Digital health systems to support pandemic response in **Uganda**

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

June 2021

Introduction

The Ministry of Health (MOH)'s *Uganda National eHealth Strategy: 2017–2021* outlines its goal "to harness and create an enabling environment for the development and utilization of sustainable, ethically sound and harmonized Information and Communications Technology at all levels to promote health and improve health services delivery in Uganda." The COVID-19 pandemic brought a new level of urgency to this goal with the strain it put on the health system. Leveraging digital health tools is a rapid, cost-effective strategy to accelerate Uganda's COVID-19 response while at the same time reinforcing the health system at large.

Background

Digital Square conducted a landscape analysis of Uganda's digital systems in the ten-year period from 2010–2020 with information validated by tool implementers and designers, digital health experts, and MOH 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 Uganda, map the tools already deployed for COVID-19 response to relevant uses cases, and highlight opportunities where existing tools can quickly be adapted and deployed to support COVID-19 response.

91 digital tools identified

42 tools scaled nationally

35 tools deployed for COVID-19

28 tools potentially adapted for COVID-19

Analysis overview

Map and Match's analysis found that Uganda's health system uses 91 digital health tools, with at least 35 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 Uganda's digital health systems' response to COVID-19. The use cases of health facility provider and administration, One Health, and vaccine delivery and planning are where gaps were identified with only one tool currently addressing each one of them. 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..

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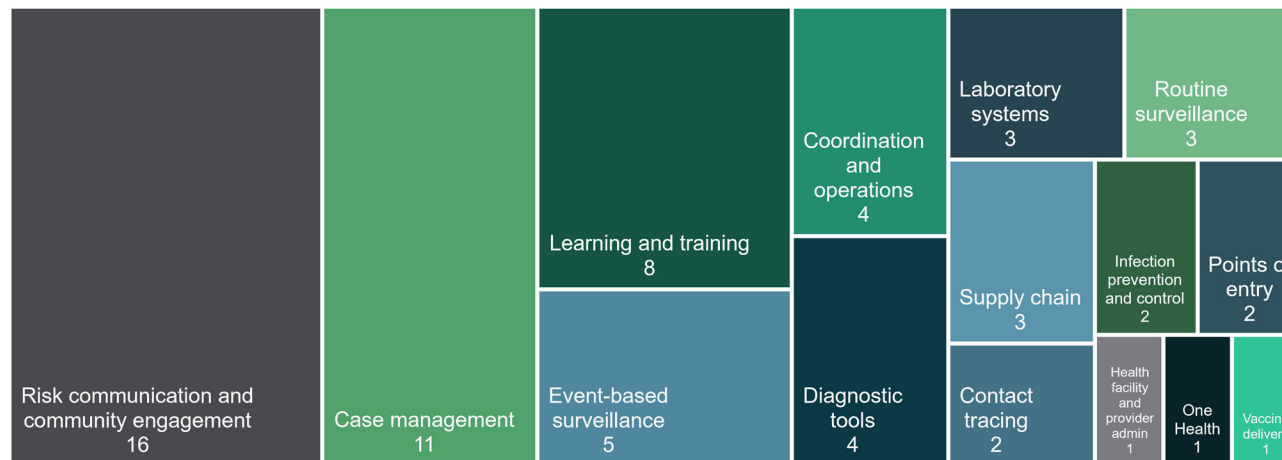

Figure 1 illustrates that many use cases are addressed using several tools in Uganda's COVID-19 response while other use cases are filled by a sole tool.

Table 1. Mapping and matching digital health tools to strengthen Uganda'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 Uganda's COVID-19 response. Digital Square matched opportunities for tool adaptation across the pandemic use cases in **green** to reveal places where Uganda can reuse parts of its existing digital health systems to strengthen its COVID-19 response.

DIGITAL HEALTH TOOLS	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
3-2-1 Service (161 Service)							blue					blue			
ART ACCESS Application	blue					blue								blue	green
Audiopedia												blue			
Call for Life (DHIS2)	blue			blue	blue							blue			
Call the Clinic App		blue										blue			
CommCare	blue	green			green	green	green	green	green		green	green		green	
Community Health Toolkit (CHT)	green	green	green		green	green	green		green			blue	green		green
COVID Blog									blue						
Electronic Infectious Disease Surveillance and Response (eIDSR) system (DHIS2)	blue				blue			blue		blue	blue				
e-SRHR												blue			
Everwell Hub	blue			blue											
Foundation for Profesional Development (FPD) E-learning technology									blue						
HealthConnect	blue											blue			
Healthy Entrepreneurs	blue								blue					blue	
iHRIS						green			blue						green
Kolibri App									blue						
Longitudinal surveys conducted via Interactive Voice Response (IVR) for resilience impact assessment												blue	blue		
Matibabu				blue											
mHero (iHRIS)	green	green	green		blue	green			green		green	blue		green	
MoH Capacity Building App									blue			blue			
mTrac (DHIS2)		blue	blue					blue						green	

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

Table 1. Mapping and matching digital health tools to strengthen Uganda's COVID-19 response, continued.

Legend: **D** = Digital tools deployed for COVID-19 response (blue); **O** = Opportunities to adapt tools for pandemic response (green).

DIGITAL HEALTH TOOLS	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
NextGenCoviaAI			D									D		D	
Open Deliver									D						
Reference Laboratory Information System (EID/VL LIMS) (DHIS2, OpenMRS)								D							
Regional Electronic Cargo Tracking System (RECTS)											D				
SafeBoda App												D			
SmartHealth App (plus Performance Tracking App) (CHT, ODK)	D			D		O									
sTrack												D			
Uganda HMIS (DHIS2 + Aggregate + Tracker)	D	O	O	O	D			O		O	O		D	O	D
UgandaEMR (OpenMRS)	D	O	D		O	O							O		O
U-Report												D			
Wanji Game												D			
WelTel	D				D							D			
World Continuing Education Alliance (WCEA)									D						
Xente COVID-19 Response							D								
AitaHealth	O			O											
Bahmni (OpenMRS)	O			O	O						O				
Cadasta platform														O	
Digital Community Scorecard App						O								O	
E-referral System	O		O		O							O			
GxAlert	O			O	O			O							
ICCM/ Village Health Team (VHT) reporting form					O										
integrated Health Facility Management Information System (iHFMIS) (DHIS2)	O		O	O	O	O									

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

Table 1. Mapping and matching digital health tools to strengthen Uganda's COVID-19 response, continued.

DIGITAL HEALTH TOOLS	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
Integrated Supportive Supervision (ISS) (ODK)	●														●
Journey Solution (OpenHIM)															●
Laboratory Management Information System (LMIS) (Logistimo)														●	
mUzima for Health Providers (OpenMRS)	●	●			●							●			
MyChild Solution															●
NoviGuide	●								●						
Open Data Kit (ODK)	●	●		●	●					●					●
OpenHIE															
OpenHIM		●													
Parsyl														●	●
Quantimed			●											●	
Self-regulatory quality improvement system plus (SQIS+)						●									
SMAPP mobile phone app					●			●							
Stre@mline (DHIS2)						●		●					●	●	
The Amplio Talking Book								●				●			
TweetDeck												●			
Uganda DREAMS-OVC Tracking System (UDTS) and Passport (DHIS2)		●										●			
Vantage			●												
Veoc			●												
VigiFlow								●							
Weltel		●									●				

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

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 to support the three use case gaps below, namely health facility and provider administration, One Health, and vaccine delivery and planning. 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.

Health facility and provider administration

ART ACCESS Application	CommCare
Community Health Toolkit	Digital Community Scorecard App
iHRIS Manage	iHFMIS (DHIS2)
mHero	SQIS+
SmartHealth App (CHT, ODK)	Stre@mline (DHIS2)
UgandaEMR (OpenMRS)	

One Health

eIDSR (DHIS2)	ODK
Uganda HMIS (DHIS2 + Tracker)	

Vaccine delivery and planning

Uganda HMIS (DHIS2 + Tracker)	ART ACCESS Application
Community Health Toolkit	iHRIS Manage
ISS (ODK)	Journey Solution (OpenHIM)
MyChild Solution	ODK
Parsyl	UgandaEMR (OpenMRS)

Examples of global goods ready for adaptation for COVID-19 response in Uganda

Community Health Toolkit

Community Health Toolkit (CHT) is a collection of open source technologies and open access design, technical, and implementer resources and is a community of practice for digitally supported care delivery. It is designed to support community health systems and teams delivering care in the hardest-to-reach communities. Medic Mobile serves as the technical lead and initial steward—building and supporting the CHT as a global public good and facilitating contributions from others.

CHT-powered tools are supporting COVID-19 response efforts in the Democratic Republic of the Congo, Kenya, Malawi, Mali, Nepal, and Niger among others. CHT supports adaptations to primary care in response to COVID-19. CHT provides a remote training on COVID-19 for community health workers. CHT delivers routine health checks for community health workers, including mental health, well-being, and regarding adequate protective equipment.

Open Data Kit

Open Data Kit (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 is switching its name to a new brand, Data Software for Social Good (DSFSG). 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.

ODK is being utilized in the COVID-19 response for disease surveillance, rapid diagnostics, and vaccine trials. ODK is used in Rwanda, Somalia, South Sudan, and Zimbabwe for contact tracing. In Kenya, community health volunteers utilize ODK to capture potential human and animals cases (One Health).

11 PANDEMIC USE CASES
1 USE CASES UTILIZED
11 ADAPTATION OPPORTUNITIES IDENTIFIED

- Case management
- Contact tracing
- Coordination and operations
- Event-based surveillance
- Health facility and provider administration
- Infection prevention and control
- Learning and training
- Points of entry
- Risk communication and community engagement
- Routine surveillance
- Vaccine delivery and planning

6 PANDEMIC USE CASES
0 USE CASES UTILIZED
6 ADAPTATION OPPORTUNITIES IDENTIFIED

- Case management
- Contact tracing
- Diagnostic tools
- Event-based surveillance
- One Health
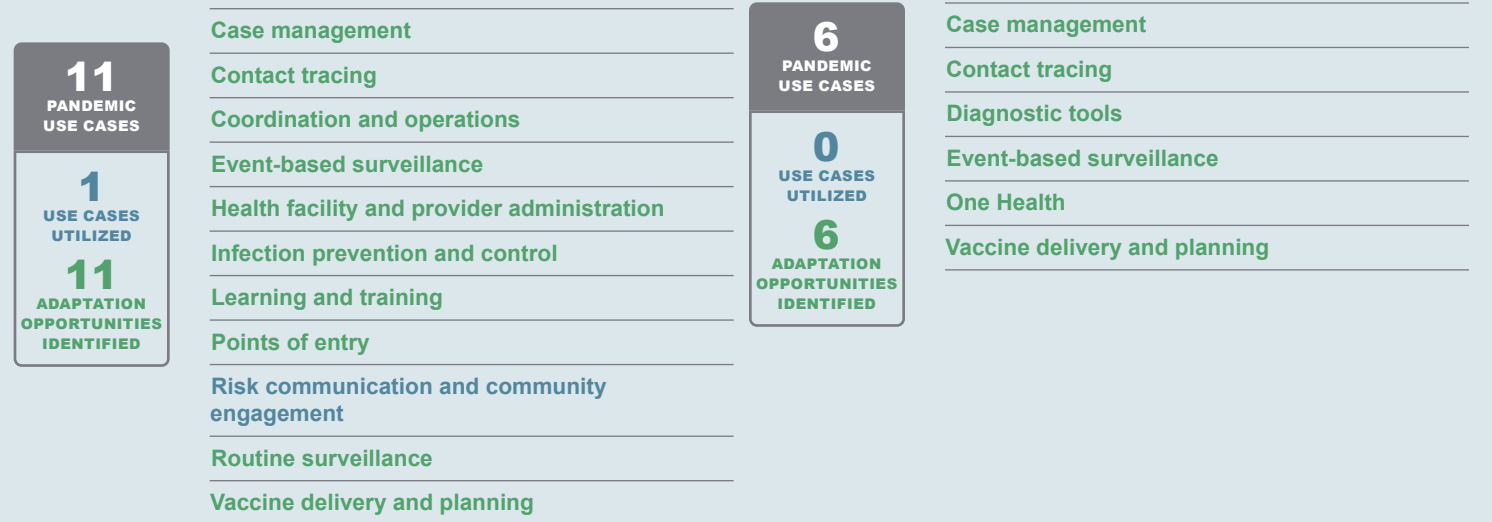- Vaccine delivery and planning

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
3-2-1 Service (161 Service)	Locally known as the 161 Service in Uganda, Viamo's 3-2-1 Service provides a source of information for people in Uganda without smartphones or with limited literacy using voice, USSD, and SMS provided across six languages. The current content includes information on agriculture, climate action, environment and global climate change, financial services, health and well-being, no poverty, and zero hunger. Viamo's flagship product, the 3-2-1 Service, enables callers to access prerecorded audio messages in local languages for free. When callers dial into the 3-2-1 Service and choose to listen to COVID-19 messages, they are presented with the option of using the symptom checker for self-triage. Based on the risk category the individual falls into, they are given targeted advice on the appropriate behavior to follow (such as social distancing or an immediate visit to the health facility). The service implemented a hotline for refugees in Uganda to check their possible COVID-19 symptoms. High-risk respondents are then tested to validate whether they have COVID-19.	Infection prevention and control, risk communication and community engagement	Surgo Ventures	FHI 360, Global Resilience Partnership, Mercy Corps, Pace, PSI, Self Help Africa, University of Washington, Viamo	Proprietary	National
ART ACCESS application	ART ACCESS is used to link patient information on antiretroviral therapy (ART) and viral load to an algorithm, which guides a community pharmacy on ART delivery without the need for patients to go to health facilities for drug refills. The application captures the patient's demographics, unique identifier, current ART regimen, current viral load, treatment adherence score, clinical complaints, follow-up outcomes, and reasons for missing appointments. During the COVID-19 pandemic, Uganda supported scale-up of ART ACESSS to ensure continued HIV care during facility overloading because of the pandemic. The application allows for routine medication refills issued by the government to be safely accessed in private/community pharmacies.	Case management, health facility and provider administration, supply chain, vaccine delivery and planning	FCDO, UK Medical Research Council	IDI, IDI Kampala, Kampala City Council Authority, Makere University, MOH, UAHII	Proprietary	Subnational
Audiopedia	Audiopedia is an ecosystem of localized digital audio content and technologies for social and behavior change communication campaigns. Audiopedia includes audio health education delivered through web applications for smartphones and feature phones. For COVID-19, Audiopedia published the Corona WhatsApp Audio Campaign on Audiopedia.IO. Recorded messages can be shared through WhatsApp and fight fake information.	Risk communication and community engagement		DAHW, URIDU	Open source	
Call for Life (DHIS2)	Call for Life is an IVR tool, previously used for HIV and TB treatment adherence, and now adapted for COVID-19 surveillance and case management. Call for Life is being used for symptom surveillance of high-risk COVID-19 contacts (2,900 screened) and post-quarantine surveillance. The MOH added a mental health screening tool for those discharged from the hospital (3,500 screened) to screen for mental health, GBV, and stigma. Call for Life is linked to Strong Minds, an NGO for mental health counseling. Call for Life can also supply health information tips and is available in ten languages.	Case management, diagnostic tools, event-based surveillance, risk communication and community engagement	CDC, J&J	IDI, Makerere University, MOH	Open source	National
Call the Clinic App	Call the Clinic App is a contact tracing app that alerts users and the MOH in the case that someone has been in contact with a COVID-19-positive person. The app uses smartphone technologies such as GPS and Bluetooth to collect and share the data, which are agile and easy to use. Individuals have access to COVID-19 information from the MOH on the latest updates and statistics. The app educates the public on symptoms and preventive measures against COVID-19. The community can send anonymous notifications of local symptomatic patients. Android users can download the app from the Google Play Store or access the link on the MOH website. Users register their credentials, and doctors can remotely diagnose patients and recommend necessary treatment actions with the information provided.	Contact tracing, risk communication and community engagement		CTI Africa, Ministry of ICT and National Guidance, MOH		National
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 to end users, uses simple device deployment, and includes translation features. In Uganda, CommCare is used for electronic data capture by village health teams during iCCM/ProCCM implementation to enable timely data transmission and analysis.	Case management, contact tracing, event-based surveillance, health facility and provider administration, infection prevention and control, laboratory systems, learning and training, points of entry, risk communication and community engagement, supply chain	Gates Foundation, Pilgrim Africa, PMI, Rotary International	CRS, Dimagi, Pilgrim Africa, World Vision	Open source	Subnational

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Community Health Toolkit (CHT)	CHT is a collection of open source technologies and open access design, technical, and implementer resources and is a community of practice for digitally supported care delivery. It is designed to support community health systems and teams delivering care in the hardest-to-reach communities. It serves as an integrated platform to onboard, train, supervise, and support CHWs and is quickly configurable to meet specific needs. In Uganda, community health networks are using apps built on CHT. CHT has been adapted through a set of modular tools and workflows designed for COVID-19 preparedness and surveillance, patient care, and community health response efforts. CHT supports event-based surveillance, enabling the detection of public health events early to guide interventions and gain visibility into signals, reports, and investigations. CHT supports contact tracing to coordinate registration and tracking of contacts within communities to prevent secondary virus spread. CHT facilitates port of entry screening by enabling enrollment, screening, and self-isolation follow-up of all incoming travelers at major ports of entry. CHT protects and supports health workers through routine health checks for CHWs, including checks on mental health, well-being, and adequate protective equipment, as they provide essential care. CHT provides remote onboarding and training of CHWs on care workflows through app use. CHT systems have been adapted for care coordination to ensure continuity of primary care amid the pandemic. Other workflows include community health education, home-based care and support, and remote support for care teams.	**Case management, contact tracing, coordination and operations, event-based surveillance, health facility and provider administration, infection prevention and control, learning and training, points of entry, risk communication and community engagement, routine surveillance, vaccine delivery and planning**	USAID and others	BRAC, CDFU, IntraHealth International, Living Goods, Malaria Consortium, Medic Mobile, TASO	Open source	National
COVID Blog	UNAIDS collaborated with WeDoctor, a Chinese medical service platform, to organize virtual sessions for building skills and expertise for COVID-19 care and management. These sessions connected more than 250 African doctors from Kenya, South Sudan, and Uganda with leading Chinese frontline medical experts, sharing China's experience with the COVID-19 response.	**Learning and training**		UNAIDS, WeDoctor		
Electronic Infectious Disease Surveillance and Response (eIDSR) system (DHIS2)	eIDSR is a homegrown electronic surveillance system based on the DHIS2 architecture. It enables the community and health workers to send unstructured alerts using the 6767 short code on their phones in Uganda. Alerts are received at the national level by staff who triage, validate, and decide on the necessary course of action. eIDSR has evolved with the launch of the Global Health Security demo project in 2013, piloting the case notification, specimen tracking, and linking of cases to lab testing for viral hemorrhagic fever, cholera, and TB. eIDSR notifies key human and animal notifiable diseases, including COVID-19. eIDSR has been configured to conduct case notification, investigation, lab integration, points of entry, and case management for COVID-19.	**Case management, event-based surveillance, laboratory systems, points of entry, One Health**		HISP Uganda, MOH	Open source	National
e-SRHR	The e-SRHR program is an intervention aimed at providing timely, accurate, and up-to-date sexual and reproductive health and rights (SRHR) and family planning options, information, and services to adolescent girls and youth in Uganda using a range of online and mobile tools. The website (http://esrhr.org/) has an integrated online radio (e-SRHR Radio) that broadcasts using mobile devices. e-SRHR shares information from MOH on COVID-19 (https://www.esrhr.org/covid-19/).	**Risk communication and community engagement**	PEPFAR	Youth Equality Center		
Everwell Hub	The Everwell Hub platform covers the entire digital cascade of care and is the core digital infrastructure that officers, health workers, and patients use to support diagnosis, treatment success, and recovery from TB. The Everwell Hub supports a broad patient management ecosystem (i.e., mobile, web, SMS, IVR).	**Case management, diagnostic tools**		Everwell, Government of Uganda	Open source	
Foundation for Professional Development (FPD) e-learning technology	FPD's e-learning technology includes online courses available on Moodle that are designed to transfer large amounts of knowledge and skills to delegates. These formally accredited courses require between 20 and 120 hours to complete, depending on the nature of the course. Courses for health professionals can be accredited for CPD starting at a minimum of one-hour tuition time with an assessment. Non-accredited short courses range from 15 minutes and more. FPD includes virtual training sessions that allow presenters to stream live sessions to delegates from virtual classrooms. PowToons is an educational tool using captivating videos with a combination of visual, auditory, and kinesthetic tools to engage various learning styles. FPD uses webinars from its virtual training classroom or via FPD's Microsoft Teams license. FPD offers micro-training in multiple structures (e.g., short videos, guidelines, journals, or newsletters). The structure uses the on-demand online e-learning (Moodle) structure but is shorter than a full training course and is intended to provide delegates with concise information. FPD's EdTech platform offers educators and professionals a comprehensive professional development experience. To access FPD's EdTech platform, users must have a smartphone, tablet, or PC with an internet connection of at least 2 Mbps. Users can log in from web browsers.	**Learning and training**		FPD	Proprietary	

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
HealthConnect	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. For COVID-19, WHO launched a dedicated messaging service in Arabic, English, French, Hindi, Italian, Spanish, and Portuguese with partners WhatsApp and Facebook to keep people safe by getting information directly into the hands of those that need it. From government leaders to health workers and family and friends, this messaging service provides the latest news and information on COVID-19, including details on symptoms and how people can protect themselves and others. It also provides the latest situation reports and numbers in real time to help government decision-makers protect the health of their populations. The service, which uses Turn machine learning technology, can be accessed by a link that opens a conversation on WhatsApp.	**Case management, risk communication and community engagement**	GCC	Praekelt	Open source	
Healthy Entrepreneurs	Healthy Entrepreneurs developed a telehealth platform. Health workers serving last-mile populations together with online nurses and health experts conduct remote triaging, risk assessments, and referrals to coordinate a community response and alleviate burden on the district health care systems. Healthy Entrepreneurs' COVID-19 module supports health workers with their infectious disease response through (1) a dedicated toll-free line for health workers, (2) development and distribution of contextualized communication materials for districts, health workers, and the public, (3) providing remote capacity building information to health workers via SMS, and (4) additional health services and products for health workers.	**Case management, learning and training, supply chain**	GCC	Healthy Entrepreneurs, MOH	Proprietary	National
iHRIS	iHRIS is a free, open source software package that helps countries around the world track and manage their health workforce data to improve access to services. Countries use it to capture and maintain high-quality information for health workforce planning, management, regulation, and training. Uganda deploys the iHRIS Train instance to support preservice and in-service training. iHRIS is used by the national-level MOH, district health offices, and regional referral hospitals for workforce planning and management. iHRIS is used by the examination boards for nurses, midwives, and allied health workers. The Allied Health Professional Council, Uganda Medical and Dental Practitioners Council, Uganda Nurses and Midwives Council, and Uganda Pharmacy Board use iHRIS to track licensing, registration data, and registration fees. All Ugandans can send an SMS to find out if their practitioner is licensed through the iHRIS Mobile Reference Directory.	**Health facility and provider administration, learning and training, vaccine delivery and planning**	USAID	IntraHealth International, MOH, Ministry of Education and Sports	Open source	National
Kolibri app	Kolibri is an adaptable set of open source solutions developed to support learning for those without internet access. Centered around an offline-first learning platform that runs on a variety of low-cost and legacy devices, the Kolibri Product Ecosystem includes a curricular tool, a library of open educational resources, and a toolkit of resources to support training and implementation in formal, informal, and nonformal learning environments. Kolibri is being used in more than 200 countries and territories around the world and serves millions of learners and educators living in underserved contexts where the internet is costly, unreliable, or simply beyond reach. Kolibri makes high-quality education technology available in low-resource communities such as rural schools, refugee camps, orphanages, nonformal school systems, and prison systems, especially to support those marginalized from education during COVID-19.	**Learning and training**			Open source	
Longitudinal surveys conducted via interactive voice response (IVR) for resilience impact assessment	In Uganda, Ghana, Kenya, and Rwanda, Viamo deployed longitudinal surveys to monitor the impact of programs, COVID-19, and lockdowns on beneficiaries of Mastercard Foundation's grantees. These surveys use IVR technology, which allows anyone, regardless of literacy level, to access the information. In Rwanda, the survey is targeted to participants of a program that provides business development support and grant funding to more than 3,500 micro, small, and medium-sized enterprises that require working capital or re-launch capital due to the impact of COVID-19 on their businesses. Survey results are shareable with other health information management and reporting platforms via open data standards, including Flow Interoperability standards, a REST API, SQL, and Google BigQuery. In Uganda, the survey is targeted to participants of a program supporting small and medium-sized enterprises, and it is offered in English and Luganda.	**Risk communication and community engagement, routine surveillance**	Mastercard Foundation	Viamo	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
Matibabu	Matibabu is a smartphone app that helps diagnose malaria without a blood sample. A finger is inserted into the device to diagnose, and the results are viewed via a smartphone. This provides users with their malaria status in the shortest possible time with up to 80 percent accuracy. The easy-to-use mobile app monitors, registers, and informs users about their current health condition. This software is an extension of the noninvasive device that provides updated information without any need to go to a health center or hospital.	**Diagnostic tools**		Matibabu		
mHero (iHRIS)	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. Created in 2014 to support health-sector communication during the Ebola outbreak in West Africa, the platform has since adapted for general health-sector communication, disease surveillance, and COVID-19 response. Messages can be customized for health workers based on cadre, location, or skill set. mHero has basic data collection capabilities but it is not a structured data collection platform. mHero is being deployed for COVID-19 in the DRC, Guinea, Kenya, Liberia, Mali, Senegal, Sierra Leone, Tanzania, and Uganda. mHero features COVID-19 disease surveillance workflows and can send messages from any FHIR-compliant database, such as OpenMRS, to update any FHIR-compliant database with new respondent information. mHero can also respond to messages via WhatsApp and Facebook Messenger.	**Case management, contact tracing, coordination and operations, event-based surveillance, health facility and provider administration, learning and training, points of entry, risk communication and community engagement, supply chain**	Digital Square, UNICEF	IntraHealth, MOH, UNICEF	Open source	National
MOH Capacity Building App	The MOH Capacity Building App is a digital platform for health worker capacity building through delivery of multimedia digital training content. The tool hosts training courses for COVID-19 management, home-based care for COVID-19, and continuity of essential health services during COVID-19.	**Learning and training, risk communication and community engagement**	Last Mile Health, Seed Global Health	Last Mile Health, Makerere University, MOH	Public domain	Subnational
mTrac (DHIS2)	mTrac is a mobile phone–based system that enables VHTs and CHWs to electronically submit information about supplies, send stockout alerts, and conduct disease surveillance. mTrac is part of the MOH's national HMIS system, integrated into DHIS2 and iHRIS. It allows submission of Weekly HMIS Surveillance Forms by SMS, alerts to predefined user groups based on notifiable events or data outliers, and communications/surveys/polls initiated by government staff at the national and district levels to all health workers. It also allows health care consumers to report on their experiences as well as any service delivery issues (e.g., stockouts of commodities, extortion). mTrac includes an SMS Health Service Delivery Complaints Hotline to report absenteeism, drug theft, impersonation, and abuse. Uganda adapted mTrac on the Go.Data software to create a specific module to facilitate COVID-19 case investigation and contact tracing, with specific support of timely sharing of test results.	**Contact tracing, Coordination and operations, laboratory systems, supply chain**	FCDO, MOH, UNICEF, WHO	Aliko Dangote Foundation, CHAI, FCDO, GBCHealth, Makerere University, MOH, UNECA, UNICEF, WHO	Open source	National
NextGenCoviaAI	NextGenCoviaAI is an Integrated Digital National COVID-19 Health Information Management Platform. The platform can be used by the MOH to (1) register all the screening units/hubs and provide a platform for online collaboration and telemedicine support among these hubs; (2) view in real time all patients screened with results at each hub; (3) manage task forces and human resource at each hub; (4) manage resource allocation, planning, quantification and forecasting, and quarantine management; and (5) provide instant communication to the public. The platform can be used by screening hubs to (1) register patients, (2) screen patients, (3) communicate among hubs, (4) communicate to testing labs (like Uganda Virus Research Institute), (5) share images for telemedicine support with support for automated analysis, (6) assign daily tasks, and (7) request resources from the MOH. The platform can be used by the community to (1) obtain instant and real-time communication from the MOH or hubs, (2) provide secure two-way communication to the MOH or nearest screening hub about a suspected COVID-19 patient, and (3) provide automated COVID-19 risk factors assessment from home or from the nearest health center via a tablet module installed at designated points.	**Coordination and operations, risk communication and community engagement, routine surveillance, supply chain**		Global Auto Systems Ltd Uganda, MOH, WHO		National
Open Deliver	Open Deliver is an open source mobile learning platform for delivering learning content, video, and quizzes, specifically designed for low-resource environments with poor internet connectivity. The MOH uses Open Deliver as the primary platform for distributing digital educational content to CHWs.	**Learning and training**	FCDO, mPowering Frontline Health Workers	Jhpiego, Last Mile Health, Makerere University, MOH	Open source	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
Reference Laboratory Information System (EID/VL LIMS) (DHIS2, OpenMRS)	This system is used for data capture, processing, and generation of lab test results for viral load (VL) and early infant diagnosis (EID) programs at the national reference laboratory, Uganda National Health Laboratory Services-Central Public Health Laboratories (UNHLS-CPHL). Data collected are disseminated via the EID and VL dashboards. For the VL dashboard, the system tracks the 90-90-90 at national, district, hub, and facility levels.	**Laboratory systems**	CDC	METS, UNHLS	Open source	National
Regional Electronic Cargo Tracking System (RECTS)	RECTS is a truck driver application created by and for East African Community countries. Its goal is to ease movement of goods in the region. Everywhere drivers go, they simply scan their credentials. RECTS is used to track COVID-19 tests.	**Points of entry**		TMEA, Uganda Revenue Authority		
SafeBoda app	In Uganda, small- and medium-sized enterprises were badly impacted when public transportation halted due to COVID-19. This app is an e-commerce platform that connects market vendors to customers during the COVID-19 lockdown and beyond. The app helps SafeBoda's fleet of 18,000 riders earn income while reaching a projected 50,000 customers daily with food stuffs and good delivery. The app preserves local value chains while at the same time sharing vital information and safety practices around COVID-19.	**Risk communication and community engagement**	Sida	SafeBoda, UNCDF		National
SmartHealth app (plus Performance Tracking app) (CHT, ODK)	The LG SmartHealth app is an Android application with functionality for household registrations, pregnancy registrations and follow-ups (e.g., ANC/PNC), and disease diagnosis and treatment protocols (iCCM). LG SmartHealth is designed to assist CHWs/VHTs with data capture, disease diagnosis, tasks, and performance management. The app includes family planning and immunization workflows. The LG Performance Tracker app for CHW supervisors is an Android application with functionality for monitoring the performance of CHWs enrolled with LG and actively using the LG SmartHealth app. Supervisors have access to the performance metrics of the CHWs garnered through the LG SmartHealth application and can record their own observations of CHW behavior, activity, and aptitude to paint a complete picture of performance of any given CHW. Within the performance tracking app, a supervisor has access to and can update information on stock status, aptitude on conducting sick child assessment, pregnancy registration and follow-ups, newborn health checks, and household registrations and interactions. The app helps assist the CHWs to be more competent and conduct public health education. For COVID-19, SmartHealth has adapted to disseminate prevention messages for CHWs and to share national guidelines that enable CHWs to safely deliver services.	**Case management, diagnostic tools, health facility and provider administration**	CIFF, ELMA Philanthropies, Gates Foundation, Gavi, Skoll Foundation	BRAC, Gavi, Living Goods, Medic Mobile	Open source	Subnational
sTrack	sTrack, the Uganda National Schools Electronic Registry, makes accurate and authentic information about schools available to all citizens and stakeholders in the education system in Uganda in an efficient, timely, and cost-effective manner. The COVID-19 response provides academic materials to the public amid the COVID-19 pandemic. The project's aim is to give every school a digital ID.	**Risk communication and community engagement**	Ministry of ICT and National Guidance, NIISP	Ministry of ICT and National Guidance		
Uganda HMIS (DHIS2 + Aggregate + Tracker)	District Health Information Software 2 (DHIS2) is an open source, web-based HMIS platform. 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 Tracker is an open source, web-based application that supports data collection, and analysis of transactional or disaggregated data. Uganda began using DHIS2 in 2012 with health center IIIs. At the health center II and III levels, service provision information is first recorded by hand in paper-based registers and then entered into DHIS2 at the health center III level. The DHIS2 digital data package for COVID-19 is designed to accelerate case detection, situation reporting, active surveillance, and response in countries. The COVID-19 digital data package includes standard metadata aligned with WHO's technical guidance on COVID-19 surveillance and has been adapted to local country context and language in this implementation.	**Case management, contact tracing, coordination and operations, diagnostic tools, event-based surveillance, laboratory systems, One Health, points of entry, routine surveillance, supply chain, vaccine delivery and planning**	CDC, DHIS2, Gates Foundation, Gavi, HISP, Malaria Consortium, METS, Norad, The Global Fund, UNICEF, WFP	DHIS2, HISP Uganda, MOH	Open source	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
UgandaEMR (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 and to report data out efficiently to DHIS2 for public health surveillance. In Uganda, the Monitoring and Evaluation Technical Support (METS) program received support to customize and support the national scale-up of OpenMRS. METS upgraded the existing OpenMRS to Version 1.11.6 and rebranded it from OpenMRS to UgandaEMR. OpenMRS has deployed an active COVID-19 Response Squad that identifies 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, contact tracing, coordination and operations, event-based surveillance, health facility and provider administration, routine surveillance, vaccine delivery and planning**	CDC	ICF International, Makerere University, MEASURE Evaluation, METS	Open source	National
U-Report	U-Report has been used as a focused mHealth application, specifically providing real-time mobile counseling and conducting coordinated polls on HIV/AIDS among adolescents and young people. Youth networks use SMS and radio to facilitate community monitoring, discussion, and dialogue around key development issues, strengthening citizenship and democracy. During the Ebola response in Uganda, SMS alerts were carefully drafted and sent to Kibaale, Hoima, Kiboga, Mubende, Ntoroko, Bundibugyo, Kabarole, Kyenjojo, Kyegegwa, Kyankwanzi, and Ibanda. Alerts included a notice about Ebola outbreaks and how to stay safe. The service is free, requires no training, and anyone in Uganda with any mobile phone can directly participate.	**Risk communication and community engagement**	UNICEF	UNICEF	Open source	National
Wanji Game	The Wanji Game launched in Uganda to teach players about COVID-19 prevention. This interactive "listen-then-choose" audio game promotes positive behaviors and tests players' current knowledge and understanding of prevention techniques.	**Risk communication and community engagement**		PVI, Viamo	Proprietary	National
WelTel	WelTel is an evidence-based text messaging solution for improving patient adherence. The tool is used in many countries to support evidence-based integrated patient engagement, virtual care, communication outreach, and data collection for COVID-19 and many other health areas (e.g., MNCH, TB, HIV, PrEP). The tool has been validated to impact positive behavior change to improve health outcomes and save lives. WelTel's system supports appointment scheduling and reminders, and it broadcasts videos of public health information on a secure patient portal. WelTel is currently deployed for COVID-19 response in Rwanda, Uganda, Tanzania, and the United Kingdom.	**Case management, contact tracing, event-based surveillance, points of entry, risk communication and community engagement**	CDC, CIHR, GCC, IRAP, NIH, PEPFAR	BC Children's and Women's Hospital, University of British Columbia, University College London, WelTel Inc.	Proprietary	
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**		WCEA	Proprietary	National
Xente COVID-19 Response	Xente helps small enterprises in Kampala stay in business during the crisis by listing them as vendors on its app. It has waived the setup fees and commission for three months for micro-enterprises.	**Infection prevention and control**		Xente	Proprietary	Subnational
AitaHealth	AitaHealth is a mobile application used to register, screen, and identify at-risk individuals from their homes. The intuitive design assists community health workers to capture data from the households they visit daily and assists with decision-making during the assessment. A broad household "triage assessment" is also conducted to determine if any household members require assistance with key health issues.	**Case management, diagnostic tools**		AitaHealth, Mezzanine, University of Pretoria	Proprietary	
Bahmni	Bahmni is an open source EMR and hospital information system that is currently deployed in more than 50 countries. Bahmni is a distribution of the OpenMRS medical record platform that is designed to help health care providers to improve the efficiency and quality of patient care, reduce the margin of error in clinical diagnosis, and advocate for policies related to public health in rural areas. The system 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.	**Case management, diagnostic tools, event-based surveillance, points of entry**			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
Cadasta platform	Cadasta provides a common global platform and set of technology and training tools that allow local organizations, government entities, and communities to document and map land and its occupants in a more quick, efficient, and affordable way. The Cadasta platform is an Esri-based suite of best-in-class tools and technologies that collects and manages land-related data and migration of data into government systems. It is supported by a range of applications, including mobile and web-based tools, to help users easily and securely document, visualize, analyze, and share crucial community land and resource rights data. In addition, users define data models and workflows, assisting with the collection of imagery via satellites and drones. Cadasta has been used in other countries to provide consistent and cohesive community-level data concerning resources for COVID-19 response efforts, including medical clinics, pharmacies, hospitals, testing sites, and other treatment centers.	**Routine surveillance**		Cadasta, Ugandan Ministry of Lands Housing and Urban Development	Proprietary	Subnational
Digital Community Scorecard App	Community scorecards are widely used to build a trusted and constructive relationship between communities and health facility staff. The Digital Community Scorecard App helps staff or volunteers running community scorecards to digitize and analyze the data generated from this process. The app includes three related tools: a simplified data entry app that is designed to work offline, a program management app that includes real-time analysis tools, and a data hub to aggregate and visualize data.	**Health facility and provider administration, routine surveillance**	VSO	Kwantu, VSO	Open source	Subnational
E-referral system	The e-referral system is a mobile, web-based application that uses basic handheld devices to reach clients remotely in the community and avails them a host of health information (e.g., TB, HIV, family planning) as well as referrals to health facilities for services. It has a client reminder component in multiple local languages both in text and audio and is used for real-time reporting. The e-referral system allows classification of services referred and triaging of appointment requests to support linkage and retention in Mubende Region.	**Case management, coordination and operations, event-based surveillance, risk communication and community engagement**	CDC, Mildmay	PACE, PSI		Subnational
GxAlert	GxAlert is a digital platform that facilitates country-level surveillance of viral load laboratory testing results by allowing data to flow across the health system. GxAlert can connect to other electronic tuberculosis managers or M&E systems. GxAlert can also send targeted SMS alerts to facility managers, health officers, and suppliers. GxAlert enabled a solution to address the following gaps: (1) device management, monitoring, and reporting; (2) calibration, maintenance, and procurement planning; (3) lab technologists' capacity, availability, and training; (4) real-time results notifications to respective stakeholders including rapid case notifications for all positive results to all relevant health care officers; and (5) inventory management and notifications to reduce stockouts and expires. Countries can leverage GxAlert to quickly enable real-time reporting and notification of COVID-19 diagnostic data. In a pilot study, SystemOne partnered with Yo! Uganda to develop an automated SMS platform to send Xpert results to patients and referring health centers.	**Case management, diagnostic tools, event-based surveillance, laboratory systems**	Stop TB Partnership	Government of Uganda, SystemOne	Proprietary	National
Integrated Community Case Management (iCCM)/ Village Health Team (VHT) reporting form	The iCCM form is used to summarize services offered by a VHT in a quarter. The form includes number of children who had fevers and were treated within 24 hours.	**Event-based surveillance**	MOH	MOH		National
Integrated Health Facility Management Information System (iHFMIS) (DHIS2)	iHFMIS manages hospital clinical and business processes. The tool is a collection of software components representing different business processes carried out in a health facility, including components that support management functions at local, district, and national levels.	**Case management, coordination and operations, diagnostic tools, health facility and provider administration,**	Government of Uganda, The Global Fund	IICS Technologies, MOH	Open source	National
Integrated Supportive Supervision (ISS) (ODK)	ISS is an electronic checklist used for supervision during active case search and routine immunization.	**Case management, vaccine delivery and planning**			Open source	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
Journey Solution (OpenHIM)	Journey Solution is a digital tool that provides continuity of care for mobile populations in cross-border environments between Kenya and Uganda. Journey relies on Near Field Communication cards to enable patients to carry their own data and access care across national borders without risking personal information sharing. It provides mobile electronic immunization records for migrant populations stored on smartcards that can be read using a mobile device reader at Journey-enabled facilities. Data stored on the card provides personal health records with potential for diagnostics record storage. Mothers in cross-border regions can carry their children's immunization records, avoiding loss of paper-based registers or the difficulty health workers experience trying to retrieve records via paper register books.	**Vaccine delivery and planning**	Gates Foundation, USAID	BroadReach, Jembi Health Systems	Open source	Subnational
Laboratory Management Information System (LMIS) (Logistimo)	This tool is a full-featured LMIS deployed at scale. Logistimo is a fully mobile-enabled platform for supply chain management that enables a country to optimize supply chain performance across its network to achieve optimal service quality. It enables inventory management, order management, demand forecasting, inventory optimization, remote temperature monitoring for cold chains, and transportation logistics management.	**Supply chain**	Gavi	Logistimo	Open source	National
mUzima for Health Providers (OpenMRS)	mUzima is a mobile extension to the widely deployed OpenMRS electronic medical record system, and it improves the reach of clinical care beyond tethered and connected settings. mUzima innovatively uses mobile technology to improve the health of the underserved across all care domains. mUzima handles multiple use cases (e.g., HIV, HTS, outreach, CDM), adds forms without repackaging, allows users to view historical data as well as capture data, handles record deduplication, and enforces security. The mUzima for Health Providers application has been enhanced to implement the mUzima for COVID-19 App. This first version of mUzima for COVID-19 App focuses on supporting screening, contact tracing, and capturing of testing information using forms designed in line with WHO guidelines. Health workers can view a COVID-19 patient's historical data even when offline, with relevant data availed from the electronic health record system. mUzima leverages a GPS feature for contact tracing. All data within mUzima is encrypted within the mobile device and exchanged with a secured electronic record system to ensure patient data privacy.	**Case management, contact tracing, event-based surveillance, routine surveillance**	METS, MOH	METS	Open source	National
MyChild Solution	The MyChild system is an EIR to register and follow up on every child, to reduce administration efforts and to generate real-time data at individual and population levels for decision-makers. Smart Paper Technology uses optimized paper-reporting forms and digital scanning technology to capture and scan data from health facilities and can be used in combination with other LMIS software solutions. Smart Paper Technology is appropriate for district-level and last-mile deployments.	**Vaccine delivery and planning**	CIFF, IKARE Ltd, IKEA Foundation, Shifo Foundation, Swedish Postcode Foundation	MOH, Plan International, Shifo Foundation, WHO	Open source	Subnational
NoviGuide	NoviGuide is a tablet-based companion for clinicians who care for newborns. Quick, visually engaging, and fully featured, NoviGuide's dynamic decision trees support providers through a care encounter, expanding lines of questioning in response to danger signs. It includes complex neonatal care protocols and automatic calculations. Care delivery is combined with data collection, so each encounter helps build a picture of the care landscape. Data syncing can be conducted later if connectivity is limited. An Insights Dashboard provides lively visualizations, identifies problem areas, and can connect to a DHIS2 instance. NoviGuide is a platform for rapidly creating and deploying clinical decision support algorithms. Native American communities in the United States have deployed the NoviGuide for COVID-19 clinical algorithms. NoviGuide has a fully functioning COVID-19 anticoagulation algorithm that can be quickly converted for use in inpatient settings globally. The NoviGuide is suited for complex clinical algorithms. It could be used to design, deploy, and serially amend frontline decision support for (1) lung protective ventilation, (2) steroid and other pharmacologic decision-making, (3) oxygen escalation and others, and (4) case categorization, among others.	**Case management, learning and training**	Global Strategies, University of California San Francisco	Global Strategies, IDRC	Proprietary	Subnational
Open Data Kit (ODK)	Open Data Kit (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 has 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. This tool has been used to support surveillance for vaccination campaigns in Uganda.	**Case management, contact tracing, diagnostic tools, event-based surveillance, One Health, vaccine delivery and planning**	WHO	MOH, WHO	Open source	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
Open Health Information Exchange (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. The purpose of the Health Information Exchange is to promote the appropriate and secure access and retrieval of a patient's health information to improve the cost, quality, safety, and speed of patient care, and to inform planning and policymaking.	Interoperability		Jembi Health Systems, METS	Open source	National
Open Health Information Mediator (OpenHIM)	OpenHIM is a middleware component designed to ease interoperability between disparate information systems. It provides secure communications and data governance, as well as support for routing, orchestrating, and translating requests as they flow between systems. OpenHIM is intended as an extensible tool to support interoperability workflows across a wide range of information systems, metadata services and HIE components, and data standards. The packaged version also has a published set of workflows available and is preconfigured to a particular use case, such as HIV case-based surveillance, to allow implementers to engage with the solutions and test their applicability.	Contact tracing, event-based surveillance, interoperability		Jembi Health Systems	Open source	National
Parsyl	Parsyl is currently working in Senegal and Uganda. Vaccines require strict temperature control to remain potent and effective. Parsyl monitors vaccines to ensure they reach clients safely by providing insights from granular data about environmental conditions experienced during shipment and in storage to inform and encourage supply chain best practices. Parsyl's monitoring devices combined with its mobile application and web platform will provide, for the first time, near real-time visibility of the entire vaccine supply chain. Using a combination of proprietary wireless sensing devices and data analytics, Parsyl provides a solution that allows global health supply chain partners to answer critical questions about what happened to vaccines during shipment and storage, the causes and locations of any vaccine degradation, and what improvements can be made.	Supply chain, vaccine delivery and planning	Gavi		Proprietary	
Quantimed	Quantimed conducts the quantification of essential medicines and supplies. Quantimed is designed to improve the accuracy of order planning and budgeting by providing a systematic approach to organizing and analyzing data. Quantimed facilitates the calculation of commodity needs using either a single method or a combination of any of the three primary quantification methods: past consumption, morbidity patterns, and proxy consumption. Depending on the availability of data, Quantimed can be applied at the local level with one facility, the regional level with several facilities, or at the country level for a national control program.	Coordination and operations, supply chain	USAID	MSH, USAID	Open source	
Self-regulatory quality improvement system plus (SQIS+)	The SQIS+ and the e-health licensing platform can be applied to any facility irrespective of size and complexity of services offered. The SQIS+ allows users an in-depth check of the prevailing standards of care and to identify areas of weakness that can be addressed to meet licensure requirements. The SQIS+ can be used for accreditation of facilities into networks such as the National Health Insurance Scheme and can be potentially linked to the e-licensing platform as a transparent mechanism for health facility first-time registration and licensure, and annual professional and facility license renewals. Digitizing and linking these systems will realize a vision of the MOH to move toward harmonization of regulations, quality measurement, and improvement tools by creating a standardized licensure and certification system for all facility types. Considering the current challenges in mobility, the digitized tool can be accessed by users through smartphones or similar devices.	Health facility and provider administration	IFC, MasterCard Foundation, Merck for Mothers, Private Sector Foundation Uganda, USAID, World Bank	MOH, UHF		National
SMAPP mobile phone app	SMAPP is an application installed on a smartphone device (with disabled calling, web browsing, and other app capabilities) that allows the health worker to log a visually read rapid diagnostic test (RDT) result (e.g., for malaria, HIV, or TB) and transmit that result to the web-based system LIS hosted at the UNHLS Data Center. SMAPP relays test results for different RDTs and associated patient demographic information. The data loggers are fitted with the Near Field Communication (NFC) scanning feature, which enables the data logger to automatically read the batch number of the test kit. The data logger scans an NFC tag embedded on the test kit and uploads (1) disease type, (2) test type, (3) batch number, (4) lot number, and (5) expiry date.	Event-based surveillance, laboratory systems	Abbott, MOH	MOH, UNHLS		Subnational

■ 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
Stre@mline (DHIS2)	Stre@mline is an e-health platform that enables clinicians in low-resource settings to deliver health care efficiently by providing key patient safety prompts across the entire patient journey. Stre@mline follows the patient journey, incorporating demographics, triage, consultation, patient safety, investigation ordering and results, prescriptions, stock control of medicines, insurance, and finances. Stre@mline can generate statistical data needed for monthly HMIS reports and graphical trend data.	Health facility and provider administration, learning and training, routine surveillance, supply chain	Church of Uganda Kisiizi Hospital, Innovation Streams Limited, UNFPA	Church of Uganda Kisiizi Hospital, Innovation Streams Limited	Proprietary	National
Amplio Talking Book	The Amplio Talking Book is a rugged, battery-powered audio device for low-literate adults and youth. Governments and development organizations use Amplio Talking Book to amplify their reach and share knowledge in rural remote communities. Talking Book overcomes barriers such as lack of infrastructure, illiteracy, and traditional gender norms and biases that often limit access to information.	Learning and training, risk communication and community engagement	Government of Japan, Paul and Cathy Cotton Family		Proprietary	
TweetDeck	TweetDeck enables users to track real-time conversations about topics that matter to bring insights through a customizable layout. Uganda uses it for routine surveillance.	Routine surveillance				
Uganda DREAMS-OVC Tracking System (UDTS) and Passport (DHIS2)	This system tracks services provided to AGYWs and OVCs through the DREAMS partnership. At the core of this system is the enrollment dataset, which has a unique record for each beneficiary enrolled in the program. This record includes a unique DREAMS ID number, identifying information (e.g., name and address), and characteristics of the beneficiary at the time of her enrollment: age; whether her parents are alive; school attendance; whether she has had a child by age 15; whether she was pregnant; marital status; HIV risk segment (as determined by the program partner); and whether she was tested for HIV at the time of enrollment. These data are entered only once and are not updated. The DREAMS Passport captures all relevant bio data for the DREAMS clients and the services received and it is entered in the Uganda DREAMS tracking system. The tracking system produces an aggregate of all health services received by all girls and a national report.	Contact tracing, risk communication and community engagement	CDC, USAID	METS, MOH, PEPFAR	Open source	National
Vantage	Vantage is an AI-enabled cloud platform that empowers health care workers to make decisions. The cloud-based platform can instantaneously analyze data and communicate findings and direct meaningful actions through automatically generated dashboards and targeted push notifications.	Coordination and operations	IDI, Microsoft, PEPFAR	BroadReach	Proprietary	Subnational
Virtual emergency operations centers (VEOC)	A VEOC communicates via the Internet, intranet/virtual private networks, smartphones, and satellite phones. Authorized people have "anytime, anywhere" access with a username, password, and secure server. A VEOC can reduce response times and pinpoint the best use of available resources during a disaster.	Coordination and operations				
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

"Uganda's COVID-19 response is governed by a national task force made up of eight subcommittees, which each come up with their own priorities. The national task force includes a software subcommittee that supports building of in-house digital health tools.

From experience with past public health emergencies, such as Ebola and cholera, there is some difficulty with having quick deployment of applicable tools. Sometimes in these pandemic situations you're just using an Excel sheet because of the lack of time to create these systems."

—Joshua Kayiwa, Information Analyst, Uganda's Ministry of Health

At a glance

Figure 2 shows that Uganda's digital health tools rely on different software licensing types for sustainability with open source and proprietary being the most common. Figure 3 demonstrates that Uganda has 42 digital health tools deployed on a national scale while 23 operate on a subnational scale. A limitation of the Map and Match analysis was the inability to find complete information about licensing type and scale of some of these tools in Uganda. These figures are not specific to COVID-19 response, but they provide an overall picture of Uganda's digital health infrastructure.

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

- Unspecified 25%
- Open source 48%
- Public domain 3%
- Proprietary 24%
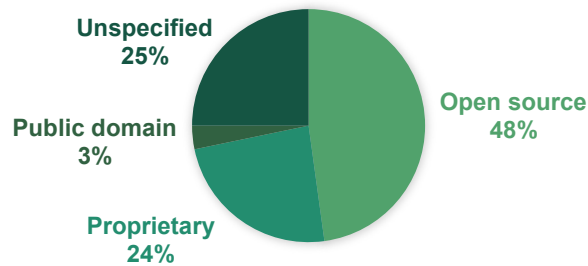
Figure 3. Number of digital tools deployed at scale in Uganda.

National	Subnational	Unspecified
42	23	26
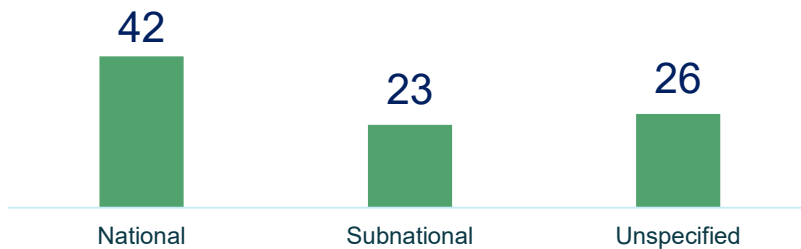
Conclusion

Digital Square mapped 91 existing, adaptable digital health tools in Uganda 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 Uganda'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 Uganda'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 Uganda's digital health systems** and their role in the COVID-19 response by reviewing Uganda'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.

Annex 1. Abbreviations

Acronym	Definition
AGYWs	adolescent girls and young women
AI	artificial intelligence
AIDS	acquired immunodeficiency syndrome
ANC/PNC	antenatal and postnatal care
ART	antiretroviral therapy
CDC	Centers for Disease Control and Prevention
CDFU	Communication for Development Foundation Uganda
CDM	clinical data management
CHAI	Clinton Health Access Initiative
CHWs	community health workers
CIFF	Children's Investment Fund Foundation
CIHR	Canadian Institutes of Health Research
CPD	certifications for professional development
CRS	Catholic Relief Services
CHT	Community Health Toolkit
DAHW	German Leprosy & Tuberculosis Relief Association
DHIS2	District Health Information Software 2
DRC	Democratic Republic of the Congo
EID	early infant diagnosis
EIR	electronic immunization registry
EMR	electronic medical record
FCDO	UK Foreign, Commonwealth & Development Office
FHIR	Fast Healthcare Interoperability Resources
FPD	Foundation for Professional Development
Gavi	Gavi, the Vaccine Alliance
GBV	gender-based violence
GCC	Grand Challenges Canada
GPS	Global Positioning System
HIE	Health Information Exchange
HISP	Health Information Systems Programme
HMIS	health management information system
HTS	HIV testing services
iCCM	Integrated Community Case Management
ICT	information and communications technology
ID	identification number
IDI	Infectious Diseases Institute
IDRC	Infectious Diseases Research Collaboration
IICS	Integrated Intelligent Computer Systems
IRAP	Industrial Research Assistance Program
IVR	interactive voice response
J&J	Johnson & Johnson
LIS	laboratory information system
M&E	monitoring and evaluation
METS	Monitoring and Evaluation Technical Support
MNCH	maternal, newborn, and child health
MOH	Ministry of Health
MSH	Management Sciences for Health
NGO	nongovernmental organization
NIH	National Institutes of Health
NIISP	National ICT Initiatives Support Program
OpenMRS	open source Medical Record System
OVC	orphans and vulnerable children
PACE	Programme for Accessible Health Communication and Education
PEPFAR	US President's Emergency Plan for AIDS Relief
PMI	President's Malaria Initiative

Annex 1. Abbreviations

Acronym	Definition
PrEP	pre-exposure prophylaxis
ProCCM	Proactive Community Case Management
PSI	Population Services International
PVI	Peripheral Vision International
Sida	Swedish International Development Cooperation Agency
SMS	short message service
TASO	The Aids Support Organization of Uganda
TB	tuberculosis
TMEA	TradeMark East Africa
UAHII	Ugandan Academy for Health Innovation and Impact
UHF	Uganda Healthcare Federation
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCDF	United Nations Capital Development Fund
UNECA	United Nations Economic Commission for Africa
UNFPA	United Nations Population Fund
UNHLS	Uganda National Health Laboratory Services
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USSD	unstructured supplementary service data
VHTs	village health teams
VL	viral load
VSO	Voluntary Service Overseas
WCEA	World Continuing Education Alliance
WFP	World Food Programme
WHO	World Health Organization

Annex 2. Use case definitions

Category	Objective	Functional description
Case management	Systematic processing of suspected infected persons	Systems for documenting patient details and clinical interactions
Contact tracing	Reduction of epidemic reproduction rate	Identification and follow-up with people who have had high-risk interactions with infected persons
Coordination and operations (including emergency operations centers)	Preparedness and response plans, support for multisectoral responses	Systems to support cross-coordination for multisectoral response, emergency operations centers, and executing response plans
Data analytics, visualizations, and use	Efficient and effective response to validated outbreaks	Systems for enabling data-driven decision-making and communications to field teams
Diagnostic tools	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
Event-based surveillance (including rapid response teams, case investigations)	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
Health facility and provider administration	Robust organizational underpinning for response	Systems for managing facility accounting and HR
Infection prevention and control	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
Interoperability	Improve effectiveness of tools	Provision of standardized interfaces to other software modules
Laboratory systems	Validation of infectious disease incidence	Systems with functionality to order lab tests, follow progress of patient sample, receive test results (confirm suspected case)
Learning and training	Support health worker readiness, including improve patient data collection and sample testing	Localized E-learning solutions for health workers and others
One Health	Prevent zoonotic disease outbreaks	Monitoring of potential vectors to humans by tracking infectious diseases in local wildlife and livestock
Points of entry	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
Risk communication and community engagement	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
Routine surveillance	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
Supply chain	Support allocation of resources to aid in response	Systems for monitoring facility readiness and stock levels
Vaccine delivery and planning	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
Plan for vaccine introduction in country	
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.	Messaging
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.	Microplanning
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.	Training
Support vaccine introduction	
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.	Patient monitoring
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.	Supply chain
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.	Vaccine management
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.	

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
Enhance roll-out of vaccine, support ongoing vaccine monitoring 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. 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. 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.	**EIRs** **Supply chain** **Patient monitoring** **Vaccine management**
Enhance communication to sustain vaccine demand 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. 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.	**EIRs** **Messaging** **Patient monitoring**
Use data to inform vaccine-related decisions 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, this publication explains how Gavi and UNICEF are working to scale up use of digital tools for vaccination campaign performance monitoring. 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.	**EIRs** **Patient monitoring** **Supply chain** **Vaccine management**

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.