

# Mapping of Digital Health Tools and Technologies: Sudan Country Brief April 2022





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April 2022

Joint regional mapping of digital health tools and  
technologies for Reproductive, Maternal, Newborn,  
Child and Adolescent Health

WHO EMRO

UNFPA ASRO

UNICEF MENARO

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## Abbreviations and Acronyms

CBIS	Community Based Information System
CDC	Centers for Disease Control
CO	Country Office
COD	Common Operational Datasets
DHA	Digital Health Atlas
DHIS2	District Health Information System 2
DIAL	Digital Impact Alliance
DICE	Digital Health Center of Excellence
DIIG	Digital Implementation Investment Guide
EMR	Electronic Medical Record
EU	European Union
GIS	Geographic Information Systems
HMIS	Health Management Information System
INGO	International Non-governmental Organization
LMIS	Logistics Management Information System
MOH	Ministry of Health
NGO	Non-governmental organization
ODK	Open Data Kit
RCCE	Risk Communication and Community Engagement
RMNCAH	Reproductive, Maternal, Newborn, Child, and Adolescent Health
RO	Regional Office
UN	United Nations
UNFPA	United Nations Population Fund
UNICEF	United Children's Fund
USAID	United States Aid
WHO	World Health Organization

## Overview

### Introduction

Sudan is the third-largest country in Africa and has a population of over 40 million. Sudan's children make up half of the total population and the past two decades have seen their lives improve. Fewer boys and girls are dying before their first birthday. Immunization coverage is high and the country remains polio-free. Primary school attendance is increasing. Still millions of children continue to suffer from chronic conflict, seasonal natural disasters and disease outbreaks, and under-investment in basic social services.

In 2005, the Ministry of Health (MOH) through the World Health Organization (WHO) requested the drafting of a [National eHealth Strategy for Sudan](#). The study has been conducted for drafting the strategy and it identified several priorities requests: 1) development of a national health information platform, 2) development of a national health care management information to support day-to-day health care services, 3) extension of the National Telemedicine Network, 4) development of a national health data dictionary for standards of data and related procedures, and 5) enforcement of digital security. Since then a few digital health tools have been implemented throughout the country, some of them with the support of the MOH. However, digital health is still nascent and it would benefit from the guidance and legal framework that a digital health strategy can provide before continuing to grow and develop.

The current COVID-19 pandemic has only more acutely brought forth the urgency of the presence of a strong and integrated digital health ecosystem. It has also brought forth the urgency of the presence of a strong and integrated digital health ecosystem because this pandemic has necessitated the use of alternative mechanisms for delivering essential Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCAH) and reaching the affected populations. The need to reduce unnecessary face-to-face contact with health care providers and the increased demand for many innovations that could offer safer and better-quality health services has been increasing.

From the perspective of RMNCAH, the aim of this mapping is to chart and review the situation on the use of digital solutions in RMNCAH program implementation, utilization, and provision of RMNCAH services and its enabling environments such as digital health infrastructure in the member states of WHO Eastern Mediterranean Region (also including countries covered by UNFPA Arab States Regional Office (ASRO) and UNICEF Middle East and North Africa Regional Office (MENARO)) and to find about opportunities for effective adoption, integration, and scale-up of digital solutions in RMNCAH so that women, mothers, newborn babies, children, and adolescents can reach and utilize essential RMNCAH services and health care providers can provide those services effectively and efficiently while they protect their own safety in the context of COVID-19 and beyond. Following this overview, this report presents the digital health tools that are in use in Sudan with details of their usage and scale, and, where available, information about implementing agencies, donors, etc; briefly presents the enabling environment for digital health in Sudan; a proposed path forward; and a word of acknowledgement. The report concludes with appendices that provide additional resources and information.

### Methodology and Analysis Overview

A joint regional questionnaire for mapping has been developed based on the UNICEF Digital Health Mapping tool, WHO AFRO "Understanding the use of digital health for mitigating the effects of COVID-19 on continuity of essential SRMNCAAH services" and Global Digital Health Index.

The main sources of information are the personnel working at each WHO/ UNFPA/ UNICEF country office along with other main actors and champions in the field of digital health in the country including the Ministry of Health. The questionnaire has been sent out from UNICEF MENARO focal point on behalf of three organizations to the country focal points (RMNCAH and digital health). At the country level, one focal point should be assigned as a team lead to follow up the process. The country office colleagues communicate internally and among the organizations before jointly reaching out to the Ministry of Health about this mapping. The county could choose 1) doing an online interview with all relevant stakeholders (UNICEF HQ and MENARO conduct the interview), 2) filling out the questionnaire by all relevant stakeholders using a face-to-face meeting (including relevant technical working group) or 3) filling out the questionnaire shared online. The content should be answered, reviewed and endorsed by the Ministry of Health, WHO, UNFPA, UNICEF and other relevant stakeholders in the country.

Sudan has opted out for option 3) and the self-assessment questionnaire was filled out by colleagues at UNICEF Sudan's country office (CO), United Nations Population Fund (UNFPA) Sudan's CO, and WHO Sudan's CO during August and September 2021. The information gathered was supplemented with data (when available) from the World Bank's Digital Health Landscaping assessment, the [Map & Match exercise](#) by Digital Square, the [Digital Health Atlas](#) (DHA), [INVENT](#), and the [Digital Impact Alliance \(DIAL\) Catalog of Digital Solutions](#). The collated data was entered in the [Mapping of Digital Health Tools and Technologies tool](#).

There are 10 digital health implementations currently being used in Sudan. Two are implemented at the national level and the other eight are implemented at the subnational level. None of these tools are bespoke (custom made) but two of them (DHIS2 and RapidPro) are considered [global digital public goods](#).

### Strengths

- The implementation and use of DHIS2 seem to have significant support from the MOH and other international organizations which could help establish a strong foundation from which to continue to grow digital health.
- All the tools and solutions being used are well-established digital health tools (as opposed to having multiple bespoke tools) which may make it easier in the future to scale up and foster interoperability.

### Gaps

- Only two tools (DHIS2 and U-Report) are used on a national scale. The remaining tools are either used in localized areas or are pilots. Analyzing and understanding if the tools being used at the subnational level should be scaled up and strengthened should be a priority before seeking to implement new tools or solutions.
- A digital health strategy or a guiding document on digital health could provide a clear path forward in regards to digital health before the field grows too fragmented and siloed.
- It is acknowledged that the mapping tool reflects the knowledge of the stakeholders included in the interview(s) and self-assessment and maybe excludes systems not known to them. It would be imperative to engage with all organizations operating in the health space for a more comprehensive view.

### Opportunities

- Explore the need and define the potential benefits and added value of developing a digital health strategy for Sudan as the digital health landscape continues to grow, particularly within the COVID -19 evolving context.
- Before deploying new tools, study the potential benefits global digital public goods may have over bespoke (custom made) or proprietary software to ensure interoperability and scalability.
- Continue to invest in human resources capacity, relevant infrastructure, and the overall enabling environment to establish a more robust foundation for the digital health ecosystem to grow.
- Foster coordination with other UN agencies, INGOs, and entities engaged in digital health interventions as well as with the MOH to ensure a more comprehensive mapping of the digital health ecosystem

## Digital Health Tools and Technologies

National	Subnational
<ul style="list-style-type: none"> <li>• <a href="#">DHIS2</a></li> <li>• <a href="#">U-Report</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">mSupply</a></li> <li>• <a href="#">Vaccination Supplies Stock Management (VSSM)</a></li> <li>• <a href="#">ICE3 and COLDCLOUD Platform</a></li> <li>• <a href="#">Berlinger</a></li> <li>• <a href="#">QGIS</a></li> <li>• <a href="#">R</a></li> <li>• <a href="#">Sudan NEMO</a></li> <li>• <a href="#">THINKMD</a></li> </ul>

Digital Health Tool	DHIS2
<b>Description</b>	<p>DHIS2 is used as a national health information system platform for integrated data management and analysis for program monitoring and evaluation in 70+ countries. It is primarily used for reporting and analysis of routine health data; but also serves as a de facto facility registry, can be deployed for service availability mapping and other periodic survey activities, and as a data warehouse to facilitate integrated analysis. Increasingly, it is also used as a 'last-mile' solution for logistics monitoring, particularly at the health facility level.</p> <p>DHIS2 comes with three data models 1) aggregate, 2) single events (e.g. for line-listing data), and 3) longitudinal tracking of any entity (patient or otherwise) over time. The core DHIS2 software includes several web apps for data capture, analysis, reports, maintenance, user management, data quality, etc. The tracker model supports use cases such as case-based surveillance and patient follow-up; it can be used in tandem with other data models. In addition, an Android app is a core component of the platform to enable out-of-the-box mobile data collection with no interoperability layers required. A DHIS2 Android Software Development Kit (SDK) enables developers to customize mobile application interfaces that integrate natively with DHIS2, supporting all three data models (aggregate, event, tracker). DHIS2 is entirely generic and configurable through a web interface, which means it can be used for any number of</p>

	<p>use cases.</p> <p>In Sudan, there are ongoing implementations and further training for both <a href="#">DHIS2</a> and <a href="#">DHIS2 for COVID-19 Surveillance</a>.</p>
<b><u>Current Use Case(s)</u></b>	Health Management Information System (HMIS), Community Based Information System (CBIS), Master Facility Registry, Data Visualization
<b>Scale</b>	National
<b>Implementer(s)</b>	MoH, John Snow, Inc. (JSI)
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	<a href="https://dhis2.org/">https://dhis2.org/</a>
<b>Covid-19 Specific Functions</b>	<p><a href="#">Digital packages for COVID-19</a> capitalize on the core functionality of DHIS2 and the DHIS2 Android Capture app to support COVID-19 surveillance and response activities. COVID-19 metadata packages are modular in nature and can be installed together or separately in a country's DHIS2 system.</p> <p>COVID-19 Case-based surveillance [tracker data model]: enrolls &amp; tracks suspected cases; captures symptoms, demographics, risk factors &amp; exposures; creates lab requests and captures laboratory data about the case; links confirmed cases with contacts, and monitors patient outcomes. This package can be installed as a standalone COVID-19 form or can be integrated into a country's existing integrated disease surveillance &amp; response tracker.</p> <p>Contact registration &amp; follow-up program [tracker data model]: strengthens active case detection through contact tracing activities, such as identification and follow-up of contacts of a suspected or confirmed COVID-19 case.</p> <p>Ports of Entry screening &amp; follow-up program [tracker]: enrolls travellers who have visited high-risk locations at Ports of Entry for 14-day monitoring and follow-up.</p> <p>COVID-19 Surveillance Event Program [event]: a simplified line-list that captures a subset of minimum critical data points to facilitate rapid analysis &amp; response, particularly useful when caseloads or burden of reporting exceeds capacity for a case-based surveillance tracker.</p> <p>COVID-19 Aggregate Surveillance [aggregate]: an aggregate reporting dataset that captures minimum necessary data points for daily or weekly reporting.</p> <p>Core DHIS2 functionality to support COVID-19 includes longitudinal tracking of suspected and confirmed COVID-19 cases (through Tracker data model), line-listing (through Event data model), alerts &amp; notifications (e.g. thresholds), working lists, DHIS2 Android App for seamless mobile</p>

	data capture, automated dashboards, on-the-fly calculation of key indicators and data-push features for exporting and sharing COVID-19 data.
<b>RMNCAH Functions</b>	<p>RMNCAH indicators are collected monthly at the local level and quarterly at the state and national levels. This collection is supported by UNFPA, WHO and UNICEF.</p> <p>The following indicators are collected through the HMIS:</p> <ul style="list-style-type: none"> <li>● Number of live births</li> <li>● Number of maternal deaths</li> <li>● Number of pregnant women and adolescent girls who attended 1st ANC</li> <li>● Number of pregnant women and adolescent girls who attended 4th ANC</li> <li>● Number of total deliveries</li> <li>● Number of delivery with cesarean section</li> <li>● Neonatal mortality rate/ number of newborn deaths</li> <li>● Number of newborns who received early postnatal care in first 48 hours</li> <li>● Under-five mortality rate/ number of under-five deaths</li> <li>● Number of children under 5 with diarrhoea who received treatment according to national guidelines</li> <li>● Number of children under 5 diagnosed with pneumonia that were treated with amoxicillin</li> </ul>
<b>Digital Health Tool</b>	<b>mSupply</b>
<b>Description</b>	<p>mSupply is a pharmaceutical supply chain management software primarily used by developing nations around the world. mSupply is designed from the ground up with pharmaceutical warehouses, stores and hospital dispensaries in mind.</p> <p>In Sudan, the most pressing task was to increase efficiency and minimize the risk of wastage and stock-outs for the storage and deliveries for HIV, Malaria, and TB programs. Akesis collaborated with major stakeholders to design an agile supply chain system capable of delivering the right quality products in the right quantity, to the right place, at the right time, and at costs suitable to the programs. The new system included updated SOPs for computerization management of stock, forecasting and quantification, and an effective delivery system for commodities. More on how mSupply is implemented in Sudan can be found <a href="#">here</a>.</p>
<b><u>Current Use Case(s)</u></b>	Logistics Management Information System (LMIS)
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	Akesis (previously the Axios Foundation), the Central Medical Supplies Corporation, the Sudan National Malaria Control Program, the Sudan National AIDS Program, and the Sudan National Tuberculosis Program.
<b>Donor(s)</b>	-
<b>Licensing</b>	Proprietary

<b>Website</b>	<a href="https://msupply.org.nz/">https://msupply.org.nz/</a>
<b>Covid-19 Specific Functions</b>	mSupply features multiple tools to support vaccination programs, including COVID-19 vaccination efforts: mSupply Desktop, mSupply Mobile, mSupply ColdChain, mSupply Dashboard, and mSupply Synchronization. mSupply has been used for patient registration, stock management, vaccination distribution and stock management, and data visualization by countries during their COVID-19 vaccination campaigns. A presentation of the COVID-10 related work can be seen <a href="#">here</a> .
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>Vaccination Supplies Stock Management (VSSM)</b>
<b>Description</b>	Vaccination Supplies Stock Management (VSSM) is an inventory management tool whose overarching goal is to improve management of the supply chain so that vaccines and diluents and other related commodities neither suffer from being overstocked and avoid that any item is out of stock. It provides 40 different reports to help program managers to plan ahead and have up-to-date information about all stock levels for all items in the stores. It also provides the managers with a remaining net capacity for different storage areas.
<b><u>Current Use Case(s)</u></b>	Immunization Stock Forecasting
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	-
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	-
<b>Covid-19 Specific Functions</b>	-
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>ICE3 and COLDCLOUD Platform</b>
<b>Description</b>	<p>The ICE<sup>3</sup>'s dual-SIM design with global SIM card with data included gives it complete network redundancy anywhere in the world without the need for physical network infrastructure. The ICE<sup>3</sup>'s off-the-grid design makes it completely immune to damage from electrical spikes, surges, and blackouts. This is advantageous in parts of the world where power supply can be both unreliable and dirty.</p> <p>ColdCloud is a state-of-the-art web-based online cold chain management platform, which requires no software or physical infrastructure. All you need is an internet connection. The ICE3 and ICE3 Extra remote temperature monitoring devices log and monitor the temperatures, door positions, and power supply status of your refrigerators. This data is</p>

	uploaded via the local cellular network to the internet ColdCloud where users can view and download the data as well as configure alarms, so that should the temperatures deviate outside the specified range, or if a door is left open for too long, or even if the power fails, the right people are immediately notified, by both email and SMS.
<b><u>Current Use Case(s)</u></b>	Cold Chain Monitoring
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	Beyond Wireless
<b>Donor(s)</b>	-
<b>Licensing</b>	Proprietary
<b>Website</b>	<a href="https://beyondwireless.com.au/">https://beyondwireless.com.au/</a>
<b>Covid-19 Specific Functions</b>	-
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>Berlinger</b>
<b>Description</b>	External thermometer and alarm system for refrigerators and freezers used to store vaccinations.
<b><u>Current Use Case(s)</u></b>	Cold Chain Monitoring
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	-
<b>Donor(s)</b>	-
<b>Licensing</b>	Proprietary
<b>Website</b>	<a href="https://www.berlingerusa.com/">https://www.berlingerusa.com/</a>
<b>Covid-19 Specific Functions</b>	-
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>QGIS</b>
<b>Description</b>	A Geographic Information System is a software for viewing data with a spatial reference for real-world viewing, mapping, and analysis. The primary segment of the data seen in a GIS is its spatial component – i.e. where is it on earth? Each piece of data will also contain non-spatial data known as attribute data. Attribute data is generally defined as additional information about a spatial feature, for example, a government building. The actual location of the government building is the spatial data. The attribute data includes the building name, the number of floors in the

	building, the government departments that use the building when it was built etc. GIS is now commonly used in many aspects of our day-to-day lives. For example, Google Maps on our phones to find an address is a type of GIS.
<b><u>Current Use Case(s)</u></b>	Geographic Information System Mapping (GIS)
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	-
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	<a href="https://qgis.org/en/site/">https://qgis.org/en/site/</a>
<b>Covid-19 Specific Functions</b>	The widespread use of GIS for COVID-19 response has demonstrated the power of geospatial thinking and the scalability, speed, and insight provided by GIS. More than simply mapping phenomena, GIS uses geography to furnish context for events in a common reference system. Applying spatial analysis tools, GIS brings out the relationships, patterns, and associations that are often hidden by the complexity of data. More information on the possible uses of GIS technology for COVID-19 can be found <a href="#">here</a> .
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>R</b>
<b>Description</b>	R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and macOS.
<b><u>Current Use Case(s)</u></b>	Geographic Information System Mapping (GIS)
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	-
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	<a href="https://www.r-project.org/">https://www.r-project.org/</a>
<b>Covid-19 Specific Functions</b>	-
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>Sudan NEMO</b>
<b>Description</b>	NEMO is a server software that provides a user-friendly portal accessible as a website through a web browser. When logged into the server, the

user can design survey forms using a simple and intuitive process that does not require an understanding of XML code (interpreted by Open Data Kit Collect). The user then can publish the forms as XML to make them accessible to Android tablets that connect to the NEMO server using the administratively assigned secure credentials of the tablet user. After collection and submission of completed survey responses, the NEMO portal also allows for aggregating response data to build and export data sets and generate reports that can be saved in the user portal like a dashboard.

One of the primary uses in Sudan is for district-level health surveys throughout different regions of the country. More information [here](#).

<b><u>Current Use Case(s)</u></b>	Open Data Kit (ODK)
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	The Carter Center
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	<a href="https://getnemo.org/">https://getnemo.org/</a>
<b>Covid-19 Specific Functions</b>	-
<b>RMNCAH Functions</b>	-

Digital Health Tool	U-Report
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**Description** U-Report is an open-source mobile messaging program managed at the country-level by UNICEF alongside youth and NGO partners. Launched in 2011, it is free to the user and in 2019 has a worldwide footprint in 55 countries. U-Report encourages participation through the very social media channels young people already use, plus SMS, in the safest way. It gives young people and their communities a voice on issues that matter to them. Collected as 'data' these voices are analyzed in real-time and applied to informing development work and amplified to advocate and inform positive change through decision making. As well as collecting their views and feedback, information relevant to all UNICEF's Goal Areas is shared back with U-Reporters in an effort to improve or save young people's lives through access to accurate and engaging content. Data is mapped at the local level and compiled nationally. Results are displayed on a public website in aggregate for transparent and safe access by age, gender and location. U-Report is anonymous and completely transparent. UReport has reached over 6.5 million users in 55 countries, with more countries scheduled to launch and a new U-Reporter joining every thirty seconds.

In Sudan, SMS polls and alerts are sent out to U-Reporters and real-time response information is collected. Results and ideas are shared back with the community. Issues polled include among others health,

	education, water, sanitation and hygiene, youth unemployment, HIV/AIDS, disease outbreaks; social welfare sectors. Data received can be disaggregated by age, gender, and district in real-time. Registration is voluntary with SMS, Facebook or Twitter, free to the users across all networks. U-Report is an innovation-based, user-centred social monitoring tool based on simple Short Message Service (SMS) messages (poll questions, results, and sharing of useful information) designed to strengthen community-led development, citizen engagement and positive change.
<b><u>Current Use Case(s)</u></b>	RapidPro for Health, RapidPro for Education, Social Monitoring
<b>Scale</b>	National
<b>Implementer(s)</b>	UNICEF
<b>Donor(s)</b>	-
<b>Licensing</b>	Open Source
<b>Website</b>	<a href="https://www.unicef.org/innovation/U-Report">https://www.unicef.org/innovation/U-Report</a>
<b>Covid-19 Specific Functions</b>	In February 2020 the U-Report for Humanitarian Action initiative, a joint effort of Office of Innovation, Programme division, Communication for development and Office of Emergency programmes developed a U-Report Information chatbot to support COVID-19 Risk Communication and Community Engagement (RCCE). As of 20th June 2020, U-Report's Covid-19 bot has been accessed by over 6 million people, across 52 countries, with over 7 million interactions and, with over 20 million young people and communities engaged on COVID-19 through U-Report. More information on the use of U-Report for COVID-19 can be found <a href="#">here</a> .
<b>RMNCAH Functions</b>	-
<b>Digital Health Tool</b>	<b>THINKMD</b>
<b>Description</b>	<p>THINKMD was founded by physicians from the University of Vermont Larner College of Medicine committed to developing disruptive solutions to improve quality healthcare for everyone, everywhere. The company's mission is to eliminate preventable deaths by combining next-generation digital clinical intelligence logic with mobile technology in order to dramatically increase global primary healthcare capacity and improve access by decentralizing the healthcare delivery paradigm. Our team includes clinicians, engineers, data scientists, finance, and global health specialists. We utilize an integrative patient-centric approach to develop novel technology to change healthcare delivery and leverage critical public health data that will improve clinical decisions, disease, and population surveillance, healthcare monitoring and evaluation globally.</p> <p>In Sudan, the MEDSINC platform is currently being implemented by Medical Assistants working in community clinics within East and West Darfur. Medical Assistants can triage and treat incoming patients. Through the use of THINKMD's platform, Medical Assistants can automatically record all patient interactions; automatically generate</p>

	<p>triage, treatment and follow-up recommendations; monitor their workforce; monitor each facilities' patient flow; track population health; report to the Ministry of Health. More information can be found <a href="#">here</a> and <a href="#">here</a>.</p>
<b>Current Use Case(s)</b>	Capacity Building
<b>Scale</b>	Subnational
<b>Implementer(s)</b>	American Refugee Committee
<b>Donor(s)</b>	-
<b>Licensing</b>	Proprietary
<b>Website</b>	<a href="https://thinkmd.org/">https://thinkmd.org/</a>
<b>Covid-19 Specific Functions</b>	<p><a href="#">THINKMD has released a COVID-19 screening and educational tool</a> that guides users through a COVID-19 self-risk assessment. It is based on the latest published peer-reviewed WHO and CDC clinical data on presenting signs, symptoms and risk factors. Each personal assessment determines if an individual has none, some or many of the clinical symptoms and presenting features associated with COVID-19. The tool also provides an individual with WHO and CDC educational information on how and when to seek medical care and recommended protective and preventive measures.</p>
<b>RMNCAH Functions</b>	-

### Auxiliary tools

Tool	Common Operational Datasets (COD)
<b>Description</b>	<p>CODs are authoritative reference datasets used to support operations and decision-making in the initial response to humanitarian emergencies as well as to enable activities such as micro-planning. Frequently collected and used CODs are geographical shapefiles, health facility catchment areas, settlements, population estimates, satellite imagery, and ancillary geospatial layers.</p>
<b>Current Use Case(s)</b>	Common Operational Datasets
<b>Scale</b>	National
<b>Access to CODs</b>	<a href="#">Sudan's CODs</a>

Tool	SMS Aggregator
<b>Description</b>	<p>SMS aggregators act as a buffer between wireless carriers and SMS software providers.</p> <p>In Sudan, this is used during vaccination campaigns.</p>

<b><u>Current Use Case(s)</u></b>	Core Mobile Services
<b>Scale</b>	National
<b>Implementer</b>	MOH

<b>Tool</b>	<b>TV</b>
<b>Description</b>	TV is used for health messaging and/or risk communication and community engagement.
<b><u>Current Use Case(s)</u></b>	Traditional Media, RCCE
<b>Scale</b>	National
<b>Implementer(s)</b>	MOH

## Enabling Environment

### Infrastructure

- There is no stable electricity in Sudan. Electricity coverage is limited and the supply is not stable. Currently, there are programmed cut-offs of electricity for up to 8 hours per day.
- There is no stable and good connectivity to a fixed broadband internet connection. A significant challenge is the geographical coverage needed for Sudan (the third-largest country in Africa).
- Household subscriptions to fixed broadband internet are almost non-existent while a mobile broadband subscription to the internet is more common (42% of the population). However, only 19% of the population reportedly use the internet. This could be because many users have dual SIM-card devices. Male vs female use of the internet is 17% vs 11%. More information can be found [here](#).
- Subscriptions to mobile phone services are 80% which may allow SMS-based digital health interventions to gain more traction in Sudan than internet-based digital health interventions.
- In general, it is challenging to buy or renew a cellular or smartphone due to lack of affordability and currency devaluation.

### Leadership and Governance

- There is no national digital health governance framework, digital health strategy, technical working group, or task force in place in Sudan. The protracted political, financial, and humanitarian crisis makes it difficult to move forward in this regard.

### Legal Framework for Data Protection and Security

- There are no mechanisms in place to ensure the privacy and security of data and information. The protracted political, financial, and humanitarian crisis makes it difficult to move forward in this regard.

### Laws or Regulations for Privacy, Confidentiality, and Access to Health Information

- There are some laws to protect individual privacy, governing ownership, and access and sharing of individually identifiable digital health data.

### Mechanism to monitor/ measure the implementation of digital solutions on RMNCAH including specific indicators

- There are no mechanisms to monitor or measure the implementation of digital health solutions for RMNCAH including frameworks or specific indicators.

## The Way Forward

Sudan has been implementing 10 digital health tools. The mapping exercise explores a part of seven key categories of the enabling environments recommended by the Global Digital Health Index: Leadership and governance, Legislation, Policy, and Compliance, and Infrastructure.

In terms of Infrastructure, the situation in Sudan is not optimal as there is no stable electricity and connectivity and geographical coverage are limited. However, subscriptions to mobile phone services are 80% which may allow SMS-based digital health interventions to gain more traction in Sudan than internet-based digital health interventions.

With the protracted crisis making the situation more difficult, there seems to be no clear strategy, framework or governing bodies for digital health. For a way forward, the key categories of the enabling environment should be strengthened especially Leadership and Governance, Strategy and Investment, and Legislation, Policy, and Compliance as the study in 2015 showed the need for standards, security, confidentiality and legislation. A national digital health strategy is needed to set up a direction, explore where to invest, to ensure standards and interoperability of digital health tools to avoid fragmentation and siloed implementations as the existing digital health tools are scaled up or more digital health tools are deployed.

The currently available digital health tools have been addressing several health system challenges: information, availability, quality, acceptability, efficiency and accountability (Table 2). However, the level of implementation of these digital health tools is mostly subnational (Table 2). Those subnational digital health tools should be assessed and whether they should be scaled up nationwide. When scaling up, the use of global digital public goods should be considered to reduce the cost and ensure interoperability in future, especially with those already being used nationwide with global public goods (DHIS2 and RapidPro).

Currently, the thematic areas addressed by digital health tools are limited to immunization, public or humanitarian emergencies and risk communication and community engagement. Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH) services and care should be integrated ideally from the initial stage. The Health Management Information System has already included the indicators for RMNCAH and they should be integrated into the country's nationwide implementation of DHIS2. Health workforce needs to be trained on collecting, reporting and analysing data in HMIS/ DHIS2. As subscriptions to mobile phone services are 80% which may allow SMS-based digital health intervention, U Report/ RapidPro could also be utilised to engage with the pregnant and lactating women, caregivers, and adolescents to empower them. A study in 2015 has shown that there is a Telemedicine Network, however, this mapping exercise does not reveal much information on this network, however, this could address the issues related to access and demand of health services and cares with quality and it should be explored along with the available infrastructure and risk management and community engagement.

Figure1. Key seven categories of the enabling environment



Table 1. Health system challenges possibly addressed by digital health tools

Health system challenges	Digital health tools	Levels of implementation
Information	DHIS2 (Global public goods) COD QGIS (Open source) R (Open source) NEMO (Open source)	National National Subnational Subnational Subnational
Availability	mSupply VSSM (Open source) ICE3&COLDCLOUD Berlinger	Subnational Subnational Subnational Subnational
Quality	VSSM ICE3&COLDCLOUD Berlinger THINKMD	Subnational Subnational Subnational Subnational
Acceptability	U Report (RapidPro) (Global public goods)	National
Utilisation		
Efficiency	THINKMD	Subnational
Cost		
Accountability	U Report (RapidPro) (Global public goods)	National

Table 2. Thematic areas and use of digital health tools

Thematic areas	Sudan
Communicable disease	mSupply
Immunization	VSSM ICE3&COLDCLOUD platform Berlinger
Public Health Emergency & humanitarian emergencies	COD

Risk Communication and Community Engagement	U Report (RapidPro)
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In addition to this, recently UNICEF and the World Health Organization (WHO) have co-founded the COVID-19 [Digital Health Center of Excellence \(DICE\)](#) to provide coordinated, standardized support and technical assistance to national governments and partners on digital health implementations and solutions, including COVID-19, COVID-19 vaccine delivery, and beyond. If you would like to request support from the DICE, please write to [contact@digitalhealthcoe.org](mailto:contact@digitalhealthcoe.org).

## Appendix: Use Case Definitions

Use Case	Description
<b>Civil Registration and Vital Statistics (CRVS)</b>	Digital systems used to record statistics on vital events, such as births, deaths, marriages, divorces, and fetal deaths
<b>Cold Chain Equipment Inventory</b>	Technology to continually keep track of cold chain equipment status (inventory and working status)
<b>Cold Chain Monitoring</b>	Technology to continually monitor temperature-sensitive products being transported in a “cold chain”—that is, a supply chain of perishable and/or temperature-sensitive
<b>Common Operational Datasets</b>	Authoritative reference datasets needed to support operations and decision-making for all actors in a humanitarian response.
<b>Community Based Information System (CBIS)</b>	Family-centered health information system designed for CHWs to manage their work in educating households and delivering an integrated package of promotive, preventive, and basic curative health services
<b>Comorbidity Registry</b>	The presence of comorbidities can significantly affect a patient's treatment options, quality of life, and survival. Comorbidity registries keep track of comorbidities which help inform medical decisions
<b>Contact Tracing</b>	Contact tracing is the process of identifying all people that a positive patient has come in contact with
<b>Core Mobile Services</b>	Services used by GSM cellular phones (feature phones) (SMS Aggregator, SMS Shortcode, IVR Shortcode, USSD Services)
<b>Data Visualization</b>	Digital tools used for graphical representation of information and data
<b>Digital Yellow Card</b>	Digital credentialing for vaccinations
<b>Electronic Medical Record (EMR)</b>	Electronic record for patients - includes information about a patient's health history, such as diagnoses, medicines, tests, allergies, immunizations, and treatment plans
<b>Geographic Information System</b>	Framework for gathering, managing, and analyzing data
<b>Health Management Information Systems (HMIS)</b>	Data collection system to support planning, management, and decision making in health facilities and organizations. It can provide reliable and timely info on health system performance
<b>Health Worker Registry</b>	A registry of all the health workers in the country
<b>Immunization Delivery Monitoring</b>	Digital tools that are used for vaccine handling, distribution, and tracking of vaccines
<b>Immunization Forecasting</b>	The Immunization Calculation Engine (ICE) is an immunization evaluation and forecasting system, whose default immunization schedule supports all routine childhood, adolescent, and adult immunizations. ICE evaluates a patient's immunization history and generates the appropriate immunization recommendations for patients

<b>Immunization Stock Forecasting</b>	System or platforms that can forecast vaccine orders based on utilization which can enable COs to identify risks of stock outs or overstocking and take action before they occur
<b>Interactive Voice Response (IVR)</b>	Automated phone system technology that allows incoming callers to access information via a voice response system of pre-recorded messages
<b>Laboratory and Diagnostics Information Systems (LDIS)</b>	Software system that records, manages, and stores data for laboratories and can send laboratory test orders to lab instruments, tracking those orders, and then recording the results
<b>Logistics Management Information System (LMIS)</b>	System of records and reports used to aggregate, analyze, validate, and display data (from all levels of the logistics system) that can be used to make logistics decisions and manage the supply chain. Includes stock on hand, losses and adjustments, consumption, demand, issues, shipment status, and information about the cost of commodities managed in the system
<b>Master Facility Registry</b>	Comprehensive repository of health facilities of the country - would include all admin information and the status of the facility, staff, CCes, etc.
<b>Mobile Community Health Worker Learning Management System (CHW LMS)</b>	Learning management systems functioning in the country for community health workers
<b>National ID</b>	Digital national identity systems
<b>Patient Registry</b>	A patient registry is an organized system that uses observational study methods to collect uniform data (clinical and other) to evaluate specified outcomes for a population defined by a particular disease, condition, or exposure, and that serves one or more predetermined scientific, clinical, or policy purposes.
<b>Pharmacy Information System</b>	Supports the distribution and management of drugs, shows drug and medical device inventory, and facilitates preparing needed reports
<b>Public Health and Disease Surveillance</b>	Contributes data and information to assess and characterize the burden and distribution of adverse health events, prioritize public health actions, monitor the impact of control measures, and identify emerging health conditions that may have a significant impact upon population health
<b>RapidPro</b>	RapidPro is a software product that allows you to visually build the workflow logic for running mobile-based services. This software includes features for managing your users' contacts dynamically, graphically analyzing the data your service receives, connecting to multiple communication channels (ie SMS, voice, USSD, and social media), sending messages in multiple languages, and interoperating with external systems

<b>Social Media for Risk Communication and Community Engagement (RCCE)</b>	Utilization of social media for health messaging dissemination
<b>Social Monitoring</b>	Capture of what is said in social media platforms
<b>Telemedicine</b>	Platform used by providers to connect with patients and share video and images. It can be integrated with a provider's electronic health record and scheduling systems
<b>Track and Trace System</b>	Track and Trace systems enable the traceability/visibility of products from origin through various distribution processes down to patient
<b>Traditional Media</b>	Traditional media that may be used for outreach and messaging (TV, radio, other)

## Additional Resources

Resources	Description	Website
Mapping of Digital Health Tools and Technologies in Countries (View only)	This workbook indicates the presence of tools and digital technologies being used for health initiatives and other sectors in UNICEF Country Offices (COs)	<a href="http://uni.cf/mapping-digital-health">http://uni.cf/mapping-digital-health</a>
M&M Global goods possible use cases	This document provides a list of Digital Square approved global goods mapped across the use cases visualized in the DATEC. The global goods are grouped by those that have already been adapted to match a use case and those that could be adapted to match a use case (i.e., simple, easy, low-lift adaptations).	<a href="https://static1.squarespace.com/static/59bc3457ccc5c5890fe7caccd/t/60522885399dca3568666606/1615997063979/Global+Goods+COVID+Map.pdf">https://static1.squarespace.com/static/59bc3457ccc5c5890fe7caccd/t/60522885399dca3568666606/1615997063979/Global+Goods+COVID+Map.pdf</a>
Digital Implementation Investment Guide (DIIG): Integrating Digital Interventions into Health Programmes	This practical guide provides a systematic process for countries to develop a costed implementation plan for digital health within one or more health program areas, drawing guidance from the WHO guideline-recommended digital health interventions, providing direction to ensure investments are needs-based and contribute effective and interoperable systems aligned with national digital architecture, country readiness, health system and policy goals.	<a href="https://www.who.int/publications/item/9789240010567">https://www.who.int/publications/item/9789240010567</a>
Digital Health Atlas	The Digital Health Atlas is a WHO global technology registry platform aiming to strengthen the value and impact of digital health investments, improve coordination, and facilitate institutionalization and scale.	<a href="https://digitalhealthatlas.org/en/-/">https://digitalhealthatlas.org/en/-/</a>
Global Digital Health Index Country Profile	The Global Digital Health Index is an interactive digital resource that tracks, monitors, and evaluates the use of digital technology for health across countries.	<a href="http://index.digitalhealthindex.org/map">http://index.digitalhealthindex.org/map</a>

<p>Assessing country readiness for COVID-19 vaccines</p>	<p>The country readiness assessments for COVID-19 vaccines are undertaken jointly by governments; the World Bank; Gavi, the Global Vaccine Alliance; the Global Fund to Fight AIDS, Malaria and Tuberculosis; UNICEF and the World Health Organization. This report presents initial findings of 128 countries as of March 2021</p>	<p><a href="https://documents1.worldbank.org/curated/en/467291615997445437/pdf/Assessing-Country-Readiness-for-COVID-19-Vaccines-First-Insights-from-the-Assessment-Rollout.pdf">https://documents1.worldbank.org/curated/en/467291615997445437/pdf/Assessing-Country-Readiness-for-COVID-19-Vaccines-First-Insights-from-the-Assessment-Rollout.pdf</a></p>
<p>DICE Website</p>	<p>The Digital Health Centre of Excellence - or DICE - is a mechanism to deliver agile and coordinated technical assistance to National Governments on sustainable and scalable deployment of carefully chosen mature digital health solutions that address health priorities in the context of the COVID-19 pandemic and post-pandemic health systems needs</p>	<p><a href="https://www.digitalhealthcoe.org/">https://www.digitalhealthcoe.org/</a></p>
<p>DICE's YouTube Channel</p>	<p>DICE's YouTube Channel where past webinars can be accessed</p>	<p><a href="https://www.youtube.com/channel/UCi--Kf5uVzYv-unxv7DqR9g/featured">https://www.youtube.com/channel/UCi--Kf5uVzYv-unxv7DqR9g/featured</a></p>
<p>UNICEF's Sudan Site</p>	<p>UNICEF's Sudan's information page</p>	<p><a href="https://www.unicef.org/sudan/">https://www.unicef.org/sudan/</a></p>
<p>ITU Digital Development Dashboard for Sudan</p>		<p><a href="https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx">https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx</a></p>