

# Digital health systems to support pandemic response in Sierra Leone

## Mapping digital health tools and matching deployment opportunities in response to COVID-19

June 2021

### IN THIS TECHNICAL BRIEF

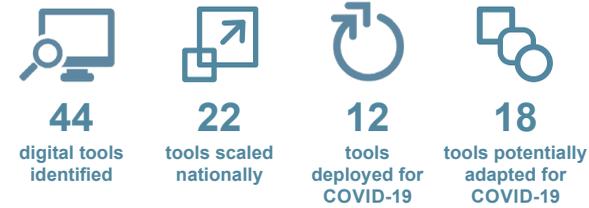
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## Introduction

Sierra Leone's Ministry of Health and Sanitation (MOHS) in collaboration with its Ministry of Information and Communication articulates its vision statement for strengthening health information systems in its *National Digital Health Strategy: 2018–2023*: "By 2023 an effective and efficient ICT enabled system supports delivery of quality, accessible, affordable, equitable, and timely healthcare services and moves Sierra Leone closer to achieving universal health coverage." The COVID-19 pandemic brought a new level of urgency to this vision. Leveraging digital health tools is a rapid, cost-effective strategy to accelerate Sierra Leone's COVID-19 response while at the same time reinforcing the health system at large.

## Background

Digital Square conducted a landscape analysis of Sierra Leone's digital systems in the ten-year period from 2010–2020 with information validated by tool implementers and designers, digital health experts, and MOHS stakeholders as part of the US Agency for International Development (USAID)–funded Map and Match project. The purpose was to identify the existing digital tools used in Sierra Leone, map the tools already deployed for COVID-19 response to relevant use cases, and highlight opportunities where existing tools can quickly be adapted and deployed to support COVID-19 response.



## Analysis overview

Map and Match's analysis found that Sierra Leone's health system uses 44 digital health tools, with at least 12 already deployed for COVID-19 response. This brief identifies opportunities for existing digital tools to be adapted to pandemic use cases to respond to needs for the COVID-19 response and potential future epidemics. Mapping of the existing tools to the use cases revealed where there are strengths and opportunities in Sierra Leone's digital health systems' response to COVID-19. For example, the analysis identified only one tool that currently supports contact tracing, with additional tools ready for adaptation to further address this use case. Strategic adaptation of existing digital health tools will accelerate the COVID-19 response, offering greater efficiency and more robust support to the government, health workers, clients, and other stakeholders.

## Key definitions

**Pandemic use case** refers to the specific type of information collected, stored, tracked, analyzed, or visualized as it relates to the functional response to an epidemiological event, specifically COVID-19.

**Digital health tool** refers to a website, application, or other computer or mobile technology that supports data collection, storage, tracking, analysis, or visualization. The tool must have an electronic interface. One digital tool can address multiple use cases.

**Application** refers to components of digital tools that are primarily designed for use by clients of the health system or by health workers. Applications can be reused to address more than one use case, or applications can be uniquely used for only one use case.

**Adaptation** refers to making improvements to existing digital tools to improve their applicability and impact in the context of COVID-19.

Figure 1. Current number of digital health tool deployments mapped to pandemic use cases in Sierra Leone.

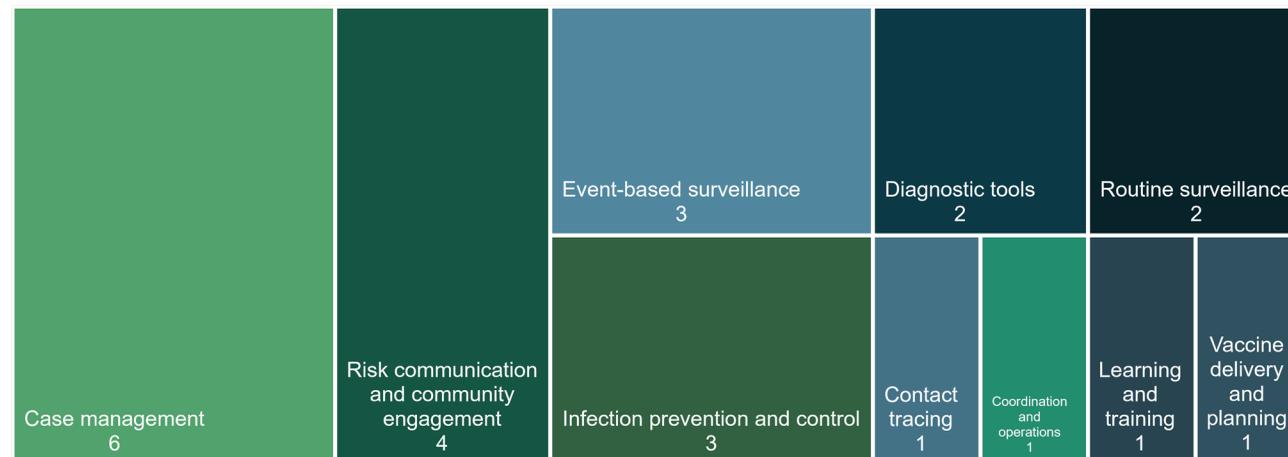


Figure 1 illustrates that many use cases are addressed using several tools in Sierra Leone's COVID-19 response while other use cases are filled by a sole tool.

**Table 1. Mapping and matching digital health tools to strengthen Sierra Leone’s COVID-19 response.**

Digital Square mapped the current state of tools’ functionality across the pandemic use cases in **blue** to illustrate how the digital health systems are supporting Sierra Leone’s COVID-19 response. Digital Square matched opportunities for tool adaptation across the pandemic use cases in **green** to reveal places where Sierra Leone can reuse parts of its existing digital health systems to strengthen its COVID-19 response.

	PANDEMIC USE CASES														
	Case management	Contact tracing	Coordination and operations	Diagnostic tools	Event-based surveillance (including rapid response teams, case investigation)	Health facility and provider administration	Infection prevention and control	Laboratory systems	Learning and training	One Health	Points of entry	Risk communication and community engagement	Routine surveillance	Supply chain	Vaccine delivery and planning
117 Alerts System															
3-2-1 Service															
468 SMS Service COVID Self-Check															
Child Health and Mortality Prevention Surveillance (CHAMPS)															
CommCare															
Computer Aided Detection for COVID-19 (CAD4COVID)															
Country HMIS (DHIS2 + Tracker + COVID)															
COVID-19 Triage Tool															
HealthAlert															
RECOVR (ODK)															
Timed and Targeted Counselling mHealth application (mTTC) (CommCare)															
World Continuing Education Alliance (WCEA)															
Bahmni/OpenMRS															
Breakthrough ACTION Interactive Voice Response (IVR)															
Ebola Vaccine Deployment, Acceptance and Compliance (EBODAC) mobile training and support (MOTS)															

■ Digital tools deployed for COVID-19 response     
 ■ Opportunities to adapt tools for pandemic response

Table 1. Mapping and matching digital health tools to strengthen Sierra Leone’s COVID-19 response, continued.

	PANDEMIC USE CASES														
	Case management	Contact tracing	Coordination and operations	Diagnostic tools	Event-based surveillance (including rapid response teams, case investigation)	Health facility and provider administration	Infection prevention and control	Laboratory systems	Learning and training	One Health	Points of entry	Risk communication and community engagement	Routine surveillance	Supply chain	Vaccine delivery and planning
Ebola Vaccine Deployment, Acceptance and Compliance (EBODAC) Mobile Technology for Community Health (MOTECH)															
Fionet															
Fistula Hotline															
Global Open Facility Registry (GOFR) Reconciliation Tool (DHIS2)															
iHRIS															
mHero															
mSupply (ColdChain and Mobile Vaccine module)															
Open Data Kit (ODK)															
OpenHIE															
OpenMRS															
Safe Delivery App															
U-Report															
Vantage															
VaxTrac (CommCare, DHIS2)															

*“We have a lot of tools, but a key issue is data quality. If we have health medical records and good case management tools, we think this will help our data quality.”*

—Gerald Thomas, Information Communication Technology Manager at Sierra Leone’s Ministry of Health and Sanitation

## Matching digital health tools ready for adaptation to fill the pandemic use case gaps

Map and Match's analysis identified existing digital tools that can be adapted to support COVID-19 response for all nine use case gaps below. Use case gaps are defined as use cases that have fewer than two tools addressing them.

To learn more about the tools in the matrix below, please see Table 2 for more details to facilitate adaptations. To find out more about all the Digital Square approved global goods mapped across these pandemic use cases, please see [this Map and Match resource](#), which can provide decision-makers with targeted information to deploy and adapt global goods to fulfill gaps in the COVID-19 response.

Contact tracing		Learning and training	
Country HMIS (DHIS2 + Tracker)	CommCare	World Continuing Education Alliance	Breakthrough ACTION IVR
ODK	mTTC (CommCare)	CommCare	EBODAC MOTS
		mHero	Safe Delivery App
		mTTC (CommCare)	
Coordination and operations		One Health	
RECOVR (ODK)	Country HMIS (DHIS2 + Tracker)	Bahmni/OpenMRS	
GOFR Reconciliation Tool (DHIS2)	mHero		
Vantage			
Health facility and provider administration		Points of entry	
Bahmni/OpenMRS	CommCare	Bahmni/OpenMRS	CommCare
Country HMIS (DHIS2 + Tracker)	iHRIS	Country HMIS (DHIS2 + Tracker)	mTTC (CommCare)
mHero	mTTC (CommCare)		
Laboratory systems		Supply chain	
Bahmni/OpenMRS	CommCare	Bahmni/OpenMRS	Breakthrough ACTION IVR
Country HMIS (DHIS2 + Tracker)	mTTC (CommCare)	Country HMIS (DHIS2 + Tracker)	mHero
VigiFlow		mSupply	
Vaccine delivery and planning			
Country HMIS (DHIS2 + Tracker)		EBODAC MOTECH	
EBODAC MOTS		iHRIS	
mHero		mSupply	
OpenMRS		VacTrac (CommCare, DHIS2)	

## Examples of global goods ready for adaption for COVID-19 response in Sierra Leone

### iHRIS

iHRIS is built on a flexible framework that can be adapted to meet a wide variety of needs for managing health workforce information. iHRIS supports the MOH and other service delivery organizations to:

- Track, manage, deploy, and map their health workforce.
- Predict workforce changes and needs under different scenarios.
- Plan and cost workforce retention interventions.
- Manage training activities, including pre-service and in-service education.

iHRIS can be adapted to support COVID-19 response to manage and track health workers' vaccinations and to conduct workforce planning for COVID-19 hotspots and staffing needs (e.g., personal protective equipment).

### Bahmni/OpenMRS

Bahmni is an open source EMR and hospital information system developed in the global south to meet the needs of low-resource environments and is currently deployed in 50+ countries. Bahmni is a distribution of the OpenMRS medical record platform. It manages patient information in a flexible fashion throughout the care cycle, including registration, various points of care, investigations, laboratory orders and results management, picture archiving and communication systems, and billing. Bahmni released a COVID-19 kit that uses an OpenMRS module initializer to install forms that capture travel history and contact tracing, enable patient screening, and track information on home quarantining.

<b>2</b> PANDEMIC USE CASES
<b>0</b> USE CASES UTILIZED
<b>2</b> ADAPTATION OPPORTUNITIES IDENTIFIED

Health facility and provider administration

Vaccine delivery and planning

<b>7</b> PANDEMIC USE CASES
<b>0</b> USE CASES UTILIZED
<b>7</b> ADAPTATION OPPORTUNITIES IDENTIFIED

Case management

Diagnostic tools

Event-based surveillance

Health facility and provider administration

Laboratory systems

Points of entry

Supply chain

**Table 2. An in-depth look at digital health tools to support the COVID-19 response.**

Digital health tool	Purpose	Use case(s)	Funder(s)	Implementer(s)	Licensing	Scale
117 Alerts System	The 117 Alerts System is a toll-free, nationwide, 24-hour hotline built as a syndromic and mortality surveillance tool for early detection of disease outbreaks. The system can receive alerts from the public and trigger burial and surveillance teams. Sierra Leone established this phone alert system for rapid notification and response during the 2014–2015 Ebola epidemic. The system remained in place after the end of the epidemic under a policy of mandatory reporting and Ebola testing for all deaths, and from June 2016, testing only in case of suspected Ebola. Recently, the 117 Call Center has seen a major transformation from extending the facility and giving it a facelift, to upgrading software for a more efficient system for use from Sierra Leone citizens.	Routine surveillance	CDC, FCDO, World Bank	eHealth Africa	Open source	National
3-2-1 Service	Viamo's 3-2-1 Service is a toll-free, automated information hotline available in 18 countries. Subscribers can access information hosted on this hotline by dialing a toll-free short code (such as 3-2-1) and then easily navigating a menu of topics with various options, such as "Press 1 to learn about the symptoms of COVID-19" or "Press 2 to learn how to prevent the spread of COVID-19." Messages are distributed on mobile telephones (smart or feature) and made available for free as part of Viamo's prenegotiated agreements with MNOs. The 3-2-1 Service communicates information through audio using IVR technology, which allows anyone, regardless of literacy level, to access the information. The service can host both static and dynamic content, which is recorded by native speakers in local languages, validated by experts, and approved by the relevant government stakeholders. For COVID-19, Viamo worked with outbreak experts and relevant local stakeholders to identify key messages to increase awareness of health services relating to COVID-19 and share those messages with anyone, on demand. In 2020, 6.8 million people across the world called the 3-2-1 Service to learn more about COVID-19. In Sierra Leone, the 3-2-1 Service mobilized communities and enhanced uptake of an Ebola vaccine in Sierra Leone. As a result of this success, clinics continue to use the service to track number of vaccinations and promote awareness of COVID-19.	Diagnostic tools, risk communication and community engagement	Grameen Foundation	Viamo	Proprietary	Subnational
468 SMS Service COVID Self-Check	Sierra Leone expanded the existing *468# (*GOV#) Government USSD platform to allow citizens to conduct a self-check against their COVID-19 symptoms, learn COVID-19 prevention tips, and receive updates on Sierra Leone's COVID-19 situation, including the number of cases, deaths, and the quarantine status. Sierra Leone also has a complimentary SMS mobile application that offers users the same functionalities.	Case management, infection prevention and control, risk communication and community engagement	DSTI, UNICEF	DSTI, the Emergency Operations Center, Fix Solution, Senegal Ministry of Information and Communication, Senegal MOHS, UNICEF	Proprietary	National
Child Health and Mortality Prevention Surveillance (CHAMPS)	CHAMPS is a global surveillance network that generates and shares accurate cause of death data on child mortality. CHAMPS aims to ensure that all deaths are reported to the 117 Alerts System, from both hospitals and communities, to improve mortality surveillance and identify causes of deaths in under-fives. From April to October 2020, CHAMPS pivoted to support the COVID-19 response in Bombali District. During that period, CHAMPS suspended minimally invasive tissue sampling, but it continued to remotely respond to deaths.	Event-based surveillance	Gates Foundation	eHealth Africa	Open source	Subnational
CommCare	CommCare is an offline-capable mobile data collection and service delivery platform used in more than 80 countries. CommCare is popular for its offline case management capabilities proven to be effective at scale. It is designed for everything from simple surveys to comprehensive longitudinal data tracking. It allows for easy digitization of surveys, has forms that are intuitive for end users, uses simple device deployment, and includes translation features.	Case management, contact tracing, event-based surveillance, health facility and provider administration, infection prevention control, laboratory systems, learning and training, points of entry, risk communication and community engagement	MOHS	DSTI, Dimagi, MOHS	Freemium	Subnational
Computer Aided Detection for COVID-19 (CAD4COVID)	CAD4COVID is a free solution that uses artificial intelligence on chest X-rays to triage suspected COVID-19 cases to support triaging in resource-constrained settings and high-prevalence areas.	Case management, diagnostic tools, event-based surveillance, infection prevention and control	Delft Imaging	Delft Imaging	Proprietary	National

 Digital tools deployed for COVID-19 response  Opportunities to adapt tools for pandemic response

**Table 2. An in-depth look at digital health tools to support the COVID-19 response, continued.**

Digital health tool	Purpose	Use case(s)	Funder(s)	Implementer(s)	Licensing	Scale
Country HMIS (DHIS2 + Tracker + COVID)	District Health Information Software 2 (DHIS2) is an open source, web-based platform, typically used in national health information systems for data management and analysis purposes, for health program monitoring and evaluation, as facility registries and service availability mapping, for logistics management, and for mobile tracking of pregnant mothers in rural communities. DHIS2 supports the collection, analysis, visualization, and sharing of both aggregate and individual-level data, including mobile and offline data collection using the DHIS2 Android app. DHIS2 has developed toolkits to support COVID-19 surveillance and national vaccine delivery plans. Installable metadata packages facilitate uptake of global data standards and best design practices in the national HMIS, while enabling flexibility for localization and customization for country workflows. Accompanying technical guidance, implementation guides, demo databases, and training materials provide all the resources a country needs to hit the ground running and implement fit-for-purpose solutions to curb the pandemic. In Sierra Leone, DHIS2 is used to accelerate case detection, situation reporting, active surveillance, and response for COVID-19.	Case management, contact tracing, coordination and operations, diagnostic tools, event-based surveillance, health facility and provider administration, laboratory systems, one health, points of entry, risk communication and community engagement, routine surveillance, supply chain, vaccine delivery and planning	CDC, DHIS2, MOHS, Gavi, The Global Fund, Norad, USAID, World Bank, WHO	DHIS2, eHealth Africa, HISP West Central Africa, MOHS	Open source	National
COVID-19 Triage Tool	Wellvis COVID-19 Triage Tool is an application that allows users to self-assess their COVID-19 risk category based on their symptoms and exposure history. It is free to users. The application also allows digital health care appointments that can be paid online.	Case management, infection prevention and control, risk communication and community engagement	Lagos Innovates, Vouchery	Wellvis	Proprietary	National
HealthAlert	HealthConnect enables effective health communication with patients, health providers, and the health system at large. HealthConnect has been adapted for COVID-19 to provide national messaging services on behalf of WHO and several other country governments on COVID-19-related information via individual modules such as HealthAlert, HealthCheck, and HealthWorkerAlert.	Risk communication and community engagement	MOHS	Praekelt		National
RECOVR (ODK)	Tracking how people's lives are affected by the COVID-19 pandemic can enable policymakers to better understand the situation in their countries and make data-driven policy decisions. To respond to this need, RECOVR is a panel survey that facilitates comparisons, documents real-time trends of policy concern, and informs decision-makers about the communities that are hardest hit by the economic toll of the pandemic.	Coordination and operations	Gates Foundation, Northwestern University's Global Poverty Research Lab, UBS Optimus Foundation,	IPA, SurveyCTO	Open source	
Timed and Targeted Counselling mHealth application (mTTC) (CommCare)	The mTTC app is built in the common MOTECH Suite (CommCare), allowing easy adaptation and alignment to national data systems. The mTTC app is used by CHWs conducting Timed and Targeted Counselling (TTC) home visits to communicate and track health practices for maternal, newborn, and child health at the household level. The app collects real-time household-level data on practices, which can easily be assimilated and used in data-based feedback and supervision. The app ensures CHWs time home visits correctly by gestation/age of child, sending reminders on missed visits and follow-up, and improves workload management. It includes audiovisuals with multiple language settings and press-play messages to give accurate information to caregivers.	Case management, contact tracing, event-based surveillance, health facility and provider administration, infection prevention control, laboratory systems, learning and training, points of entry, risk communication and community engagement	Irish Aid, USAID, World Vision	Dimagi, MOHS, World Vision	Open source	Subnational
World Continuing Education Alliance (WCEA)	This learning management system is a multifield eLearning and mHealth system that supports virtual and blended learning linked to certifications for professional development and lifelong learning. Examples of content includes modules about nursing and midwifery and COVID-19 (both clinical and nonclinical). The platform generates reports on study habits and data of users (i.e., age, gender, location, qualification, role, employment status).	Learning and training		Regulatory Body & Professional Associations	Proprietary	National

 Digital tools deployed for COVID-19 response  Opportunities to adapt tools for pandemic response

**Table 2. An in-depth look at digital health tools to support the COVID-19 response, continued.**

Digital health tool	Purpose	Use case(s)	Funder(s)	Implementer(s)	Licensing	Scale
Bahmni/OpenMRS	Bahmni is an open source electronic medical record and hospital information system developed in the global south to meet the needs of low-resource environments. It is currently deployed in 50+ countries. Bahmni is a distribution of the OpenMRS medical record platform. It manages patient information in a flexible fashion throughout the care cycle, including registration, various points of care, investigations, laboratory orders and results management, picture archiving and communication systems, and billing. To support its community of implementers, Bahmni released a set of preconfigured templates that can be adopted by any implementer and used for COVID-19 contact tracing. The Bahmni COVID-19 Starter Kit enables health workers to use Bahmni to capture COVID-19-specific data and report disease statistics. The Bahmni COVID-19 Vaccine Kit enables the capture of vaccination details of patients being vaccinated. Implementers in the community have built a teleconsulting module using Bahmni's appointment scheduling feature to reduce the strain on health systems due to patient inflow while maintaining continuity of care during the pandemic.	Case management, diagnostic tools, event-based surveillance, health facility and provider administration, laboratory systems, points of entry, supply chain	Wellbody Alliance	Partners in Health	Open source	Subnational
Breakthrough ACTION Interactive Voice Response (IVR)	Breakthrough ACTION Sierra Leone collaborated with the government to develop a training for health workers caring for individuals who have or may have COVID-19. The training aims to help address the psychosocial needs of these health workers and their patients, and it covers some basics around COVID-19 prevention, PPE, patient care, and rumor management. The training is delivered in Krio over any type of mobile phone through a series of phone calls using an IVR platform. The health worker can interact with the recording by selecting answers to quiz questions and receiving the appropriate response. There are six lessons in the entire training, each 5–6 minutes in length, delivered over a two-week period. The training includes a pre- and post-training survey to assess knowledge. Breakthrough ACTION is coordinating with Last Mile Health to include the training recordings on its COVID-19 classroom app that features existing COVID-19 tools and resources. The tool can be adapted for multiple purposes as many people in Sierra Leone have access to at least a basic mobile phone and because it is simple to add new content. The interactive feature allows for the tool to be used as a survey for data collection, surveillance, and/or reporting purposes. Because it is audio, individuals who are illiterate or with poor eyesight can participate. By delivering content to people's phones wherever they are, it is a COVID-19-safe way to reach people because it avoids bringing people together in large groups for trainings, and it allows for the implementers to reach more people more quickly and with less costs than in-person trainings.	Event-based surveillance, infection prevention and control, learning and training, risk communication and community engagement, routine surveillance, supply chain	Johns Hopkins Center for Communication Programs, USAID	Breakthrough ACTION, Viamo	Proprietary	Subnational
Ebola Vaccine Deployment, Acceptance and Compliance (EBODAC) mobile training and support (MOTS)	The EBODAC project is developing strategies and tools to promote the acceptance and uptake of new Ebola vaccines, to help the right person receive the right vaccine at the right time and promote acceptance and uptake of new Ebola vaccines. The mobile training and support (MOTS) service aims to strengthen the training provided to CHWs. Interactive training modules, developed in line with the national health curriculum, provide CHWs with refresher training on vaccines and emergency response practices through an IVR system. Training materials are delivered to the mobile phones of remote workers as audio files in local languages to make the training as effective as possible and accessible even to those with limited literacy. CHWs can listen to the training materials in their own time, giving them greater flexibility in their learning and reducing the burden on the MOHS to organize physical trainings.	Learning and training, risk communication and community engagement, vaccine delivery and planning	Innovative Medicines Initiative	SolDevelo, World Vision Ireland		National
Ebola Vaccine Deployment, Acceptance and Compliance (EBODAC) Mobile Technology for Community Health (MOTECHE)	The EBODAC project is developing strategies and tools to promote the acceptance and uptake of new Ebola vaccines. The MOTECHE platform supports clinical trial teams to effectively recall participants to receive the second dose of the prime-boost vaccine regimen or attend scheduled clinic visits. The tool has been successfully deployed and adapted to the needs of a multilingual population with a high rate of illiteracy and a lack of familiarity with clinical trials.	Vaccine delivery and planning	Innovative Medicines Initiative	Grameen Foundation, J&J, SolDevelo, World Vision Ireland	Open source	National
Fionet	The Fionet platform combines point-of-care, handheld devices connected to online, AI-powered data services. The technology enables off-site health supervisors to see and adjust frontline health care activity and needs.	Diagnostic tools		Fio Corporation	Proprietary	Subnational
Fistula Hotline	The Fistula Hotline links women to experts to discuss concerns of fistula, which can result from prolonged labor in low-resource settings. The hotline nurses determine whether women are eligible for fistula treatment and can connect them with relevant resources for treatment.	Case management, risk communication and community engagement	Airtel, Gloag Foundation, UNFPA, USAID	Aberdeen Women's Centre		National

 Digital tools deployed for COVID-19 response  Opportunities to adapt tools for pandemic response

**Table 2. An in-depth look at digital health tools to support the COVID-19 response, continued.**

Digital health tool	Purpose	Use case(s)	Funder(s)	Implementer(s)	Licensing	Scale
Global Open Facility Registry (GOFR) Reconciliation Tool (DHIS2)	The GOFR Reconciliation Tool is an open source and open standards-based product to help anyone match lists of facilities from different data sources. The tool supports uploading data from CSV, FHIR servers, and DHIS2 instances.	Coordination and operations	Digital Square	eHealth Africa, JSI, PATH, RTI	Open source	National
iHRIS	iHRIS is a free and open source software solution that forms an integrated human resources information system, enabling countries to collect, maintain, and analyze health workforce data and manage health workforce resources at ministries of health, district health offices, and health care facilities more easily. iHRIS can be adapted to support COVID-19 response to manage and track health workers' vaccinations and to conduct workforce planning for COVID-19 hotspots and staffing needs (e.g., personal protective equipment).	Health facility and provider administration, vaccine delivery and planning	USAID	MOHS, WHO	Open source	National
mHero	mHero is a two-way, mobile phone-based communication system that connects ministries of health and health workers. mHero brings together existing health information systems with locally popular communication platforms to facilitate important health-sector communication. First created in 2014 to support health-sector communication during the Ebola outbreak in West Africa, mHero has since been adapted for general health-sector communication, disease surveillance, and COVID-19 response in other countries, such as Senegal. However, it has not yet been deployed for COVID-19 response in Sierra Leone.	Coordination and operations, event-based surveillance, health facility and provider administration, infection prevention and control, learning and training, risk communication and community engagement, routine surveillance, supply chain, vaccine delivery and planning	J&J, UNICEF, USAID	IntraHealth, MOHS, UNICEF	Open source	National
mSupply (ColdChain and Mobile Vaccine module)	mSupply can be used for inventory management. The tool can display aggregated data on dashboards about vaccine dispensation numbers and rates. The tool can produce a list of people to send SMS reminders to receive their vaccine doses and record adverse drug reactions. mSupply uses Bluetooth sensors to monitor cold chain equipment. In Sierra Leone, there are four systems (mSupply, Channel, Pharmaceutical Dashboard, and DHIS2) that collect HMIS and LMIS data, which Directorate of Drugs and Medical Supplies and other programs use to inform quantification, procurement, distribution, and reverse logistics across supply chains. Since the HMIS-LMIS integration meeting in January 2018, significant progress has been made to move forward LMIS systems and HMIS-LMIS integration in Sierra Leone, including central-level rollout of mSupply, which is an eLMIS used to manage government inventory; rollout of mSupply in eight districts at hospitals and five district stores; and a pilot of RRIV integration into DHIS2.	Supply chain, vaccine delivery and planning	FCDO, mSupply Foundation, MOHS, The Global Fund	CHAI, MOHS, NPPU	Open source	National
Open Data Kit (ODK)	ODK is free and open source software that helps millions of people collect data quickly, accurately, offline, and at scale. ODK has two tool suites (ODK, ODK-X) and created a strong community of users, implementers, and developers. ODK's lead developer, Nafundi, is offering support to COVID-19 response efforts, specifically to address contact tracing, decision support, community education, strategic mapping, and case management. In Sierra Leone, ODK has been used to create a Master Bed List, to map schools to use as treatment centers, and for surveillance.	Case management, contact tracing, event-based surveillance			Open source	Subnational
OpenHIE	The OpenHIE architecture supports interoperability by creating a framework that leverages health information standards, enables flexible implementation by country partners, and supports interchangeability of individual components. Implementing an interoperability layer improves public health reporting by facilitating tool integration.	Interoperability			Open source	
OpenMRS	OpenMRS is a software platform and a reference application that enables design of a customized medical records system. OpenMRS has adapted its software to make it easier for 5,500 existing implementations to screen, test, and manage patients (diagnostic tools) and to report data out efficiently to DHIS2 for public health surveillance. While OpenMRS is not deployed for COVID-19 in Sierra Leone yet, OpenMRS has deployed an active COVID-19 Response Squad that is working to identify existing work within the OpenMRS community that can be rapidly adapted by implementers and packaged as a suite of COVID-19 public health response tools.	Case management, event-based surveillance, vaccine delivery and planning			Open source	

 Digital tools deployed for COVID-19 response  Opportunities to adapt tools for pandemic response

**Table 2. An in-depth look at digital health tools to support the COVID-19 response, continued.**

Digital health tool	Purpose	Use case(s)	Funder(s)	Implementer(s)	Licensing	Scale
Safe Delivery App	The Safe Delivery App supports skilled birth attendants to quickly diagnose issues in pregnancy and with newborns, offering step-by-step guidelines to perform a treatment. It is free to download and can be preinstalled so that providers can watch the animated instruction videos and read the action cards and drug lists whether or not they have Wi-Fi. The Safe Delivery App includes the adaptation of a COVID-19 content module that provides skilled birth attendants (e.g., midwives) with key information, animated video instructions, and checklists to support them to limit the spread of COVID-19 in the health facilities, including information on infection prevention, breastfeeding, and vertical transmission.	Learning and training	Gates Foundation, Merck for Mothers, UNFPA	UNFPA, Government, Maternity Foundation	Proprietary	Subnational
U-Report	The MOHS is using U-Report, an mHealth application. U-Report is designed to provide real-time mobile counseling and conduct coordinated polls on HIV/AIDS among adolescents and young people.	Risk communication and community engagement	UNICEF, USAID	UNICEF	Open source	National
Vantage	Vantage is an AI-enabled cloud platform that empowers health care workers to make decisions. The cloud-based platform is able to instantaneously analyze data, communicate findings, and direct meaningful actions through automatically generated dashboards and targeted push notifications.	Coordination and operations		BroadReach	Proprietary	
VaxTrac (CommCare, DHIS2)	VaxTrac is a clinic-based vaccination registry system that health workers can use in the field to enroll children and track their immunization records. VaxTrac actively manages the data and transactions from testing and vaccination events. The platform can be deployed as an end-to-end solution or in modules. It was designed to improve short- and long-term population health with simple overlays or changes to existing infrastructure and the implementation of a digital yellow card and secure, fraud-proof health certificates. VaxTrac could be adopted for COVID-19 as an EIR for COVID-19 vaccinations.	Vaccine delivery and planning	CDC, Gates Foundation	eHealth Africa	Open source	Subnational
VigiFlow	VigiFlow is a management system for recording, processing, and sharing reports of adverse effects for medical products. VigiFlow enables maximum local control and provides an effective means for management review and analysis of national data. VigiFlow has a medicine track and trace system that will ensure that all medical products and health technologies in the market have a tracing number.	Laboratory systems	WHO		Open source	Subnational

■ Digital tools deployed for COVID-19 response
 ■ Opportunities to adapt tools for pandemic response

*“For scale, we recommend applications that are sustainable solutions like open source technologies.”*

—Gerald Thomas, Information Communication Technology Manager at Sierra Leone’s Ministry of Health and Sanitation

## At a glance

Figure 2 shows that Sierra Leone's digital health tools rely on different software licensing types for sustainability with open source being the most common. Figure 3 demonstrates that Sierra Leone has 22 digital health tools deployed on a national scale while 16 operate on a subnational scale. These figures are not specific to COVID-19 response, but they provide an overall picture of Sierra Leone's digital health infrastructure.

Figure 2. Software licensing types of Sierra Leone's digital health tools.

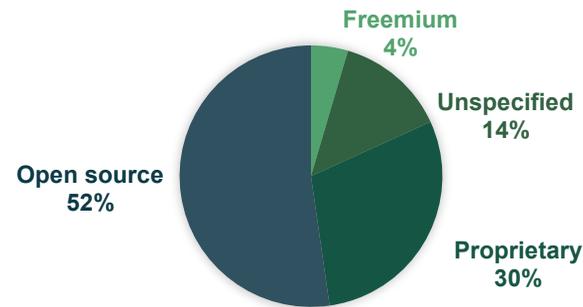
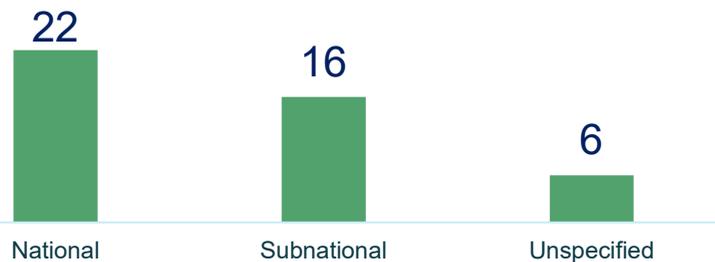


Figure 3. Number of digital tools deployed at scale in Sierra Leone.



## Conclusion

Digital Square mapped 44 existing, adaptable digital health tools in Sierra Leone and matched them to help target investments to accelerate the country's COVID-19 response and simultaneously strengthen its health system. This brief underpins how critical it is to align funding to Sierra Leone's existing digital health infrastructure to bolster its capacity to mitigate the effects of the current pandemic and prepare the country to respond to future outbreaks.

## Take action

- 
**Coordinate with all digital systems stakeholders** to create a unified, robust digital health system that can strategically and rapidly be part of the ongoing COVID-19 response. It is paramount to support the government's lead and support its national digital health strategies and the tools it approves. Visit the [Digital Health Atlas](#) to see a complete, regularly updated snapshot of Sierra Leone's digital health system. If you know of a digital system that is not identified in this brief, please add it to the [Digital Health Atlas](#).
- 
**Reuse existing tools when possible.** Do not invest in new systems if there are existing systems the government endorses that can effectively approach each of the pandemic use cases.
- 
**Learn more about Sierra Leone's digital health systems** and their role in the COVID-19 response by reviewing Sierra Leone's full Map and Match dataset.
- 
**Apply GIZ's Assessment Tool for Digital Pandemic Preparedness** to better understand the strengths and gaps in the country's COVID-19 response and to be well prepared for future disease outbreaks.

- 
**Connect with additional relevant resources, including:**

**Digital Square** continues to update its [wiki](#) with adaptations of Digital Square Global Goods and has a [COVID-19 resource page](#) that features hosted webinars that provide demos of tool adaptations.

The recently released [Global Goods Guidebook](#) (version 2.0) includes additional information about global goods deployment for COVID-19.

Map and Match's [project landing page](#) has many resources, including the Digital Applications and Tools Across an Epidemiological Curve, Global Goods Adaptations Across Use Cases, and other country briefs.

[Digital Solutions for COVID-19 Response](#), published by Johns Hopkins University, features digital platforms that have been adapted for COVID-19 case management and contact tracing needs. The assessment includes a review of nine tools that were selected based on their existing deployment, flexibility, and adaptability for COVID-19 use cases; their ability to support multiple languages; and stakeholder interest in how these applications can be leveraged in response to COVID-19.



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# Annex 1. Abbreviations

Acronym	Definition
<b>AI</b>	artificial intelligence
<b>CDC</b>	US Centers for Disease Control and Prevention
<b>CHAI</b>	Clinton Health Access Initiative
<b>CHWs</b>	community health workers
<b>CSV</b>	comma-separated values
<b>DHIS2</b>	District Health Information Software 2
<b>DSTI</b>	Directorate of Science, Technology, and Innovation
<b>EBODAC</b>	Ebola Vaccine Deployment, Acceptance and Compliance
<b>EIR</b>	electronic immunization registry
<b>EMR</b>	electronic medical records
<b>FCDO</b>	UK Foreign, Commonwealth & Development Office
<b>FHIR</b>	Fast Healthcare Interoperability Resources
<b>Gavi</b>	Gavi, the Vaccine Alliance
<b>HISP</b>	Health Information Systems Programme
<b>HMIS</b>	health information management system
<b>IPA</b>	Innovations for Poverty Action
<b>IVR</b>	interactive voice response
<b>J&amp;J</b>	Johnson & Johnson
<b>JSI</b>	John Snow Inc.
<b>LMIS</b>	logistics management information system
<b>MNOs</b>	mobile network operators
<b>MOHS</b>	Sierra Leone Ministry of Health and Sanitation
<b>MOTECH</b>	Mobile Technology for Community Health
<b>Norad</b>	Norwegian Agency for Development Cooperation
<b>NPPU</b>	Sierra Leone National Pharmaceutical Procurement Unit
<b>PPE</b>	personal protective equipment
<b>RRIV</b>	report, requisition, and issues voucher

Acronym	Definition
<b>SMS</b>	short message service
<b>UNFPA</b>	United Nations Population Fund
<b>UNICEF</b>	United Nations Children's Fund
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization

## Annex 2. Use case definitions

Category	Objective	Functional description
<b>Case management</b>	Systematic processing of suspected infected persons	Systems for documenting patient details and clinical interactions
<b>Contact tracing</b>	Reduction of epidemic reproduction rate	Identification and follow-up with people who have had high-risk interactions with infected persons
<b>Coordination and operations (including emergency operations centers)</b>	Preparedness and response plans, support for multisectoral responses	Systems to support cross-coordination for multisectoral response, emergency operations centers, and executing response plans
<b>Data analytics, visualizations, and use</b>	Efficient and effective response to validated outbreaks	Systems for enabling data-driven decision-making and communications to field teams
<b>Diagnostic tools</b>	Improve efficiency in clinical diagnosis and collection of data from diagnostic tools	Diagnostic tools with digital connectivity to support monitoring, documentation, and reporting of diagnoses
<b>Event-based surveillance (including rapid response teams, case investigations)</b>	Early detection of outbreaks and epidemics, case detection and investigation, national and subnational emergency operations to ensure rapid management of infectious disease	Systems with functionality or ability to monitor patterns indicative of infectious disease epidemic outbreak; systems to detect and document cases of emerging disease threats, investigate those threats, identify cases, and manage the response
<b>Health facility and provider administration</b>	Robust organizational underpinning for response	Systems for managing facility accounting and HR
<b>Infection prevention and control</b>	Prevent infection among patients and health workers	Systems that support triage, isolation, WASH, waste management to prevent transmission to staff, other patients, and the community
<b>Interoperability</b>	Improve effectiveness of tools	Provision of standardized interfaces to other software modules
<b>Laboratory systems</b>	Validation of infectious disease incidence	Systems with functionality to order lab tests, follow progress of patient sample, receive test results (confirm suspected case)
<b>Learning and training</b>	Support health worker readiness, including improve patient data collection and sample testing	Localized E-learning solutions for health workers and others
<b>One Health</b>	Prevent zoonotic disease outbreaks	Monitoring of potential vectors to humans by tracking infectious diseases in local wildlife and livestock
<b>Points of entry</b>	Detect and manage international spread of disease by identifying suspected infected persons at border entry points	Systems to strengthen border health security, screen, and follow-up with suspected infected persons at ports of entry and other border entry points
<b>Risk communication and community engagement</b>	Improved public awareness of facts and best practices for disease prevention	Systems for channeling messaging and communication to public to promote public awareness, counter misinformation, encourage treatment seeking behaviors, and encourage citizens to take appropriate actions to promote health
<b>Routine surveillance</b>	Routine health data monitoring to identify trends	Systems to manage health data and track trends on an ongoing basis, regardless of whether there is an outbreak or epidemic; systems usually include aggregate data
<b>Supply chain</b>	Support allocation of resources to aid in response	Systems for monitoring facility readiness and stock levels
<b>Vaccine delivery and planning</b>	Systematic monitoring of vaccinations in the population	Systems for documenting vaccinations for patients

## Annex 3. Digital tools supporting vaccine deployment

Digital technologies can act as accelerators for the introduction, deployment, and scale-up of vaccines in countries to assist health workers, communities, and other stakeholders. The use of digital tools and the data they enable facilitate rapid, iterative, and scalable approaches to ensure vaccines are safely delivered to health facilities, that health workers are equipped to administer them, and that communities are informed and confident in their efficacy.

Through the Map and Match project, Digital Square mapped the existing functionality of approved global goods to COVID-19 use cases, including those supporting planning, delivery, administration, and monitoring of COVID-19 vaccines. These adaptations and supporting resources are listed on Digital Square’s [wiki](#).

Table 3 illustrates how digital tools can support activities aligned to five use cases focused on vaccines. Digital Square has information about its approved global goods and how they align to these use cases currently as well as potential adaptations on its [website](#). This list does not include all digital public goods in the digital health ecosystem. Other tools like RapidPro and WelTel, which are not supported through Digital Square, can be included in these use cases.

**Table 3. Global goods tools to support vaccine deployment use cases.**

Description of vaccine deployment use cases	Digital Square approved global goods use cases
<p><b>Plan for vaccine introduction in country</b></p> <p>Digital tools can be used for planning and “microplanning” to inform how many vaccines are needed, where vaccines can be stored and monitored, who the most vulnerable populations are and where they are located, and other information essential to planning. Assessing the tools and data available throughout the health system, including patient data and health worker data, will inform this planning.</p> <p>As part of a vaccine introduction, governments need to build awareness of the vaccine and its benefits, and combat misinformation. Digital tools can be used for planning purposes to send messages to both health workers and communities about the vaccine.</p> <p>Training health workers is essential before introducing a new vaccine. Governments need to provide information to health workers on vaccine administration, possible side effects, and how to treat patients showing adverse reactions. Digital tools can be leveraged to rapidly share this information and offer virtual training.</p>	<p> <b>Messaging</b></p> <p> <b>Microplanning</b></p> <p> <b>Training</b></p>
<p><b>Support vaccine introduction</b></p> <p>Digital tools can enhance the launching of a vaccination campaign. Communication tools like SMS and social media can support rapid information sharing with communities as the vaccine is made available.</p> <p>Pharmacies, hospitals, clinics, and other facilities use robust digital systems to ensure vaccines are stocked at facilities by tracking inventory and shelf life and ordering additional supplies when needed. Digital tools can manage the transactional movements of vaccines within multilevel supply chains. Supply chain systems can also ensure that syringes, diluents, and other materials needed for vaccine delivery are stocked.</p> <p>Digital tools can support temperature monitoring during transport and where vaccines are stored. Remote temperature monitoring can improve cold chain performance, giving health workers assurance that vaccines are safe and effective.</p> <p>Digital tools can track when clients receive vaccines as well as other data fields (e.g., vaccine type, immediate negative reactions, and longer-term potential adverse events). Countries can adapt existing electronic immunization registries (EIRs) for vaccine monitoring and follow-up.</p>	<p> <b>Patient monitoring</b></p> <p> <b>Supply chain</b></p> <p> <b>Vaccine management</b></p>

### Digital Square approved global goods use cases



#### Electronic immunization registries

DHIS2 Tracker, OpenSRP, OpenMRS, Tamanu



#### Messaging

CommCare, Community Health Toolkit, mHero, OpenSRP



#### Microplanning

Healthsites, OpenSRP, Reveal



#### Patient monitoring

CommCare, DHIS2 Tracker, OpenSRP, SORMAS



#### Supply chain

DHIS2, OpenLMIS, Logistimo, OpenBoxes, Product Catalogue Management Tool



#### Training

CommCare, Community Health Toolkit, mHero, OpenSRP, SORMAS



#### Vaccine management

CommCare, Community Health Toolkit, DHIS2, DHIS2 Tracker, Logistimo, OpenBoxes, OpenLMIS, OpenSRP, Tamanu

**Table 3. Global goods tools to support vaccine deployment use cases, continued.**

Description of vaccine deployment use cases	Digital Square approved global goods use cases
<p><b>Enhance roll-out of vaccine, support ongoing vaccine monitoring</b></p> <p>In this phase, scaling to vaccinate large portions of the population is a priority. Vaccine roll-outs can be enhanced by adapting digital tools to add workflows and functionality as vaccine coverage expands. Governments need to consider additional information communications technology (ICT) needs like larger cloud-hosting services and use of tools that are operational offline for areas that have limited mobile network coverage.</p> <p>Supply chain is critical as vaccines are transported to more sites across the country. Digital supply chain tools, especially when paired with vaccine delivery data (e.g., from electronic medical records/EIRs), can help forecast supply needs and include decision support to prompt vaccine orders when supply falls below a defined threshold.</p> <p>EIRs and other tools can help prevent overcrowding in clinics by scheduling specific clinic times for vaccines. This ensures more equitable distribution of health services.</p>	<ul style="list-style-type: none"> <li> <b>EIRs</b></li> <li> <b>Supply chain</b></li> <li> <b>Patient monitoring</b></li> <li> <b>Vaccine management</b></li> </ul>
<p><b>Enhance communication to sustain vaccine demand</b></p> <p>Many COVID-19 vaccines are multi-dose shots. To ensure clients receive boosters, now and in the future, enhancing communication to sustain demand for the vaccine is important. Digital tools can be used to send messages to both health workers and communities about the vaccine. Communication tools can be linked with patient monitoring tools to automatically trigger direct communication to clients. Digital tools can continue to be used to increase vaccine demand and address misinformation, dispelling rumors and misinformation that cause vaccine hesitancy.</p> <p>Many EIRs include contact information and messaging features for patients' caregivers, allowing for direct communication to caregivers. These messaging features have historically been used to notify caregivers about upcoming immunization sessions or overdue vaccines. As the global community develops a greater understanding of COVID-19—including its transmission patterns, full range of symptoms, and treatment options—health workers also have the ability to share health promotion messages with patients.</p>	<ul style="list-style-type: none"> <li> <b>EIRs</b></li> <li> <b>Messaging</b></li> <li> <b>Patient monitoring</b></li> </ul>
<p><b>Use data to inform vaccine-related decisions</b></p> <p>Patient monitoring and tracking tools as well as EIRs can help generate meaningful insights for future vaccination efforts and encourage data-driven decisions when countries are able to plan for catch-up campaigns. For example, some EIRs can quantify the number of missed vaccines and determine which areas have been under-vaccinated. This individual-level data will enable decision-makers to target immunization services and allocate funding to those areas most in need. For more information, <a href="#">this publication</a> explains how Gavi and UNICEF are working to scale up use of digital tools for vaccination campaign performance monitoring.</p> <p>Interoperability is critical. As governments review the portfolio of tools and systems that are in place to support vaccine management, it is crucial that there is strong consideration given to the movement of data between systems to ensure a harmonized set of records for the population. This ensures that no individual is missed or counted twice.</p>	<ul style="list-style-type: none"> <li> <b>EIRs</b></li> <li> <b>Patient monitoring</b></li> <li> <b>Supply chain</b></li> <li> <b>Vaccine management</b></li> </ul>

**Digital Health Center of Excellence (DICE) to support the COVID-19 pandemic response**

As countries operationalize their COVID-19 vaccine rollout plans, there is an opportunity to identify areas where digital health interventions can amplify these efforts, while improving service delivery and strengthening health systems more broadly.

The success of digital health solutions often correlates with the strength of the enabling environment for these technologies, such as ICT infrastructure readiness, workforce capacity, data standards, interoperability, and the policy and regulatory environment. Poorly designed or inappropriate digital interventions, as well as vertical approaches geared only toward COVID-19, risk undermining and ultimately weakening national systems.

To more effectively organize support to countries for COVID-19 response, a multiagency COVID-19 DICE, with a UNICEF-WHO cohosted secretariat, will launch in April 2021. The DICE will provide coordinated technical assistance to low- and middle-income countries to support sustainable and scalable deployment of carefully chosen digital health solutions that support COVID-19 pandemic response plans.

Areas the COVID-19 DICE covers include:

- Support countries to conduct a structural readiness assessment of their enabling environment, define business requirements, conduct platform analysis, and map partnerships, existing tools, and gaps. Along with support to countries, this will require standardizing approaches and tools across development partners.
- Coordinate surge support to countries to assist in their development of a rapid strategic approach to meet the imminent needs of the vaccine delivery and transition to a sustainable strengthened and digitally enabled health system.
- Foster capacity and partnership with regional and national digital health experts toward the development of capacity that can provide long-term technical support to the region.
- Strategically support developers and product owners to modify and optimize software products relevant for pandemic response and vaccine delivery toward interoperability, standardization, and vaccine-specific functionalities.
- Complement and operationalize WHO and UNICEF guidelines developed in the context of the Access to COVID-19 Tools Accelerator (ACT-A) to further clarify and identify mature options open to countries building health infrastructure.
- Support the transition, alignment, and integration of COVID-19-related digital health investments through a systems strengthening lens.
- Pilot and assess transformative approaches to digital health deployments, monitor global developments and opportunities for standardized approaches, increase south-south knowledge transfer, and compile lessons learned.