The Digitalized Vaccination Ecosystem:
Ensuring Adaptability and Resilience for a COVID-free World

Abstract

Mass vaccination against COVID-19 is both an urgent and complex mission. It presents a unique, dynamic situation where speed is of essence, and it has become imperative to build a vaccination ecosystem, connecting every single stakeholder from the factories to the front line.

Globally, governments and organizations are embracing the power of technologies to create a digital web across the vaccination ecosystem to support collaborative multi-dimensional planning, seamless vaccination experience for citizens, effective cold chain distribution and ensuring data security and privacy.

The Need for Building a Vaccine Ecosystem

While the world is rejoicing in the availability of COVID-19 vaccines, some organizations have embarked on the next challenge - mass vaccination.

This unprecedented vaccination drive is a collaborative effort driven by governments and powered by private players in the health care sector, pharmacies and other community groups. The complexity of the rollout has been compounded on account of:

- Speed and scale of the vaccination exercise
- Evolving policies and underlying delivery challenges
- Need for continuous improvement of the vaccination service delivery model
- Planning amidst uncertainty
- Stringent requirements for cold chain distribution

Additionally, the vaccination drive needs to be well-orchestrated across the stakeholders with a decision-making framework, formulated by government agencies and seamlessly adopted by every single player.

Given the scale, speed and complexities associated with vaccine delivery process, the use of digital technologies such as cloud, IoT, blockchain and chatbots is vital to build a digital web with real-time insights for data-driven decisions. Digital technologies are also pivotal in this global mass vaccination to connect every single node of the vaccination value chain, creating an adaptable and resilient vaccination ecosystem.

There are five broad areas where digital technologies can play a vital role in mass vaccination efforts.

Orchestrated Planning Across the Vaccination Ecosystem: Planning for mass vaccination has multiple dimensions, including capacity requirements at vaccination sites, clinical and support staff, inventory and consumables, allocation, distribution and freight shipment.

While government agencies are already working on these plans, the dependent variables such as population size and demographics across vaccination phases, inclement weather conditions impacting vaccine distribution and service delivery model for mass vaccination are continuously changing. They need to course correct and dynamically respond to changes and for that they need full visibility into all the interdependent factors. Unfortunately, these are not interconnected as the information is locked in spreadsheets and siloed systems.

The potential solution lies in cloud-based planning tools that offer integrated planning capabilities, based on predictive models. As the vaccination ecosystem is closely knit with multiple players, there is a critical demand for a real-time, collaborative and integrated planning mechanism that can consider multiple variables, constraints, 'what-if' scenarios and driver-based modelling capabilities.

Some agencies are already using the digital tools. FedEx in partnership with Microsoft leverages predictive logistics planning for COVID-19 vaccine distribution by analyzing real-time weather forecasts and historical data to map the fastest route and mode of transportation to expedite the vaccine shipment.[1]

Modern connected and orchestrated planning tools and artificial intelligence and machine learning capabilities can enable scenario-based planning, especially in subsequent phases, when vaccine programs cater to a wider set of priority groups.

Frictionless Experience for Citizens: The last mile of getting vaccines into arms will require a seamless vaccination drive. A citizen's journey across the vaccination cycle broadly includes three phases: pre-vaccination, vaccination and post-vaccination.

The pre-vaccination journey is triggered by a robust communication plan with education and outreach campaigns. Digital marketing, supported by automation across communication channels, can drive targeted and personalized messaging and allow for quick and dynamic updates.

The scheduling of a vaccination appointment should be easy-to-follow, self-service-driven and a frictionless experience. It should allow the citizen to check eligibility, locate near-by vaccination sites and make an appointment effortlessly. Every touchpoint in this process must be carefully crafted, or the citizen might rely on false information that can impact vaccine adoption.

Digital customer experience solutions can power this effort to drive consistent and engaging experiences for citizens across web portals, mobile phones and service desks. Considering the large number of elderly and those with limited internet skills and access in the target population, digitally integrated customer service desks can ensure appointment services on phone.

Technology plays pivotal role in the post-vaccination phase as well. Vaccine recipients can get automated alerts for second dosage and easily report any adverse effects in real time through a mobile app. Citizens can self-generate digital certificates for vaccination as a mobile passport and a gateway for physical entry into public places.

Ultra-cold Vaccine Distribution, from Factories to the Front Line: More than 50% of vaccines go waste globally every year due to challenges in distribution and vaccine handling.[2] In the case of COVID-19 vaccines, the distribution is even more complex, owing

to cold storage requirements, which varies by vaccines, multi-modal transportation, multiple hand-offs before finally reaching the point of use (POU).

Digital technologies are at the forefront to monitor and proactively manage the cold supply chain in real time to ensure effective distribution, while minimizing wastage.

For example, digital solutions play a vital role in ensuring efficacy of mRNA vaccines that require stringent cold chain conditions. IoT-powered thermal sensors, coupled with GPS on every shipment, track the vehicle location and temperature across pre-set routes until they reach the distribution centers, before being shipped to POU using thermal shippers.

Some technology solutions offer tracing at a more granular level. Lyngsoe systems, a Denmark-based company, developed an RFID-based solution to digitize the tracking and monitoring of the temperature and expiry date for individual vials being stored and administered to citizens.[3]

Another interesting case of technology application is being implemented by South Warwickshire NHS Foundation Trust, part of the UK's National Health Services.[4] It uses blockchain technology to improve the traceability and tamper-proof temperature profile across the distribution chain.

Dynamic, Collaborative and Responsive Information Ecosystem: Using a digital network that enables data to flow faster and seamlessly across the value chain is critical for successful mass vaccination.

Equitable access to real-time information, such as daily appointment schedule for the vaccine provider, reporting to federal agencies, and recording an adverse event, is essential for all stakeholders.

For vaccination sites, local agencies and governments to compile and share their demand forecast in real time with vaccine manufacturers and other stakeholders requires a live ecosystem that has the capacity to exchange huge volume of real-time data.

Cloud-based integration platforms and business process management solutions are key to building a digitally connected ecosystem to power the large-scale information exchange and automate processes for this massive global exercise.

Safe and Secure Data Management: With multiple stakeholders and huge volumes of personal and vaccine-related sensitive data being exchanged, security is a key concern across the value chain.

Incidents of global phishing have already been detected, and stringent cyber security measures need to be taken to protect critical data and processes. Multifactor authentication (MFA), using end-point protection and response tools, and adopting email security best practices are some of the must-haves for vaccine delivery management.

Apart from these five intervention areas, adopting cloud-based applications for secure health care data storage and adhering to international industry standards such as Health Level7 (HL7), Fast Healthcare Interoperability Resources (FHIR) and effective open API management for secure data exchange could form part of the security guidelines in the digital playbook for vaccination.

Conclusion

In summary, the global pandemic has reiterated the need to build purpose-led ecosystems knit by public and private players and for digital platforms and technologies to power this collaborative effort toward building a safe, resilient and purposeful planet.

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