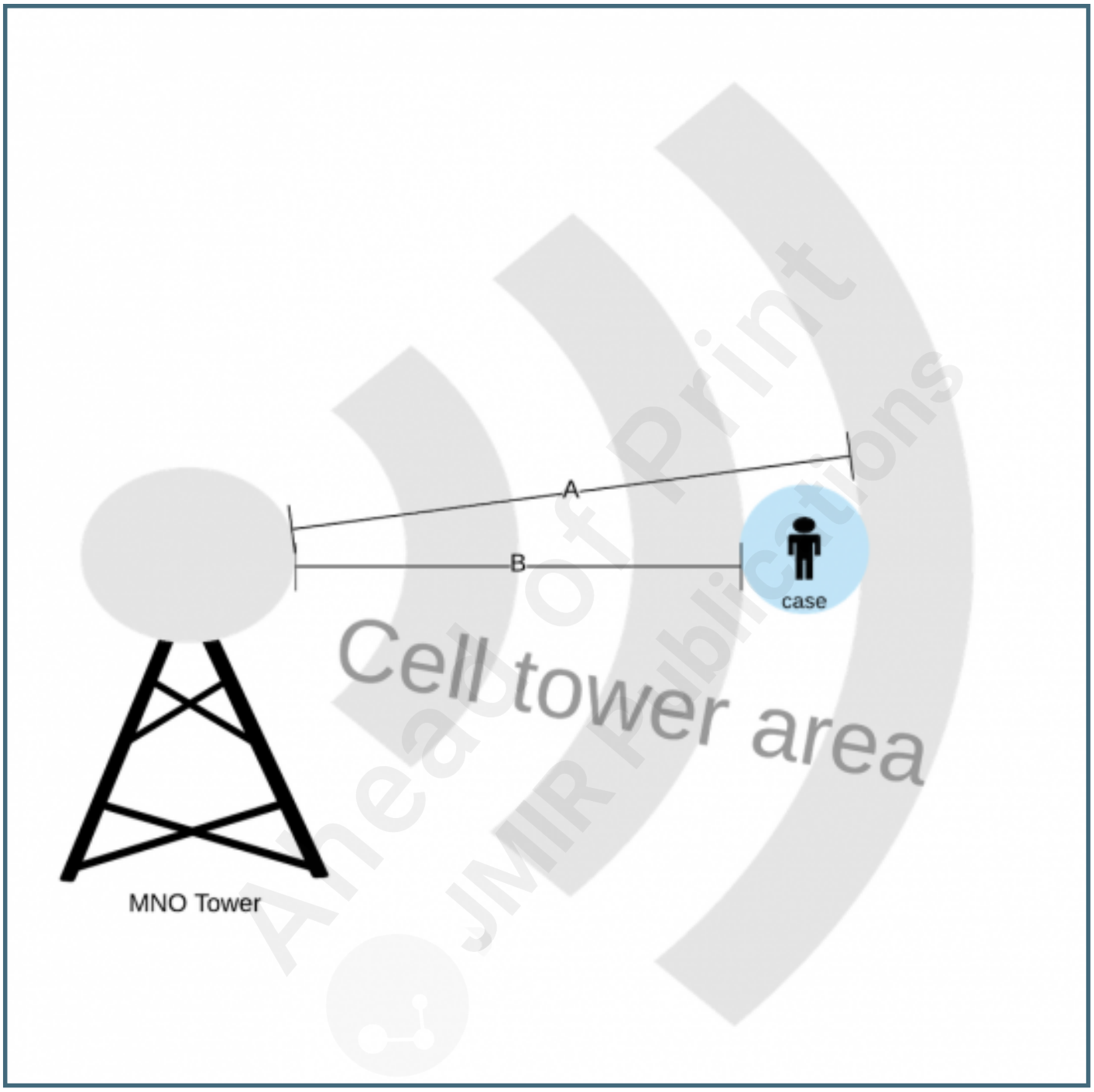
Supplementary Files

Figures

Visualization of Movement paths of cases and quarantine location.



Location of a subject with respect to a mobile network operator (MNO) cell tower.



Other materials for editor/reviewers onlies

Changes tracked.
URL: https://asset.jmir.pub/assets/a504a3aee4ff37f8d890ebc686c7d2d5.doc

Article title change to: “COVID-19 mobile positioning surveillance and contact tracing, and patient privacy”.
URL: https://asset.jmir.pub/assets/4f6ee5ef5607b84854a902f4b9d2ecd6.docx

TOC/Feature image for homepages

Image of user under cell tower coverage.