Can contact tracing stop the spread of COVID-19?

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As economies around the world start to reopen, governments are looking for ways to help track and contain new coronavirus infections. One tool is contact tracing, used by public health officials to halt the ongoing transmission of an infectious disease.

Some states have already retrained state employees to work as contact tracers, and there is an expected need of 100,000 contact tracers across the United States. Along with growing the contact-tracing workforce, Apple and Google announced earlier this spring a collaborative effort for digital tracing. The first of these tracing apps, which use Bluetooth technology to track contacts based on phone proximity, is now live as part of a large-scale pilot study in Switzerland.

But how, exactly, do these two approaches work, and what will the next phase of the pandemic look like if both strategies are used widely? To provide additional context and understanding, Penn experts discuss how contact tracing works, both the traditional "analog" and new "digital" approaches, and how both strategies could shape what everyday life looks like in the next phase of the pandemic.

Contact tracing is an epidemiological tool to curb the spread of disease.

Contact tracing is a systematic approach for tracking a new case's source of infection as well as finding others who might have been exposed to that case during their infectious period. "Contact tracing is designed to, as quickly as possible, identify any high-risk exposures the new case may have had with others and then ask those contacts to take precautions so they don't infect others," says Kevin Volpp, who, along with David Asch and Carolyn Cannuscio, is leading contact-tracing efforts at Penn Medicine. This work is typically conducted by state and local health departments, but this task has currently been delegated by the City of Philadelphia to Penn Medicine for its own patients.

"Contact tracing is not about getting people in trouble," says Cannuscio. "It's about supporting communities in order to halt transmission and lower the burden of disease."

Contact tracers conduct phone interviews with patients who recently tested positive to recreate their movements and activities and to figure out who they came in close contact with. Contact tracers also share information with local health departments to help prevent further spread, especially for cases that occurred in high-risk settings, such as communal living centers.

"When it's done well, the contact-tracing process involves not just the interview but then follow-up 'detective work' to connect the dots," says Cannuscio. After the initial interview, these "epidemiological detectives" work to identify and locate potential secondary cases so they can let them know that they should self-isolate, check for symptoms, and possibly get tested. This might be difficult to do if, for example, a positive case met someone at a party but only remembers a first name. The contact tracer needs to see what other information they can find out about that person so they can get in touch with them.

A contact tracer needs to have empathy, emotional intelligence, communication skills, and an ability to react and forge bonds very quickly.

Contact tracers also provide support to patients. They explain how to self-isolate, ask if they are having difficulties paying rent or are facing eviction, and inquire about their ability to get basic necessities like groceries. "Emotional intelligence is key in this role. It's really one shot we have with this person to convince them that we are doing this to support their family, their loved ones, and their community," Cannuscio says.

She adds that being both curious and empathetic is also essential. "I really key in on that. How curious is this person about the dynamics of COVID-19, about the life circumstances of the people they are calling,

and how much empathy can they draw on to connect with that person," she says.

Contact tracing works best as part of a package of mitigation strategies.

At this stage of the pandemic, Volpp says it's impossible for contact tracing alone to contain COVID-19. "Ideally, contact tracing would have been deployed as soon as the first cases were identified because the goal is to get containment as quickly as you can" he says. "Now, if you have hundreds of new cases a day, it's hard. Let's say everyone had on average 10 contacts, then each day you'd have to track down 2,000 people, and not everyone will be easy to reach."

As the number of new daily cases begins to decrease, contact tracing will become more useful but will still need to be part of a package of approaches, along with continued adherence to social distancing and good hygiene. "When we look at what's happened in other countries, it's clear that there's a package of tools that have been used: testing, manual contact tracing, digital contact tracing, quarantine, and isolation. When all of these tools are used together, they can be very effective at suppressing an epidemic," says Volpp.

There are privacy challenges for both analog and digital contact tracing.

For contact-tracing efforts at Penn Medicine, two different contact tracers will talk to a new case and that person's contacts in order to protect patient privacy. "If a contact were to ask, 'Who infected me?' then the contact tracer can say 'I don't know'," Volpp says.

For digital contact tracing, protecting privacy is more complicated. If a

person has downloaded a contact-tracing app, their phone will broadcast a one-time token, an encrypted string of numbers and letters, to other phones that also have the app and are within Bluetooth range. Phones will store any tokens they collect for 14 days. Then, if a person tests positive for coronavirus, they upload their results onto the app, which broadcasts their phone's tokens to a central server. The app then notifies any people whose phones have stored that same token that they should self-isolate. "People know that they've been in contact with someone who tested positive, but they don't know much more than that," says Aaron Roth.

Roth and Michael Kearns work on differential privacy in social networks, which is the approach used to protect individual privacy in large datasets. One example is Google's community mobility reports, which provide aggregated information about people's movements without providing details on any one individual. While protecting privacy on contact-tracing apps is done through cryptographic approaches, differential privacy still comes into play for protecting individuals who did not test positive. "If you haven't been diagnosed with COVID-19, then nobody who's looking at your phone should be able to figure out who you've been hanging out with," says Roth.

Apps can't completely replace manual contact tracing.

One of the biggest hurdles to app-based contact tracing is the number of users needed to be effective, and as of now only three states in the U.S. have committed to using these Bluetooth-based apps. "If 1% of the population opts into this app, and it's doing proximity detection, you won't have enough coverage for it to be useful," says Kearns.

"Given that it is likely that such apps will be offered on a voluntary opt-in basis, a major challenge will be to use nudges to increase uptake in ways that will be acceptable to the public," says Volpp.

And because these proximity tracker apps rely on Bluetooth technology, there's also a possibility for false positives, or people told they were at risk of contracting coronavirus when they actually weren't. Because Bluetooth-enabled devices can connect to one another through walls and across large open spaces, a person could be within Bluetooth range of an infected person but not have been in contact in a clinically relevant way.

With these types of contact-tracing apps, developers walk a fine line between privacy and accuracy. And, after the pandemic, governments need to avoid "mission creep."

In terms of digital privacy, Kearns, Roth, and Volpp agree that, because of the severity of the pandemic, an effective contact-tracing app would need to be one that is both widely adopted and that finds an ideal trade-off between missing potential cases and being too sensitive.

"Conceptually, it has to have some knob that adjusts the trade-off between false positives and missed cases. If you set the knob all the way in one direction, you have the app crying wolf all the time, and then people start to ignore it," says Kearns.

They add that the challenge post-pandemic would be to avoid "mission creep," where, because a tracking system is in place, governments decide to keep it active. "Mission creep would be, 'Well, now that everyone's opted in for this app …' and tracing their location all the time and also your proximity to other people. Now, it bleeds into other use cases that are not medically critical," Kearns says.

Cannuscio adds that these proximity-based apps now face new challenges in light of concerns about privacy during the ongoing protests. "With the protests, for example, if people were there who later tested

positive, people likely won't be able to name the other people they were face to face with, so the proximity trackers could be helpful. But privacy concerns are heightened in an era when there's tension between protestors and both law enforcement and government. Those issues are not simple by any stretch of the imagination," she says.

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