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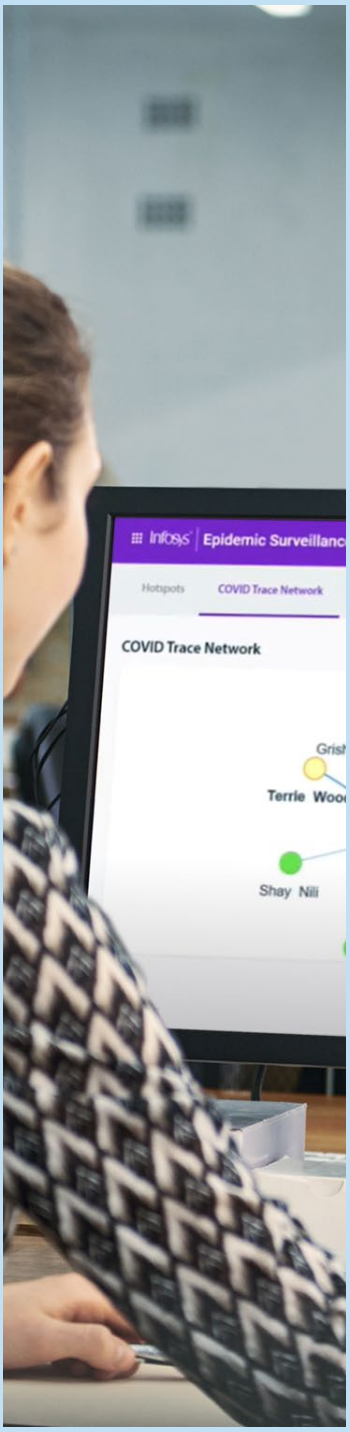

DIGITIZE AND MAKE CONTACT TRACING INSIGHTS-DRIVEN

Abstract

The novel coronavirus has started spreading rapidly again. Many experts believe that these cycles will continue and that the virus will remain with us for years to come.

Contact tracing, the approach to trace and control the spread of the virus, is an essential tool for public health agencies. But in its traditional format; i.e., manual and spreadsheet driven, the process is slow, complex and inefficient, especially for a virus as infectious as Covid-19.

Mobility, automation, data science, AI and blockchain technologies can digitize the traditional contact tracing and case management processes, enabling jurisdictions to collect, analyze, monitor and disseminate critical Covid information to every public health official faster for more effective preventive and prophylactic decision making.

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Physical contact tracing – a good but inadequate tool for Covid outbreak management

As compared to mass quarantines, physical contact tracing offers a strategic approach to contain an epidemic. Trained experts continuously track and monitor people who have come in contact with Covid-19 positive individuals, suggesting immediate isolation and quarantine of potentially infected and/or suspected individuals and providing public health agencies with a better understanding of the outbreak, enabling them to ease restrictions with more confidence.

Operational challenges with physical contact tracing for Covid

Physical contact tracing or the 'boots-on-the-ground' approach is a manual, labor-intensive process, involving meticulous collection of data through long case interviews. It is overwhelmingly complex in execution and management. All this data must be processed in compliance with the standards and guidelines defined by government healthcare agencies. The case information generally resides in spreadsheets across multiple records which makes it very difficult to manage from a compliance standpoint. Data collected through interviews include personal identification and protected health information. Paper or spread sheet-based questionnaires used for data collection and rudimentary databases for storage require human contact tracers and public health agencies to invest an inordinate amount of time and resources to ensure data privacy and security. All this slows the process down considerably.

Covid-19, however, spreads very quickly, infecting many people in a short period of time. Prolonged incubation and pre-symptomatic or asymptomatic spread makes virus transmission more difficult to trace. Silent spreaders infect people unknowingly with the hidden exposure cohort growing exponentially. Timely contact tracing for these silent spreaders and the people they infect is a major challenge.

Physical contact tracing for Covid-19 requires tracers to reach infected individuals very quickly and identify their contacts to isolate new branches of the infection. Unfortunately, because of the way the entire process is structured, human contact tracers are unable to keep pace with the spread of the virus and do not get true visibility into its transmission.

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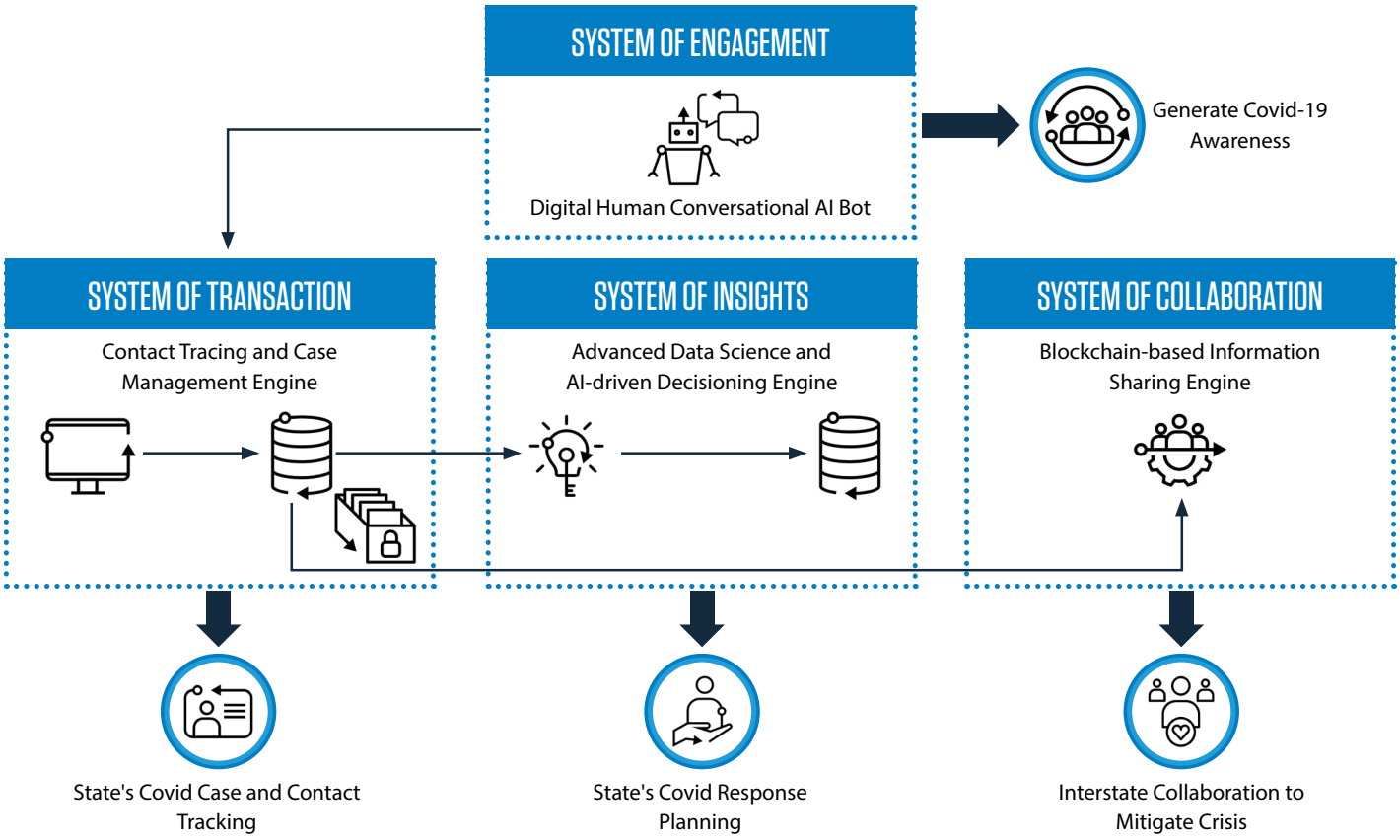
End-to-end digitization of Covid contact tracing

Covid-19 has appeared at a time when agencies have access to technologies like cloud, artificial intelligence, blockchain and mobile. These technologies amplify the collaboration, tracking and monitoring capabilities of traditional systems to control the outbreak of the disease more effectively.

To keep pace with the speed at which Covid-19 cases proliferate, human contact tracers need to engage Covid infected individuals and find their potential contacts faster than they are able to do so today. Routine case investigation activities like data collection, documentation and management needs to move more quickly with greater accuracy and minimal manual interventions.

The technology ecosystem outlined above can accomplish all of this. These technologies can complement human intelligence with machine intelligence, scaling and fast-tracking human contact tracer efforts, improving their productivity, efficiency, decision making and outcomes.

Here's how agencies can build a comprehensive system that automates and digitizes the contact tracing process:



A **"System of Transaction"** fast tracks a contact tracer's routine case interview data collection and end to end case information management. The system will enable intelligent automation and incorporate features like smarter case prioritization and automated assignment of cases, trigger alerts, and configurable rule-based process flows. Phone calling and interview recording capabilities can be integrated into the system, making it easier for human contact tracers to quickly engage with their target constituents and execute their investigations.

The system of transaction also integrates and meaningfully combines external data sets like State EHR (electronic health record), LIS (Laboratory Information System), local databases, public health data repositories, IoT monitoring devices (thermal scanners, elevated body temperature sensors, Bluetooth beacons, cameras, etc.) and test center databases to act as a centralized repository, a single source of truth for all Covid related information.

A **"System of Insights"** uses all the information collected from the investigation process and additional sources to provide crucial insights. By leveraging advanced data science techniques like automated machine learning, automated time series and graph-based analytics technologies various types of reports can be generated (descriptive, diagnostic, predictive and prescriptive) using intuitive visualizations.

The result is the rapid generation of actionable epidemiological insights. For example, a time-series view of virus transmission rate, infection case incidence rate, case fatality rates, prediction of

"System of Insights" can generate timely intelligence including transmission rate, infection case incidence rate, case fatality rates, prediction of potential risk zones, outbreak progression and pattern, detection of vulnerable populations, trending infection hot spots and more.

potential risk zones, outbreak progression and pattern, detection of vulnerable populations, trending infection hot spots, network of cases and contacts isolation of vulnerable communities/super spreaders provides the insights that public health policy makers and epidemiologists need to develop targeted policies and public safety decisions. Examples include forecasting PPE demand, healthcare resource deployment, testing kit supply as well as determining when to issue public alerts and individualized self-quarantine notifications, etc.

Contact tracing interview data may be incomplete, missing key identifiers like address, phone number, email addresses, etc. Even the Covid test results, shared electronically with the tracers, may sometimes lack the right contact coordinates of a case. Fixing these gaps manually is time consuming and effort intensive. Enriching the contact tracing system with social determinants of health (SDoH) information can address this issue.

SDoH can extend an individual's record and plug information gaps like missing phone numbers, addresses, ethnicity, race, occupation, etc. to make the data complete, meaningful and useful. SDoH information can also augment insights about people providing a more comprehensive view of an individual which includes socio-economic, behavioral and attitudinal factors. These non-clinical factors often influence their health conditions and may increase their susceptibility to acquire and spread the infection. SHoH data can help human contact tracers identify people at greater risk of being infected; e.g., cases or contacts living in a densely populated area, with poor hygiene, addicted to smoking, limited community engagement, etc. enabling a prioritized, proactive outreach to these specific individuals.

For concerted actions, all this aggregated data and intelligence should be shared securely with various stakeholders across intra and interstate agencies. This is where the **"System of Collaboration"** comes into play. APIs or blockchain-based technology makes it possible to share the data with multiple stakeholders in their preferred format, immutable and secured.

Contact tracers need to set up status monitoring and communication touchpoints with people under investigation. These individuals often require general virus and health safety information as well as help and guidance with self- assessment to determine the need for Covid testing, location of local test centers and scheduling. To free up valuable time of contact tracers, jurisdictions can implement a **"System of Engagement"** that leverages conversational AI technology to automate all these tasks, scales quickly to meet new requirements, and engages people meaningfully.

"System of Engagement" leverages conversational AI technology and engages people meaningfully.

Interfacing with the dynamic contact tracing mobile apps

Many people have difficulty remembering who they have encountered over a two-week period. Dynamic contact tracing apps are being used to solve this issue and digitize contact tracing. These apps use exposure notification technology like smart phone enabled Bluetooth and or location-based services/GPS signals which allows users to maintain a location diary. Someone who gets a positive diagnosis can disclose this diary (upon request, under consent) to help contact tracers identify and alert every individual who may have been in close proximity to the Covid-positive individual so that they can get tested and/or self-quarantine.

While these apps help with contact tracing, they cannot slow the spread of the virus on their own. They need to be combined with an end-to-end contact tracing system, like the one we outlined above, to make it easier and faster for human contact tracers to identify potential contacts of Covid-positive individuals.

When integrated with an end-to-end contact tracing and surveillance system, these apps can help jurisdictions proactively detect cases, contacts and effectively conduct routine monitoring.

Conclusion

Physical contact tracing is a tested and proven epidemiological technique to monitor and control an epidemic outbreak. Given the highly contagious nature of the novel coronavirus, the tool has assumed greater importance for mitigating the ongoing public health crisis.

While health authorities instituted physical contact tracing programs carried out by an army of trained individuals, there are indications that these programs are unable to keep up with the rapid transmission rate of the virus. Many of these programs still operate in silos, using an old school model of paper-pencil based interviews, ineffective storage and management of information. No digital, end to end case management system nor a decision support system like the **"Systems of insight"** is in place to support their efforts. And, jurisdictions are unable to share time critical information among stakeholders through a designed **"System of Collaboration."**

Forming a team of contact tracers is not enough. They need to be equipped with a smart virus monitoring system to do an effective job given the rapidly evolving situation. An ideal system leverages technologies like cloud, automation, advance data science, mobility and blockchain to automate contact tracking and tracing, accelerating outreach and optimizing interactions through low touch digital channels, quickly triangulating data from various sources, and then using data science and AI to generate actionable Covid insights. This can make the case investigation process more efficient and outcomes oriented. It will also enable jurisdictions to arrest the spread of the virus more effectively and ensure a safe reopening of economy.

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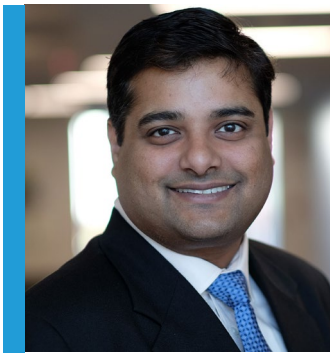
Rajib is an Associate Vice President and global head of architecture for the modernization practice at Infosys. In his previous role, he led the DevOps practice and played a key role in developing a DevOps maturity model. He also played a key role in driving AI and ML based automation to improve operational efficiency across all large support programs within Infosys. Rajib has more than 22 years of experience in the information technology industry. In his current role, he and his team of architects help Infosys clients accelerate their digital journey through adoption of open source and relevant architectural patterns. When he is not working on client projects, he spends his time writing technical articles, blogs and open source contribution.

Rajib has a Masters degree in Computer Science from Illinois State university.



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Dr. De is head of government healthcare analytics for Infosys Public Services. He has extensive experience in the public healthcare sector and previously worked for the World Health Organization, UNICEF and the Indian Public Health Association.

At Infosys, Dr. De leads the area of advanced data science and artificial intelligence-enabled population health, social determinants of health analytics, opioid management, care management, and value-based care. He is a frequent public speaker at various healthcare conferences, forums and at major universities, including the Massachusetts Institute of Technology.

Dr. De is based in Hartford, Connecticut. He holds a medical degree from the University of Calcutta and master's degree in healthcare administration from the Tata Institute of Social Sciences in Mumbai, India.

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