**Gavi Digital Health Information Strategy**
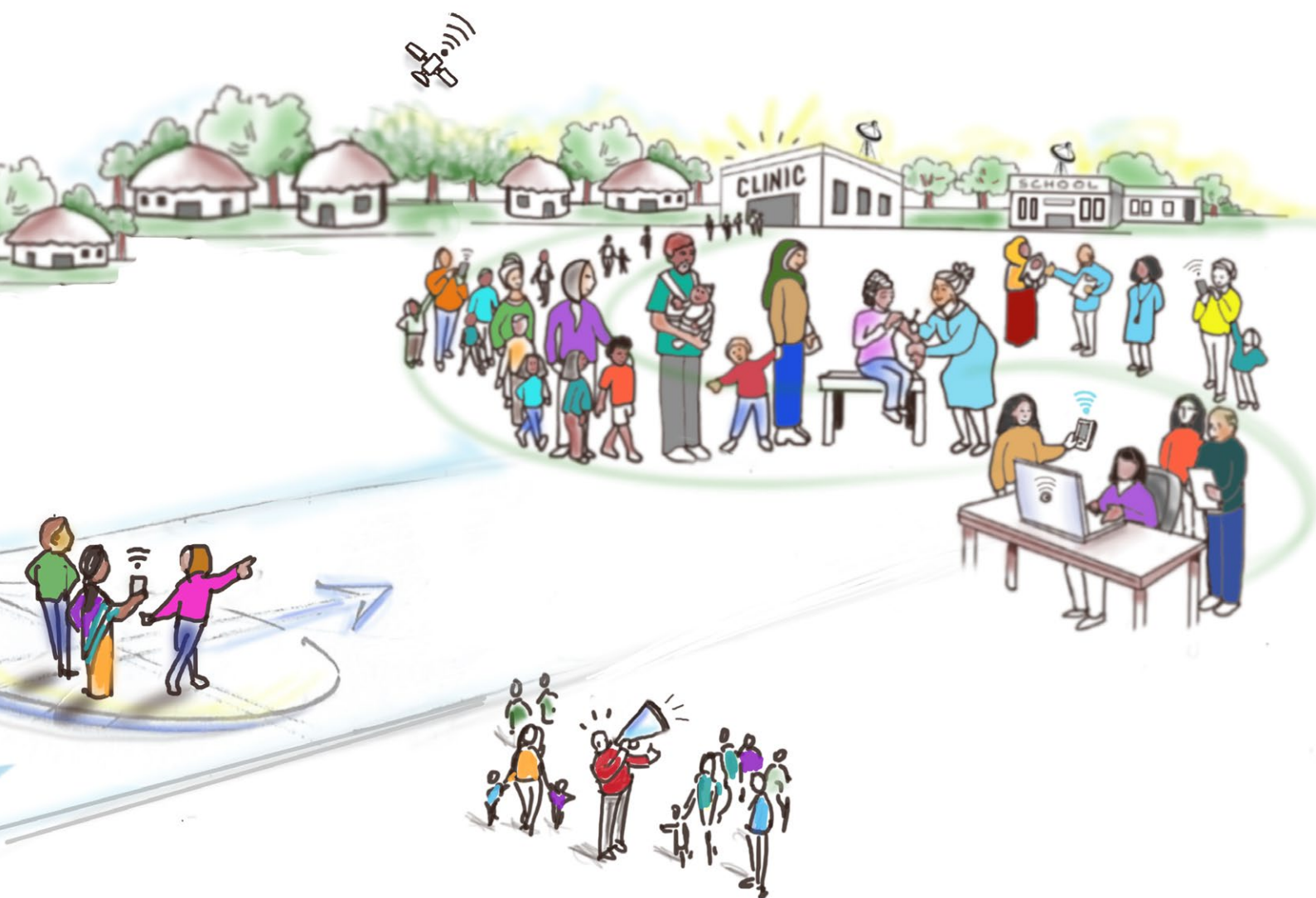# Technical Brief Series

# COVID-19 innovations and digital applications for routine immunisation



**Gavi**
The Vaccine Alliance

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# Executive summary

The COVID-19 pandemic and vaccine roll-out have created new opportunities, interest and  applications of digital tools in response to the global health emergency. Many countries have adapted existing digital health information technologies and tools or developed new ones to facilitate the planning, delivery and monitoring of COVID-19 vaccines for improving stock visibility, tracking vaccine recipients, understanding community demand and generating vaccine certificates. The pandemic has also highlighted a number of bottlenecks and persistent gaps in immunisation programme digital health information technologies and in the enabling environment. Gavi, the Vaccine Alliance, recognises the need to build on successes and lessons learned from COVID-19 innovations and digital applications, not only for future health emergencies but for routine childhood immunisation programmes as well. Drawing from recent project reports, documented country experiences and Gavi's Digital Health Information prioritisation, the following are recommendations for capturing and applying COVID-19 digital applications to future digital health investments.

## RECOMMENDATIONS

- Document experiences and lessons learned from COVID-19 innovations and digital applications in coordination with national governance and EPI programmes

- Highlight and prioritise data interoperability and integration so that COVID-19 use cases do not become separate siloed vertical systems

- Support digital health Global Goods that are dependable, reliable and adaptable to a range of applications and use cases

- Help countries transition successful COVID-19 digital applications to strengthen routine immunisation and the overall digital health ecosystem with long-term sustainability and agility for future health emergencies

This Technical Brief provides a summary and review of experiences with new and adapted digital solutions for COVID-19 vaccine delivery at the global, regional and country level to ensure that the lessons, challenges and successful application of digital health information innovations are captured as part of Gavi's Digital Health Information Strategy.

# Background

The COVID-19 pandemic has had an overwhelming impact on health systems throughout the world, including vaccination programmes. While it has been a health emergency itself, it has also had knock-on effects that have led to basic primary health services being neglected, including a reduction in routine immunisations in many countries. However, the huge investment in late 2020 and throughout 2021 for the rollout of COVID-19 vaccines has increased the capacity of the health system in many countries and demonstrated that countries can, with political will and commitment, use digital health tools and data effectively. Existing digital health platforms, many of which are Global Goods, have been re-purposed or created for the COVID-19 response. Many of these are well documented and assessed in the John Hopkins: Digital Solutions for COVID-19 Response: Assessment of digital tools for rapid scale-up for case management and contact tracing as well as other resources, including Digital Square's Map and Match initiative to assess country needs, available digital health Global Goods, and adaptation to address requirements for COVID-19 health system response. In addition, UNICEF and WHO co-lead the COVID Digital Health Center of Excellence or DICE to provide coordinated technical assistance to countries to support their COVID-19 vaccine delivery. The World Bank has also published two relevant reports into Digital Platforms for Covid-19 Vaccination Delivery and Digital ID Systems as an Enabler of Effective Covid-19 Vaccination.

These developments, which have been informed by the adaptation and evolution of tools that had been previously used for routine immunisation, are now being used as part of the emergency response in many countries in parallel with the Essential Programme for Immunisation (EPI).

A key priority for Gavi's Digital Health Information (DHI) Strategy will be to adapt and mainstream innovations that have proved to be effective for the COVID-19 response into building back and advancing the routine immunisation systems in all Gavi-supported countries. This will involve some combination of updating existing routine immunisation digital health interventions and data approaches based on COVID-19 use case product development, simplification, expansion, and with documentation of lessons learned alongside improved coordination and governance with EPI Programme engagement. Issues of data interoperability and integration of applications will need to be prioritised so that COVID-19 use cases and workflows do not become separate siloed vertical systems and instead are built upon to help strengthen the overall digital ecosystem bringing longer-term benefits. This was the experience with the Ebola outbreak in West Africa in 2013 - 2016, whereby digital health systems were strengthened during the crisis with some elements carrying over beyond the outbreak and others not. In the case of COVID-19, there are many lessons that can be learned from Ebola to facilitate these transitions more effectively.

This cross-cutting DHI Strategy lens will review how digital health data investment and innovations have been applied and advanced as part of the COVID-19 response and vaccine rollout, highlight lessons on how to learn from and integrate these advances to routine immunisation while avoiding pitfalls of siloed parallel systems in the future. There has been a huge focus on strengthening health systems to accommodate COVID-19 challenges and new vaccine rollout throughout the world. The increased uptake of digital technology solutions has raised the profile of digital health among health system policy makers. It is an opportune time to embed digital health sustainably into global health systems

# Review of frameworks, literature and experiences

Since the beginning of the pandemic, 41 countries have adopted DHIS2 COVID-19 disease surveillance modules based on the Gavi-supported disease surveillance modules. A recent report by PATH identified DHIS2 Tracker, OpenMRS, Open Smart Register Platform (OpenSRP), and Shifo's Smart Paper Technology Solutions as systems that have been implemented in two or more LMICs[1]. Of the various innovations, key informants highlighted that the systems for immunisation certificates and applications for scheduling appointments would strongly benefit routine immunisation programmes if transitioned effectively.

Digital health information solutions for COVID-19 response in Gavi-supported countries have been assessed by Johns Hopkins University's Bloomberg School of Public Health[2]: CommCare, CHT, Go.Data, OpenSRP, SORMAS, RapidPro/Textit, and WelTel. COVID-19 use cases supported across these technology solutions are case management, contact registration and follow up, port of entry screening and follow up, facility readiness and stock tracking, health worker training and monitoring, laboratory tests, event-based surveillance, geospatial event-based capability[3], reminders and notifications.

This analysis demonstrates that there are many existing systems that have been adapted for COVID-19 response, though none of them are ideally suited to the range of use cases required for a full COVID-19 health system response. The details of the analysis support decision-makers at both global and national level to assess the tools they have been using or are considering using in constructing an optimal digital health system during COVID-19, which can be expanded in future to strengthen the whole health system.

More detailed descriptions of the most commonly used of these Digital Health applications that are implemented in more than 10 countries and how they are used for COVID-19 are provided below.

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1 https://bidinitiative.org/wp-content/uploads/DigitalSquareEIRLandscape_Final.pdf
2 https://www.weltelhealth.com/static/media/digital_solution_covid19.016b74c0.pdf
3 https://www.gavi.org/sites/default/files/document/2020/GIS-and-Immunisation-Landscape_EN.pdf

# Most Used Digital Health Tools (> 10 countries) for COVID-19 in LMICs (2020)

## CommCare

**High-level description:** CommCare is an offline-capable mobile data collection and service delivery platform designed for everything from simple surveys to comprehensive longitudinal data tracking. Their application builder allows for easy digitisation of surveys and forms, as well as the integration of clinical decision support for the healthcare worker using CommCare, notifications, and SMS messaging.

**Lead developers:** CommCare is developed by Dimagi.

**Countries and users of CommCare:** There are implementations of CommCare in 130 and over 2,000 projects. It is used by over 700,000 frontline health workers.

**Countries and users of CommCare for COVID-19:** CommCare has been deployed for COVID-19 response in approximately 30 countries. For COVID-19, 20,000 users utilise CommCare applications globally.

COVID-19 Use Cases:

- COVID-19 Case Management

- Contact Registration and Follow-Up

- Port of Entry Screening and Follow-Up

- Facility Readiness and Stock Tracking

- Healthcare Worker Training and Monitoring

- Lab Test Tracking

**Setting:** Community Health Setting; Healthcare Facility Setting; Remote Communication.

## District Health Information Software 2 Tracker (DHIS2 Tracker)

**High-level description:** DHIS2 Tracker is an open-source, web-based application that supports data collection and analysis of transactional or disaggregated data. DHIS2 Tracker is an extension of DHIS2 and should not be confused with DHIS2. In practice, DHIS2 Tracker is used for tracking individual data and can be used in a community or facility setting; DHIS2 is used to track aggregate data, typically at a district-level. The DHIS2 Tracker has been built to work seamlessly with DHIS2. DHIS2 Capture is the mobile component of the DHIS2 platform.

**Lead developers:** The core DHIS2 Tracker software development is managed by the Health Information Systems Program (HISP) at the University of Oslo.

**Countries using DHIS2 Tracker:** The system has been deployed in 52 countries and 17 Indian states.

**Countries using DHIS 2 Tracker for COVID-19:** COVID-19 specific applications have been deployed in 28 countries, namely Angola, Bangladesh, Botswana, Burkina Faso, Cape Verde, Djibouti, Eritrea, Ethiopia, Gambia, Guinea Bissau, Indonesia, Ivory Coast, Laos, Madagascar, Malawi, Mali, Mozambique, Norway, Palestine, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Somalia, Somaliland, South Africa, Sri Lanka, and Uganda.

COVID-19 Use Cases:

- COVID-19 Case Management

- Contact Registration and Follow-Up

- Port of Entry Screening and Follow-Up

- Event-based Surveillance System

**Setting:** Healthcare Facility Setting; Community Health Setting

See the next section for more detailed information on DHIS2 deployments for COVID-19.

## Open Data Kit (ODK)

**High-level description:** ODK is a free open-source suite of tools that allows data collection using Android mobile devices and data submission to an online server, without an internet connection or mobile carrier service at the time of data collection. ODK's strength lies in its global community of developers and ease of adaptation and installation. Though it is being used for longitudinal client follow-up, it is primarily optimised for use cases that involve cross-sectional point-in-time data collection.

**Lead developers:** Nafundi is the primary steward for ODK and supports the ongoing development.

**Countries using ODK:** ODK is designed for organisations to self-deploy, and therefore not all deployments are known and documented. There are documented deployments for COVID-19 in 10 countries: Honduras, India, Kenya, Niger, Nigeria, Philippines, South Sudan, Spain, Zimbabwe, and Somalia. On average, there are around 400,000 users monthly who are actively using the application. The largest active project is in Honduras with 80,000 healthcare workers; the second largest is in Nigeria with 70,000 healthcare workers.

**Countries using ODK for COVID-19:** At least 10 countries have deployed ODK for COVID-19 in their response: Burundi, Honduras, Kenya, Niger, Nigeria, Philippines, Rwanda, Somalia, South Sudan, and Zimbabwe. The largest project is in Somalia where 4,000 healthcare workers are submitting contact tracing data.

COVID-19 Use Cases:

- Event-based Surveillance System

- Healthcare Worker Training and Monitoring

**Setting:** Community Health Setting

Source: John Hopkins: Digital Solutions for COVID-19 Response: Assessment of digital tools for rapid scale-up for case management and contact tracing

## DHIS2 & COVID-19

Throughout the pandemic, Gavi has continued investment in DHIS2 and supported development, implementation, and technical assistance through University of Oslo (UiO) to countries. The following summarises a recent UiO update on DHIS2 and COVID-19.

## DHIS2 & COVID-19 Modules Uptake & Country Highlights (October 2021)

### 41 Countries use DHIS2 for COVID surveillance

- 31 countries use the Tracker Case-Based Surveillance package

**Country Highlights:**

- Palestine monitors COVID cases through their Tracker-based eRegistry

- Uganda uses DHIS2 for Point of Entry screening and is piloting integrating eIDSR and school data

### 32 Countries use DHIS2 COVID Vaccine Tracker

- Several are using Tracker for the first time

**Country Highlights:**

- In São Tomé and Príncipe, vaccination teams achieved 100% reporting completeness

- Rwanda integrated the EIR with the national ID registry, for improved speed and quality

- Lao PDR uses self-registration and QR code scanning for a fast and accurate workflow

- Nigeria deployed Tracker nationwide at 3,000+ sites, registering more than 4 million clients

### 18 Countries use DHIS2 aggregate package

- Most use it in conjunction with Tracker, for example to monitor data entry completeness

**Country Highlights:**

- Mozambique collects daily aggregate vaccination data to supplement real-time Tracker data for campaign monitoring

- Uganda analyses aggregate and Tracker data to identify data entry backlogs at facility level

### 15 Countries use the DHIS2 Adverse Events Following Immunisation (AEFI) package

**Country Highlights:**

- Lao PDR uses DHIS2 to monitor AEFI from COVID-19 vaccines

- Mozambique modified the COVID Vaccine and AEFI packages to include the Sinovac vaccine

### 14 Countries use the DHIS2 for COVID vaccine stock management and monitoring

**Country Highlights:**

- Sri Lanka uses aggregate data in DHIS2 to capture stock received, issued and utilised at national, regional, and vaccine center levels

### 10 Countries use DHIS2 to generate verifiable electronic COVID vaccine certificates

**Country Highlights:**

- HISP Vietnam developed a DHIS2 solution to produce COVID vaccine certificates aligned with the EU Green Pass, piloting in Vanuatu.

- Sri Lanka has integrated DHIS2 with DIVOC, an open-source platform, to produce secure and verifiable digital certificates.

- Uganda, Rwanda, Tanzania, and East Timor have local solutions developed in coordination with HISP.

Source: COVID-19 DHIS2 Gavi TA Results_2021_10_05.pptx

## Digital Square COVID-19 Digital Health Map and Match

Complementary research, carried out by Digital Square, examined 25 countries and assessed how the range of tools available in that country have been combined and developed to support the pandemic response. Most of the countries, which are listed below, are Gavi-supported countries.

Through Map and Match, Digital Square developed a highly visual brief for prioritised countries, identifying which tools are currently in use in the country, which tools have already been used in the country's COVID-19 response, and where there are opportunities for quick adaptation of existing tools across COVID-19 response use cases. Digital Square prioritised dissemination of the country briefs and supplemental resources with national governments, investors, and other stakeholders. The Map & Match project developed a set of use cases specific to outbreak response. These use cases were developed in coordination with USAID and GIZ and align with the format of the GIZ Digital Pandemic Preparedness Assessment tool, which can be pre-populated using Map and Match data. The

Map & Match COVID-19 use cases are further defined in the *Digital Applications and Tools Across an Epidemiological Curve* and include:

● Case management

● Contact tracing

● Data science assets

● Event-based surveillance

● Health facility & provider administration

● Infection prevention control

● Laboratory systems

*The countries prioritised for Map & Match included: Afghanistan, Angola, Bangladesh, Benin, Burkina Faso, Cambodia, Cameroon, Côte d'Ivoire, Ghana, Indonesia, Kenya, Malawi, Mozambique, Myanmar, Niger, Pakistan, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Uganda, Vietnam, Zambia, and Zimbabwe.*

*Source: https://digitalsquare.org/covid19*

The full map and match dataset includes all data from the entire Map and Match project. The dataset is meant to be used for existing country landscaping to inform future assessments and implementation planning.

## Data Innovations and COVID-19: Artificial Intelligence

Apart from the use of digital health solutions for COVID-19, significant efforts have been made to leverage AI across a number of use cases and digital social listening to address vaccine hesitancy to ensure safe, effective, and equitable vaccine distribution and demand.

An article in Fortune in January 2021 highlighted 4 main use cases for AI in the race to vaccinate as many people as possible – namely supply chain management, demand estimation, and vaccine tracking- including reporting and responding to adverse effects following immunisation (AEFI).  One of the main challenges to leveraging AI in Gavi-supported countries is the often poor availability of the types of representative data needed to train the algorithms sufficiently, such as population coverage for immunisation information. Without this data, it is difficult to use AI with confidence. It is also very important that there is participation by representatives of stakeholders in the countries of implementation in the governance structure and defining the use of data. The data and AI algorithms built upon them need to be understood and governed by national authorities and users of the participating health systems.

## Data Innovations and COVID-19: Digital Social Listening

Digital social listening is an approach used by the private sector to monitor public opinion about goods and services, improve products and services, and change people's opinion with marketing strategies to encourage customers to buy more. While vaccine hesitancy has been growing over the past decade, digital social listening has been adopted by many

Gavi-supported countries as part of their risk communication strategies.  Gavi, in collaboration with UNICEF, World Health Organization (WHO), and the Vaccination Demand Hub, have collaborated with HealthEnabled on Finding the Signal through the Noise: A landscape review and framework to enhance the effective use of digital social listening for immunisation demand generation to document the state of the field and provide concrete recommendations on how to use a combination of data sources and analytical approaches to then increase demand across the Journey to Immunisation. With careful consideration of data sources, analysis and action, digital social listening and the resulting risk communications and community engagement can help build trust and confidence needed to equitably reach immunisation coverage targets.

## Examples and experiences from key informants and partners

There has been increased demand for data, especially information on who is being vaccinated against COVID-19. One important development of digital health during COVID-19 is that many countries started to implement individual-based registry monitoring, as well as the more traditional aggregate data systems. This was needed to track individual patients, trace people who had not received their second dose of vaccine, or issue digital certificates of immunisation. This can be seen as 35 countries are now using the DHIS Tracker of DHIS2, which supports individual patient records. This could be hugely beneficial to the wider implementation of digital health when the COVID-19 emergency response ends, as long as these gains are maintained and built upon. However, data reporting during the pandemic has been very patchy - only 20 out of the 92 LMIC that Gavi works with have been able to provide any useful disaggregated data.  Disaggregation of interest include comorbidities, healthcare workers, gender, and location. In practice Gavi countries are simply reporting aggregate data, as they do not currently have the capacity to do more.

One strong example of digital innovation during COVID-19 having the possibility of improving health systems more generally comes from India. Digital systems for immunisation which were introduced through Health System Strengthening grants, have catalysed the Electronic Vaccine Intelligence Network (eVIN) system which was monitoring vaccine temperatures and stock inflow/outflow. The National EPI program manager can now monitor vaccine stock levels in all provinces. The use of eVIN has greatly increased in the two years of the pandemic. This has evolved into "Co-Win" for Covid response. There is discussion now of building from this to U-WIN for "Universal immunisation program", which would be a comprehensive digital platform for immunisation.

Most Gavi partners have built their digital systems on the Global Goods mentioned above. However, not all countries have decided to do this. For example, Myanmar and Pakistan developed entirely new custom built and parallel solutions. It is interesting that during the pandemic some South-South capacity building has increased: The Vietnamese NGO GaneshAid has been maintaining and improving the Routine Immunisation system in Benin and Senegal using digital tools to improve supportive supervision.

Gavi partners in Indonesia have adapted their in-country immunisation management systems to incorporate COVID-19 vaccine management. In Myanmar there have been discussions with Gavi partners that COVID-19 has increased motivation to use digital tools for communication and supervision during restricted movement. This further embeds common digital

tools into the work culture of immunisation programmes, such as WhatsApp groups being used for surveillance, health workers sending voice messages for lower literacy areas and video-conferencing systems such as Zoom. The 'Adaptation Toolkit' of TechChange and Last Mile Health in Sierra Leone includes digitised WHO content on COVID-19. This structure can now be easily adapted for future health emergencies where new content needs to be rapidly disseminated to health workers. Similarly, in India the JSI RISE (Rapid Immunisation Skills Enhancement) program provides an application for dissemination of learning content for vaccinators.

COVID-19 vaccines have stretched the capacity of cold chains in low-resource settings. Some of the vaccines require reliable storage at -600 Celsius. This requires much improved supply chains and eLMIS systems to manage them. This is another example of digital tools that have developed rapidly for COVID-19 can strengthen routine immunisation in future. Supply chain in general is an area where digital systems have definitely strengthened during COVID-19. After the pandemic, many countries will emerge with more sophisticated digital supply chain systems, which are able to measure both inflow of supplies as well as consumption. Transferring this application and implementing such systems for routine immunisation would be very valuable. Also, scheduling of COVID-19 immunisations and tools deployed at the facility level could be implemented for routine immunisation to prevent people from having to waste half a day trying to access immunisation services. Adverse Events Following Immunisation (AEFI) surveillance is another area that has been put in place for COVID-19 and could now be transferred to strengthen the routine immunisation systems.

In Somalia, COVID-19 systems using CommCare have been able to identify individuals who did not receive a Covid vaccine, which shows this can be done in low-resource settings. This would be a huge achievement if it could be replicated for routine immunisation. There is a need for a system that allows rapid learning and sharing of best practices, such as the learning Hubs that Gavi plans to establish in, for example, Nigeria, Somalia, and elsewhere. Gavi partnering to organise hackathons, for example one in Cote d'Ivoire in December 2021, to generate new ideas to understand how challenges from Covid-19 can be overcome with local solutions.

The Digital Documentation of COVID Certification (DDCC) is an example of global best practice being developed for COVID-19 that will have many other health system applications in years to come. It is currently (January 2022) in the second round of public comments. If high quality vaccine certification can be produced for Covid, it should be possible to do the same for routine immunisation. This example places the World Health Organisation functioning as a digital clearinghouse to assist with coordination and market shaping for agreed interoperability and other standards.

In addition to using digital health information solutions that address Covid-19, the need to maintain and reduce disruption to essential health services, including routine immunisation, has become a major issue. The WHO Guide for Maintaining Essential Health: Operational Guidance for the COVID-19 Context highlights digital health as an important strategy in this regard and as a mechanism for helping countries who have fallen behind on immunisation - particularly through the use of digital health information strategies for service delivery, surveillance, and catch up campaigns.

A paper published by the International Journal of Medical Informatics on Zindagi Mehfooz – a suite of digital health tools used in Sindh Province in Pakistan for Routine Immunisation- illustrates how the systematic use of an electronic immunisation registry data is being used to better target recovery responses during the COVID-19 pandemic. In addition, innovations emerged during the pandemic for the use of on-line and mobile learning for health worker training and capacity building.

However, it is not true to say that all digital health implementations in the time of COVID-19 have been successful. There have been several parallel systems rapidly implemented for COVID-19 which are too expensive and will not be sustained by local institutions. Also, the pandemic has made visible how weak the data quality of health records is in many countries. COVID-19 has highlighted that there were weaknesses in many digital tools which were not ready to be scaled rapidly when the need arose. This again emphasises the importance of investing in and establishing Global Goods and implementation systems that are robust enough to be implemented and adapted rapidly at scale.

According to a number of respondents from Gavi and UNICEF, one positive trend is that during the COVID-19 pandemic communication on digital innovation between global and national immunisation implementation partners has greatly improved. Experience is shared more quickly than before. For example, the application of Premise, pulse surveys, and approaches to data literacy have all developed in the past two years, with lessons being shared widely through the global immunisation community.

# Key Considerations & Recommendations

As several key informants mentioned, COVID-19 has provided impetus to implement digital health systems rapidly with expanded funding, technical resources and political will. In many ways COVID-19 has pressed 'Fast Forward' on the development of digital health. Five years ago, systems for digital certificates, digital supply chain records, large-scale patient record systems, and health worker decision support were considered innovative - now they have been rapidly integrated into the health system as routine tools throughout the world. In the past two years, the response to COVID-19 has further embedded digital tools into the health system. Transferring this learning to Routine Immunisation could greatly benefit the success of EPI in the future. The COVID-19 pandemic has also demonstrated that the existing digital health systems, enabling environment and infrastructure in many countries are not strong enough to perform the desired or optimal functions.

In an ideal world, countries would have leveraged their existing DHI infrastructure to respond to the pandemic in coordination with the Essential Programme for Immunisation (EPI). However, for most countries this was not the case. Many set up parallel systems with separate governance in the form of COVID-19 Emergency task forces and used new digital health tools or parallel instances of existing digital health tools.

To transition platforms and COVID-19 innovations for use for routine immunisation, there will need to be coordination between the emergency response teams and EPI. To support this effort, Gavi should focus on documenting and understanding country experiences and lessons learned with digital innovations and solutions developed or expanded during the COVID-19 pandemic. These lessons should then be used to support countries with plans and strategies to transition appropriate and successful digital applications to strengthen routine immunisation programmes.

# Recommendations for Prioritised Gavi DHI Strategy Investment

## Global

- Systematically document Covid-19 innovation experiences across all the Alliance Members and share through Experience Exchange or Learning Hub.

- Develop a guide to rapidly adapt digital health global goods for expanding use cases in emergencies. Countries should not have to mix and match their in-country systems during a health emergency when time, capacity and finances are stretched.

- Support digital health Global Goods to evolve a dependable set of tools that meet the range of use cases and needs of resource-poor health systems both in routine immunisation and during health emergencies.

- Document positive Covid-19 innovation experiences that can be packaged and presented in ways that national Ministries of Health and other EPI implementers can use and adapt for routine immunisation. This could take the form of a written guide, videos of case studies, and a series of training workshops and webinars.

- Engage with the private sector and other role players to ensure equitable representation/ inclusion by gender, race, language, and other known biases in AI initiatives as well as responsible approaches to privacy and security.

## Country

- Support countries to develop and implement COVID-19 digital health information transition plans through participatory co-design process with EPI to extend what has worked and scaled during the pandemic to routine immunisation programmes.

- Support countries to adopt digital health global goods that are co-designed for routine immunisation and emergencies that are embedded within primary health care systems and workflows

# Conclusion

Digital health systems have been rapidly extended to respond adequately to the pressures and challenges of the COVID-19 pandemic.  The international effort over the last few years to develop digital health Global Goods has provided a way of developing and adapting systems more quickly. However, the development of digital health applications and tools during the pandemic has been a patchwork of some good examples and other examples of parallel systems not being fully interoperable and unable to adequately support all of the COVID-19 use cases required. The Map & Match research of Digital Square shows both the depth of digital health systems in many Gavi-supported countries, but it also shows how each country had to find its own way through the maze of different systems and changing requirements in a fast moving health emergency.

Covid-19 has led to many digital health systems being extended in scope and scale. However, it is uncertain whether these gains will be maintained when some form of normality returns as the pandemic declines.

# Acknowledgements