

DIGITAL PLATFORMS FOR COVID-19 VACCINATION DELIVERY



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CONTENTS

- ACKNOWLEDGMENTS1
- INTRODUCTION 2
- OVERVIEW OF THE PLATFORMS INVOLVED IN VACCINE DELIVERY3
 - The digital ecosystem 3
- CONSIDERATIONS FOR IMPLEMENTATION4
 - Systems and processes may already exist 4
 - Platform approach vs. components and toolkits 4
 - Stand-alone capabilities 4
 - Open source vs. closed source 5
- ASSESSING REQUIREMENTS ACROSS THE VACCINATION DELIVERY LIFECYCLE 6
 - Planning and management 6
 - Supply and distribution 8
 - Program delivery 9
 - Post vaccination10
 - Cross-Cutting Capabilities11
- EVALUATION CRITERIA.....12
- RECOMMENDATIONS AND OPPORTUNITIES.....13
 - Perform a rapid assessment13
 - Leverage existing systems and organizations where possible, if not, those with relevant experience13
 - Free does not always imply best14
 - Standards should be a priority14
- POTENTIAL OPPORTUNITIES15
 - Improving general health care provision15
 - Informing future vaccine development and better vaccination programs15
- ADDITIONAL RESOURCES AND ARTICLES16
- CONTACT16

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INTRODUCTION

Vaccination is a high-priority activity in the fight against the COVID-19 pandemic, as effective delivery is essential to return to normal life, recover the economy, allow international travel and most importantly, save lives. Without equitable access to vaccination, any return to near normal circumstances and reductions in excess deaths worldwide will be impossible. To assist countries in the orchestration of mass vaccination programs with vaccines that have been developed at record breaking speed, highly scalable, reliable, and efficient digital systems and digital health solutions will be required for the targeting, distribution, rollout, and monitoring of immunizations.

Digital systems, technologies, and data have the potential to transform health care and solve pernicious challenges in countries, providing an opportunity to leapfrog and improve quality of care, decision-making, and the efficient use of resources, while reducing costs and burden of diseases. As expressed in the World Health Organization's (WHO's), [approved Global Digital Health Strategy](#) approved by WHO member states in 2021, "Digital health should be an integral part of health priorities and benefit people in a way that is ethical, safe, secure, reliable, equitable and sustainable. It should be developed with principles of transparency, accessibility, scalability, replicability, interoperability, privacy, security and confidentiality."¹

Digital solutions offer an opportunity to digitalize the vaccine delivery process, registration, and certification, making it more accurate, secure, effective, and connected with other health systems to provide a comprehensive view of the vaccination campaign. However, a lot of questions have been raised in terms of ethics, privacy, inequity, costs, and standards. These have made the case to create global standards and guidelines. These standards and guidelines should provide a response in terms of how to implement and not what specific solution to implement, taking into account the different country contexts, digital maturity, and needs. Any crisis of this scale inevitably attracts a large number of potential technology solutions—some highly innovative, some based on existing proven systems, some yet unproven, and some addressing underlying problems to enable better outcomes.

This paper aims to help practitioners better understand the key capabilities of such digital systems and digital health solutions, the priorities for certain functionality, and how these systems may operate with existing country resources (e.g., Electronic Medical Record [EMR] and Management Information Systems [MIS]).

1 WHO. 2021. Global Strategy on digital health 2020-2025. <https://www.who.int/docs/default-source/documents/gd4dhdad2a9f352b0445bafbc79ca799dce4d.pdf>.

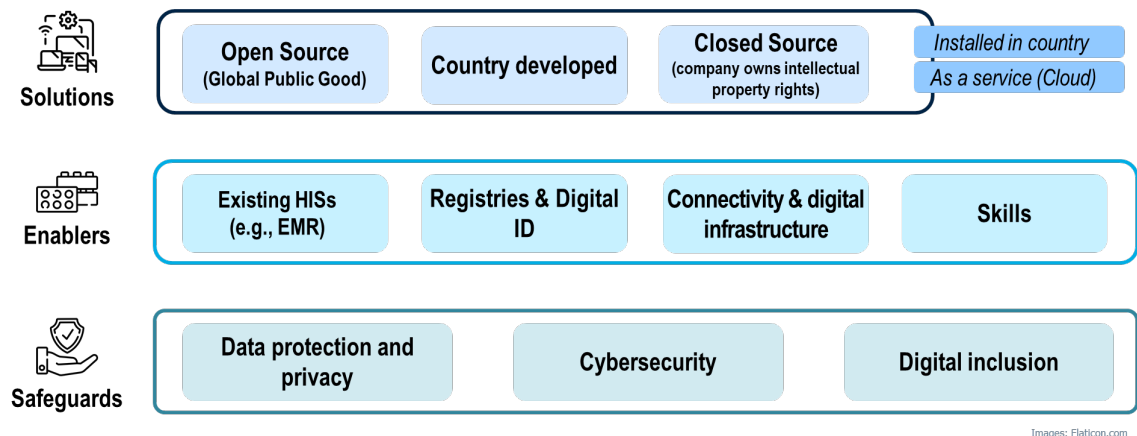
OVERVIEW OF THE PLATFORMS INVOLVED IN VACCINE DELIVERY

The digital ecosystem

The global pandemic has called for a rapid response, not only from governments and health care providers, but from technology companies seeking to return society to a recognizably normal state and to stem excess mortality. Inevitably this has led to a vast and diverse set of solutions—some building on existing architectures and solutions, some creating new applications and platforms, others complementing or plugging gaps in what already exists, and some creating completely new approaches or functions. Each has value but not all will be appropriate in every setting or country.

Digital solutions alone do not constitute a complete vaccine delivery program, but they can play a vital role in management and delivery of these programs at scale. A combination of information technology (IT) systems and digital health solutions, enablers (technology, capacity, and capability), and safeguards will be required (see figure 1) and will need to work together reliably and efficiently for the program to be effective.

Figure 1. Solutions, Enablers, and Safeguards



Source: World Bank, 2021

The range of available solutions varies in their form and focus, ranging from platform systems with a wide range and scope of services to toolkits and components aimed at specific aspects of the vaccine delivery lifecycle or enabling countries to build their own solutions.

Rather than classify available digital systems by their technical presentation (e.g., platforms and products), a high-level distinction has been made between those created as an open source or digital public goods project (e.g., DHIS2, DIVOC), those developed by a specific country (e.g., Co-WIN), and those that are closed source (e.g., Oracle).

CONSIDERATIONS FOR IMPLEMENTATION

Systems and processes may already exist

There will be existing systems and processes in most countries as part of health care delivery and perhaps in other systems such as foundational identity and logistics systems. Any new system will most likely need to fit in with existing systems and processes or face conflict with the day-to-day administration of health care. In some cases, countries might decide to run a separate vaccination program.

All of this implies that vaccine delivery systems must be interoperable and flexible to accommodate existing ways of working and to take advantage of, rather than replace existing, health care IT systems unless necessary. Countries may decide to add a specific module to an existing platform or deploy a new solution that may or may not be interoperable with existing systems. Relying on the knowledge acquired by users of existing systems will help facilitate any required integration. Standards will also undoubtedly help in many cases, and will be a far more strategic option; however, given the speed of delivery necessary for COVID-19 vaccines, the ability for new digital systems to be readily customized to adapt to the existing health care ecosystem will be vitally important.

Platform approach vs. components and toolkits

Much will depend on the current digital capability and available health care IT systems in the host country. Where key infrastructure such as Electronic Health Record (EHR) and Management Information systems (MIS) are in place and reliable, building a vaccine delivery solution from component services or toolkits may be preferable to extend existing capability.

Strategy will also play a part in the decision-making process. For example, the need to roll out COVID-19 vaccine delivery quickly may point to a separate infrastructure for that delivery that is able to interoperate with rather than replace existing systems.

Stand-alone capabilities

There are some functions required by a vaccine delivery system that can be viewed as separate systems or may already exist elsewhere in the health IT ecosystem. Key examples of this are MIS and EHR systems, both of which commonly provide the backbone of digital health care provision in many countries. Yet COVID-19 also presents the need to vaccinate far more rapidly and at larger scale than precedent vaccination campaigns. The complexity of the process means that countries need to rely on a wider set of capabilities, notably the possibility to better track the distribution of doses from their arrival in the country to the vaccination centers, the availability of workforces (e.g., doctors, nurses, support staff) and an increase of services offered to the beneficiaries (e.g., preregistration, registration, adverse event following immunization (AEFI) reporting, proof of vaccination).

Many of the solutions reviewed are aimed squarely at orchestrating delivery of the vaccines and digitally recording received doses. Adverse reaction reporting and post vaccination monitoring also feature heavily, and while often included in platforms, may also be supported by DHIS2, which includes a WHO approved AEFI tracker. In the case of COVID-19, the issuance of verifiable digital vaccination certificates to the beneficiaries, on top of the digital recording of vaccination events in the immunization registries, is a new feature needed by a majority of countries.

Open source vs. closed source

Open source and closed source software solutions are equally likely to offer value to beneficiaries and the operators of vaccination delivery systems although they may do so from differing starting points. Open source simply means software that is available to the public under a licensing agreement that allows code to be shared and modified by other users and organizations. Open source does not mean free in the sense of cost, but simply free in the sense of free speech. This open nature enables evolution of the software by a disparate set of users, often those implementing solutions, and ensures the freedom to innovate and deploy without additional license overheads. However, it does not guarantee support, service levels, or documentation.

Closed source by nature takes the opposite approach and places a cost on the license of software and its use. While the ability to innovate or evolve the software collaboratively is lost the stability and reassurance of a vendor responsible for bug fixes, regular product updates, customer support, and even service-level agreements are available. Vendor lock-in can be an issue but can be mitigated by selecting products that adopt recognized standards and provide flexible Application Programming Interfaces (APIs).

Inclusion, data protection and cybersecurity safeguards

Digital platforms involved in vaccine delivery will process (i.e., collect, store, use and disseminate) sensitive data about individuals, such as about their health and vaccination status.

The operation of such platforms must therefore be subject to robust data protection laws. It should be demonstrated that the vaccination program has a clear basis in law and that any data processing undertaken as part of the program does not go beyond what is reasonably necessary to achieve the intended purposes (for example, only the minimum amount of data should be collected). The applicable legal framework should also contain the following safeguards: requirements in respect of key data protection principles (lawfulness & transparency, purpose limitation, data minimization, accuracy, storage limitation and data security); protection of data subject rights (i.e., to access data); restrictions on overseas data transfers and on third party access to data; remedies and penalties for non-compliance; and a form of independent oversight.

Public authorities should only repurpose personal data contained in existing government databases for vaccine delivery where relevant individuals would have reasonably foreseen their data being used for the purposes of such a public health initiative. Alternatively, there should be a clear legal mandate for the public authority to repurpose the original database. Pursuant to the transparency principle, public authorities should also clearly inform individuals about how and why their personal data is being processed as part of the vaccine delivery and their rights in respect of that data.

Technical and organizational measures must also be implemented to ensure that the digital platform(s) used as part of a vaccine delivery program provide a level of security appropriate to the risks presented. Prior to undertaking any processing through such platforms, countries should undertake a data protection impact assessment (DPIA) to identify the risks linked to the deployment of the specific systems and to define appropriate mitigation measures. Technical and organizational measures to ensure appropriate security may include: the pseudonymization and encryption of personal data; a process for regularly testing and evaluating the security of the platform; and appointing a Data Protection Officer to monitor and advise on data protection compliance and to assist with the DPIA.

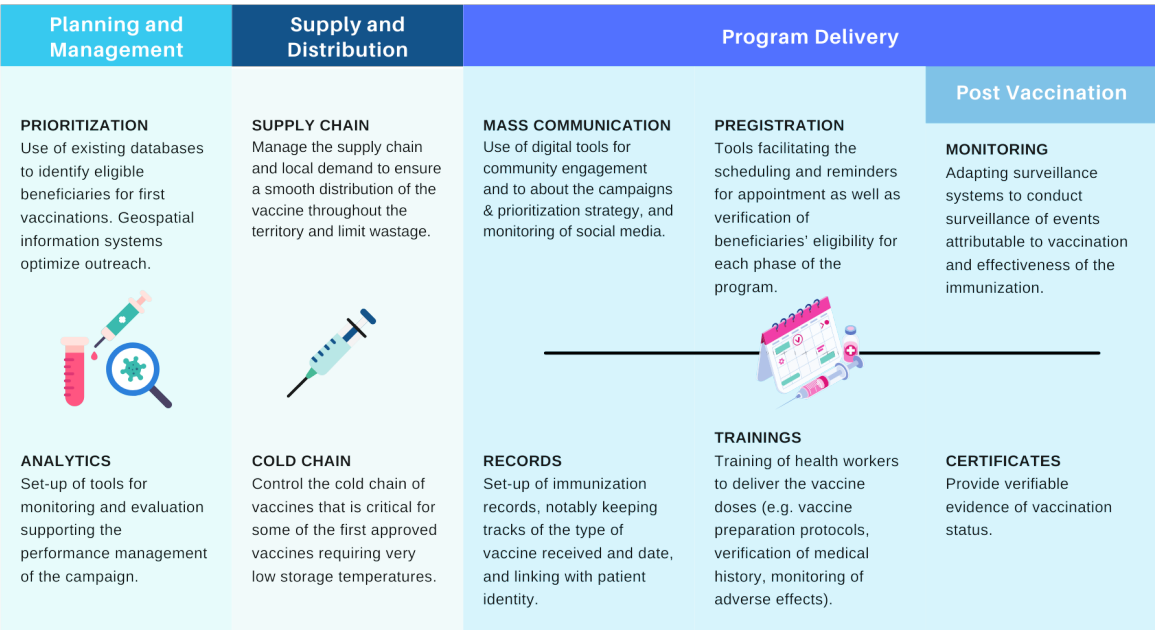
Additional safeguards should be established to ensure that the processes and tools developed or reused facilitate access of the population to the vaccines and do not lead to the exclusion of certain individuals or groups (i.e., minorities, population with low digital literacy). Engagement with the public on the potential unintended consequences in terms of barriers to access the services, data protection and privacy issues, along with effective and transparent communication, can significantly reduce such risks.

ASSESSING REQUIREMENTS ACROSS THE VACCINATION DELIVERY LIFECYCLE

Each country will have differing levels of capacity and capability about health care information systems, so it will be unlikely that one solution will meet the requirements of all countries. In many cases there will be existing systems and processes that must be observed and integrated to enable effective vaccine delivery. This must be a primary concern when considering any of these digital delivery solutions.

In general, effective vaccine delivery systems will need a supporting data infrastructure across health care services to provide reliable recording and monitoring of vaccination delivery alongside patient records. This will enable other key functionality for COVID-19 vaccine delivery, such as second dose scheduling, the recording of AEFI, and the issuance of vaccination certificates. This underlying data infrastructure may already exist, even in part, so standards and interoperability capabilities will also be vital for most countries.

Figure 2. Digital Solutions Will Play a Role at Each Step of the Vaccine Delivery



Source: World Bank, 2021

Planning and management

In order to ensure the success of a vaccination campaign, public health authorities will need to plan their strategy, which includes in the case of COVID-19, the need to prioritize the categories of population most at risk due to the initial limited supply of doses. Authorities can then plan to reuse existing databases to proactively identify which individuals are part of the prioritized population groups (for example, Box 1). Developing this strategy may be a concern separate from vaccine delivery, in which case functionality for the prioritization of beneficiaries to be vaccinated may be out of scope for the vaccine delivery system.

In parallel, analytical tools will have to be put in place to monitor the uptake of the vaccination campaign, collect data to make informed decisions about resources and dose allocations, and also track the efficacy of the overall immunization efforts.

Key Component	Overview
Beneficiary prioritization	Rules-based prioritization based on demographic, geographic, and health data.
Beneficiary targeting	Targeting of specific groups of beneficiaries, e.g., those covered by public funds vs. private schemes.
Mass campaign management	Mass campaigns are an alternative or supplement to targeted campaigns for immunization and will require separate monitoring capabilities (DHIS2 has been used for this purpose with other vaccines in places such as Bangladesh and Uganda).

As noted above, public authorities should only repurpose personal data contained in existing government databases for vaccine delivery where relevant individuals would have reasonably foreseen their data being used for the purposes of such a public health initiative, or where there is a clear legal mandate for the public authority to repurpose the original database. In respect of the latter, the authority (data controller) should be able to justify that (1) the processing of existing data is necessary for the vaccine targeting strategy and (2) implementing vaccination strategies falls within the scope of public interest under national law.

Box 1 Overview of Country Approaches to the Identification of Individuals in Prioritized Groups

There are different approaches to how individuals in prioritized groups can be identified and targeted, depending on the existing capabilities and available databases of countries:

- **Countries may reuse existing databases to identify lists of eligible beneficiaries.** Sri Lanka is using electoral lists to identify the elderly, and Denmark is using its population registry and associated database to identify individuals of a certain age or with medical preconditions. Reusing existing lists enables countries to proactively target individuals that have been prioritized.
- **In case there is no existing database covering all beneficiaries of the countries, public authorities could aggregate lists of individuals provided by syndicates (such as health care professional associations) or from local governments.**
 - DHIS2 tracker (used in 77 countries) and Co-WIN software (India) allow patient lists to be uploaded and can be set up to send invitations and reminders to the candidates for vaccination.
 - In Indonesia, individuals can verify whether they have been prioritized on a website (pedulilindungi.id) using their ID number and ask to be included if they fit the eligibility criteria.
- **Alternatively, countries could create a preregistration website with self-declaration forms like in Tunisia and Lebanon.** However, such an approach relies on the willingness of beneficiaries to register for vaccination, which can lead to a slower uptake of vaccination.
 - Eligibility can be subsequently verified against aggregated lists.
 - Individuals may be required to present supporting evidence (such as a medical record to prove co-morbidities) at the vaccination center.

Supply and distribution

Although most solutions will not encompass a fully featured Logistics Management Information System (eLIMS) there are specific concerns with regards to the delivery of vaccination programs that will be required (for example, Box 2). The following are likely to be important in most country implementations:

- **Demand management**—ensuring that local demand is reflected in national supply chains including booster doses, wastage, etc.
- **Cold chain management**—management, monitoring, and tools supporting an effective cold chain process.
- **Program administration**—operational management tools and services for regional and local vaccination clinics.

Key component	Overview
Last mile logistics/supply chain	Facility and community-based service delivery and reporting to manage last-mile supply chain issues such as cold chain issues, monitoring usage, stock levels, and re-supply from local hubs. Ideally this functionality would complement rather than replace wider supply chain and logistics systems.
Cold chain management	Vaccines will require storage at specific temperatures to remain viable—some at very low temperatures not normally provided for by medical facilities. Monitoring the safe storage of vaccines and maximizing their viability and use will be crucial. This may include systems that utilize new technologies such as Internet of Things (IoT) or distributed ledgers to better track and monitor the cold chain process.
Demand management	There is likely to be limited supplies of vaccine in the early stages of rollout. Ensuring that local supplies of vaccine match the demand seen from beneficiaries is vital. Monitoring demand and feeding back data in real time to national systems such as an eLIMS or MIS will help authorities to better understand local distribution needs.

Box 2 Example of World Bank Support to Reduce the Carbon Footprint of Vaccine Storage and Distribution^a

The World Bank's Energy Sector Management Assistance Program (ESMAP) has initiated the mobilization of grant funding from donors in the amount of over US\$20 million to combating the virus while also addressing climate change:

- In **Mongolia**, the World Bank through UNICEF has been supporting the construction of a new central facility for vaccine storage by introducing energy efficient building designs and assessing options to install solar photovoltaic (PV) as well energy efficient heat pumps. Other features such as energy efficient cold rooms, sensors controlling lighting, and air curtains minimizing heat loss are also being considered.
- In **Somalia**, with extreme heat and unreliable and expensive power, plans are focused on ensuring energy efficient vaccine storage, installing distributed solar power, and acquiring solar direct drive refrigerators for remote areas.
- In **Comoros**, innovative climate-friendly transportation such as drones and electric boats to reach inhabitants in harder to reach locations is being explored.

a World Bank, COVID-19 vaccines: Saving lives and rebuilding better. <https://blogs.worldbank.org/climatechange/covid-19-vaccines-saving-lives-and-rebuilding-better>.

Program delivery

Program delivery encompasses the core functions of vaccinating beneficiaries, maintaining medical records, managing demand and uptake, and ensuring clinical supplies (including vaccine doses) are adequate to meet that demand. There is also an emphasis on managing the local delivery (last mile) of vaccines and measures required to reduce wastage and maximize quality, such as cold chain processes.

Countries that could rely on prioritized beneficiary lists, that included contact details for individuals, like Denmark, could proactively invite residents for vaccination (for example, Box 3). In some cases, mobile vaccination units could be setup to offer a straightforward and convenient solution, notably for remote areas. Alternatively, they might offer eligible persons the opportunity to register for vaccination at a place and time of their choice via a website/app created specifically for this purpose or to rely on existing platforms used in the country. France, for example uses pre-existing physician appointment websites.

If a country can rely on a mature digital ID system, beneficiaries can be authenticated during their registration to automatically check their eligibility and link their vaccination record to their medical record (e.g., in Denmark using NemID). To avoid registration of non-prioritized individuals, countries that have been able to identify eligible candidates can also distribute vouchers (by mail, text, or email) that must be presented at the point of inoculation. It is important that all these solutions include alternative means for scheduling appointments for the groups that are less digitally able, e.g., a telephony channel for the elderly or people with disabilities.

Key component	Overview
Clinical staff onboarding and training	Demand will be high for trained and qualified clinical staff to manage and administer vaccines to beneficiaries. Some systems may include tools to onboard these staff or aid in planning for demand through MIS.
Preregistration	When digital means are available allowing beneficiaries to preregister for vaccination, this provides an opportunity to engage individuals and to gain an insight into upcoming demand.
Registration	Registration should seek to create an initial vaccination record for individuals and also begin the process of prioritization and scheduling, if not already begun. There is also an opportunity at this point to link to existing health records or a national identification system to ensure the continued identification of beneficiaries, even if scoped to the vaccination delivery process itself (i.e., to uniquely identify the individual beneficiary even if this does not link to a national register).
Screening and identification of beneficiaries	Ensuring that beneficiaries registering for vaccinations are eligible for vaccination (based on national regulations and guidelines) and that they are reliably identified for tracking purposes.
Measuring uptake and distribution	Data on vaccination utilization, wastage, cold chain, and outreach, etc. Enables authorities to fully understand how vaccines are utilized and any arising issues.
Immunization registry	Monitoring individuals (to complete a course of immunization) and follow up engagement including notifications and reminders (e.g., second dose).

Box 3 Examples of Country Approaches to Registration

- **Denmark** developed a website for self-booking appointments that uses NemID, the government-recognized digital ID that is linked to their civil registration number (CPR), which matches to their health record. A hotline is available for people who cannot use this service.
- **India** built the Co-WIN platform to orchestrate its vaccine rollout and are accepting the foundational ID (Aadhaar) or at least 11 other IDs for people to register on the app and manage appointments. The digitally verifiable vaccine certificates are linked to the recipient's Aadhaar.
- **Uruguay** is linking individuals' national ID numbers to the records in the vaccine information system that is used for all types of vaccinations. Individuals can verify using their ID number and date of birth if they have been prioritized and able to book an appointment.

Post vaccination

For many individuals, the immediate benefit of a COVID-19 vaccination may be the ability to continue working, travelling, or accessing services. Being able to prove that they have been vaccinated, when, and with which vaccine will be a major advantage socially and economically. Governments will need to monitor the effectiveness of vaccination programs and the ongoing health of beneficiaries, given that vaccines have been rushed to market and with a virus that will potentially be a continual threat to public health despite vaccination (for example, Box 4). Extending support and monitoring the point of vaccination is therefore a key feature of the ongoing fight against COVID-19.

Key component	Overview
Personal vaccination record/ proof of vaccination	Proof of vaccination linked to the immunization registry and where possible general health records (e.g., EHR systems). The proof of vaccination should be in a secure form but does not have to be digital in nature.
Adverse events tracking	<p>Adverse events tracking to record adverse reactions and effectiveness of the vaccine administered. This is vital for COVID-19 vaccines as they are relatively new, and a deeper understanding is required of adverse effects.</p> <p>For example, DHIS2 includes a module for an adverse effects recording based on the WHO model and workflow, the adverse events following immunization (AEFI) tracker.</p>
Monitoring and analytics	<p>The ability to view and analyze comprehensive data from multiple sources, including operational and logistical information, EHRs, adverse reactions, and geographic and demographic spread, etc. Should also include the ability to create alerts and dashboards to support adherence to policy and procedure.</p> <p>Some systems may include the tracking of new variants of coronavirus, which will be key to fighting the pandemic in the long term. The ability to track genome sequencing is one example.</p>

Data capture, analyses, and management information will inform policy, allow clinicians to understand the effectiveness of vaccination, and ensure a smooth supply chain process. The scale and importance of COVID-19 vaccination is unprecedented; therefore, the accurate gathering of data that complies with national and international laws and clinical best practice is essential, as will be its utilization to drive a successful vaccination program.

Monitoring should begin with the targeting and registration of beneficiaries and follow them and the process of vaccination through to any post-vaccination issues, such as adverse reactions. As such the data will also be personal in nature and closely related to medical records, meaning that the adherence to standards for the storage, processing, protection, and use of data will be critical, as will the protection of beneficiary rights.

Box 4 Examples of Country Approaches to Post Vaccination

- **The Philippines** have put in place the VaxVertPH platform that allows individuals to get digital vaccination certificates based on information recorded in the national immunization registry (VIMS)
- **EU countries** have agreed to issue a standardized digital proof of a COVID-19 vaccination in order to support continuity of care and facilitate cross-border recognition of vaccination certificates.
- In **Israel**, patients can report an adverse event online during or after COVID-19 vaccination. The country also decided to **share weekly data updates** on its COVID-19 outbreak with Pfizer/BioNTech to further understand the efficiency of vaccines and enable other countries to fine-tune their vaccination campaigns.

Cross-Cutting Capabilities

Vaccine management systems cannot operate in isolation and must be able to work alongside or in concert with other medical and public administration systems. As such, cross-cutting capabilities will be required that will feature across the vaccination delivery lifecycle. These systems may already exist in-country, so they may be a requirement for integration rather than for implementation.

Key component	Overview
Management Information System (MIS) / Health Information System (HIS)	MIS is a highly important element of a successful vaccine delivery solution, but does not have to be native to that solution, and would be more effective as a shared function across the health care ecosystem. For example, DHIS2 plays this role in many countries.
Electronic Health Record (EHR)	The ability to accurately record health interactions (e.g., vaccinations) and to do so in a way that can be used across the health sector is vital. If an EHR system is not already present in country, then it must be considered as part of or in adjunct to the implementation of a COVID-19 vaccine delivery system. If there are multiple EHR systems in a country, then interoperability should be achieved to provide a unified vision of patient's records across facilities.
Digital identity integration	Where possible, integration with a national identity scheme should be included to ensure that beneficiaries are effectively identified, that fraud is reduced, and that ongoing engagement with beneficiaries is optimized. Some countries with a particularly strong national identity system may also wish to use this integration as a means of prioritization (e.g., based on age, location, medical history, etc).
Standards compliance	Standards are vital to ensure that data are collected safely and securely as well as being stored in an interoperable format for data analyses and potential export to other systems in the future (e.g., EHR systems or to avoid vendor lock-in).

EVALUATION CRITERIA

During our research, we have examined several digital solutions that have the potential to support countries implementing a vaccination delivery system. We have used reference deployments of these digital solutions as a means of identifying a smaller selection likely to be suitable for deployment in the near term as well as highlighting some emerging digital solutions. This selection is not definitive or an endorsement but can act as a guide to what is possible and relevant in the current digital delivery ecosystem.

- **Scalability**—national or regional level deployments at a population scale.
- **Acceptability**—it is broadly adopted and has had a demonstrable impact on:
 - existing deployments with buy-in from key stakeholders, e.g., practitioners/political.
 - better health care based on evidenced positive reviews and feedback.
- **Availability**—it is working today.
 - It is flexible and can be deployed in a different jurisdiction or country.
 - There are organizations that can help to design deliver, operate, and support it.

Additionally, we have identified several critical criteria that should be considered:

- **Time/ease to deliver:** How difficult is it to deliver the system? A digital public good open source, off-the-shelf system may come with templates created by the global community that require limited customization. A closed source product may be capable of many things but may come without any configuration and require much customization by experienced professional services. Availability of training, resources, and support help in-country resources quickly and easily gain a level of competency.
- **Interoperability:** Understanding that change is always difficult, especially within the health care sector, it is likely that system(s) may be deployed in parallel rather than extending existing infrastructure. A country could make a decision to deploy something for now to meet current requirements and choose to dismantle it at a later date. Alternatively, it could be integrated into existing infrastructure or even replaced in the future.
- **System readiness:** The maturity of the system should consider a number of aspects, including stability or reliability—where in the lifecycle the product is (beta or alpha to determine the mean time between failures and maturity), how many real-world deployments in the field, and the completeness of the features (usability, scalability, security, and privacy).
- **Commercial model:** The commercial model considers how much it could cost, which will depend on whether a license or subscription is required, or whether it is free, e.g., many open source models especially those classified as “for the public good” meet this. However, care should be taken to ensure that there is no vendor lock-in for products that are free for a given time or context, i.e., to help during the pandemic or “for x years.”
- **Standards:** Ensuring that a system is designed to use recognized international standards will ensure that it has the ability to interoperate with other systems deployed elsewhere in the world. This will be of extreme importance with the introduction and adoption of vaccine certificates to enable travel and the reopening of economies across the world.

Other times, more country specific criteria might be applied such as:

- **Total cost of ownership:** The cost of licenses and expert resources to provide design, delivery, and operational and technical support can be large. It may be that there is a preference to pay for a managed service that includes everything. This could even include data centers in a box or via the cloud that countries could deploy for an interim period.
- **Technical readiness:** Assessment by the country, i.e., self-asserted or by one or more independent third parties could provide an indication of technical capability that is available. In order to design, deploy, integrate, operate, and support any new systems, it may be necessary to employ third-party resources.

RECOMMENDATIONS AND OPPORTUNITIES

A balance must be found between the need to act quickly during the global pandemic and the need to implement systems that will have a lasting effect on the health of national populations. Countries should focus on their key challenges and highest impact areas. Certain functionality is essential, such as EHR/vaccination records, operational management, and post vaccination data gathering, such as AEFI reporting. Given that COVID-19 vaccines are unprecedented in their speed of development and the lack of large-scale testing, gathering accurate data on vaccine administration and patient outcomes will be vital. The strategy of immunization rollout will play an important factor in the decision-making process. A less complex beneficiary profiling and selection phase may be more practical in countries where population data are incomplete or of poor quality. Equally, such a mass vaccination approach is also less complex and potentially quicker to initiate.

Perform a rapid assessment

Performing a rapid assessment of what systems are already in place in the country, what the major gaps are for vaccine delivery, what other donors are supporting, and where the government would like support are key to ensuring that COVID-19 projects are not repetitive or potentially even draw much needed resources from other areas.

The community of international donors may have already performed an in-depth assessment of the health care ecosystem of a given country that could be used as a basis to understand what the points of attention and further development are in the context of COVID-19 vaccine delivery.

- **Map & Match:** The [Map & Match \(M&M\) program](#) is a multi-donor effort to catalogue existing digital health investments at the country level across all lower- and middle-income countries (LMICs). Systems that are being used for COVID-19 response and vaccine distribution will be identified, as well as systems that can be adapted to support those use cases. The data will be available for further analysis in the WHO Digital Health Atlas, and 25 priority counties will receive the analysis. The data are designed to be used with the Digital Pandemic Preparedness Assessment (DPPA) tool.
- **EDIT:** The [Early Stage Digital Health Investment Tool \(EDIT\)](#) measures the level of development of human capacity, investments and funding, data capture and use, infrastructure, standards and interoperability, and governance and policy in the health sector as essential building blocks that need to be in place before designing and investing in a digital health solution.
- **DPPA:** Based on the M&M data available for the country, the [DPPA](#) validates, details, and complements the M&M information, and summarizes the existing health system in respect to specific use cases relevant for pandemic preparedness and response, including vaccination delivery. It thus supports in-country discussions with stakeholders that allow donor harmonization, the development of a country roadmap, and costed plans.

Leverage existing systems and organizations where possible, if not, those with relevant experience

If there are systems and organizations in your country working on an area needed for vaccination, evaluate to see whether they can expand their system and work area to include COVID-19. Having in-country experience and buy-in highly reduces the risk of a digital health project. For example, almost every country has an implementation of a frontline health worker mobile system or a national management information system. Even more priority should be given if these systems are part of the list of Global Goods (a catalogue of open source solutions in the

domain of eHealth)² since almost all of them have created a COVID-19 module. Finally, if none of these systems are in-country, priority should be given to both Global Goods and organizations with significant experience in global digital health, notably in LMICs. Even large multinational corporations such as Oracle, Google, or Salesforce may fail if they do not have the necessary health sector specific knowledge.³

Free does not always imply best

There are organizations offering free or low-cost platforms for vaccine distribution. They are often based on good quality systems and services, but consideration should also be given to the long-term implications of adopting such a solution. For example, skills may be an issue if the system in question is not commonly understood in the country, costs may only be reduced for a short period, and vendor lock-in (where you cannot change systems in the future) may be a concern moving forward. Cost alone should only be one factor in selection of a vaccine delivery system and should not be the driving factor.

Standards should be a priority

COVID-19 is a global pandemic, and as such the recording and interoperability of vaccination records and/or certificates will be essential requirements if public health authorities and service providers in the public and private sector are to return to normal operation.

Some standards for health data exchange (HL7 FHIR) and classification (ICD-10) already exist, and these will continue to be relevant, but it is likely that the WHO Smart Vaccination Certificate Working Group will develop new or updated common standards. The ability to adopt these key standards will be a defining factor for systems aiming to enable beneficiaries to provide proof of vaccination. This is another reason to use systems in the Global Goods list, since many have already implemented standards.

² Digital Square. 2021. Global goods and vaccinations. https://wiki.digitalsquare.io/index.php/Global_goods_and_vaccinations.

³ MIT Technology Review. 2021. What went wrong with America's \$44 million vaccine data systems?. <https://www.technologyreview.com/2021/01/30/1017086/cdc-44-million-vaccine-data-vams-problems/>.

POTENTIAL OPPORTUNITIES

Improving general health care provision

In countries where a standardized EHR or MIS system has yet to be implemented or requires upgrading, an opportunity exists to action this as part of the vaccination delivery system implementation. The provision of accurate, up-to-date health records that can be accessed across health care settings will lead to a more coordinated and efficient health care provision for patients. Having access to accurate patient information also reduces medical errors and provides safer care to all. Introducing EHR systems also creates the possibility of introducing additional systems such as e-prescriptions.

Having consolidated MIS capability for health care enables clinical leaders, researchers, and policy makers to better design health care provisions, allocate sparse resources, and identify areas for concern in public health before they become critical concerns.

Informing future vaccine development and better vaccination programs

There is an opportunity for mass vaccination programs to build a body of knowledge for analyses of the effectiveness and outcomes of COVID-19 vaccines over a wide and diverse population. Providing this data, in an anonymized form, will help researchers, regulators, and countries embarking on later mass vaccination programs to create better outcomes for beneficiaries. Where possible, an open system for the delivery of virus threat information and incident reporting could also play a part in informing national delivery of COVID-19 vaccines based on up-to-the minute health care experiences.

COVID-19 vaccination programs are only just starting and will be continuing at scale for a considerable time. Even then, they are likely to be seasonal occurrences for some years to come. Best practice case studies and lessons learned could be created to inform these ongoing vaccination programs and increase the effect of vaccination globally.

ADDITIONAL RESOURCES AND ARTICLES

- Digital Square. 2021. [Global goods and vaccinations](#).
- Digital Square. 2021. [Global Goods Guidebook](#).
- DIAL. 2021. [Catalogue of Digital Solutions](#).
- DICE. 2021. [Digital Health Center of Excellence](#)

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