USE OF
DIGITAL TOOLS
TO STRENGTHEN
COVID-19 MANAGEMENT

RWANDA
CASE STUDY

MAY 2021

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This case study was written by the Foundation for Innovative New Diagnostics based on inputs from the Rwanda Biomedical Centre and the Rwanda Information Society Authority.

INTRODUCTION

Rwanda registered its **first case of COVID-19** 14 March 2020, and...

... as of 14 March 2021, had diagnosed over **20 000 cases**, with a mortality rate of 1.4%

The sharpest peak in cases was seen in late 2020/early 2021 (**Figure 1**), prompting stringent restrictions on movement that led to a rapid decline in the number of new cases

As of April 2021, over **1.3 million people** have been tested for COVID-19 in Rwanda

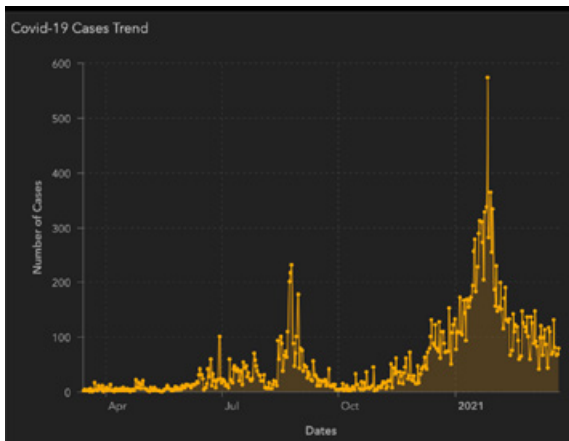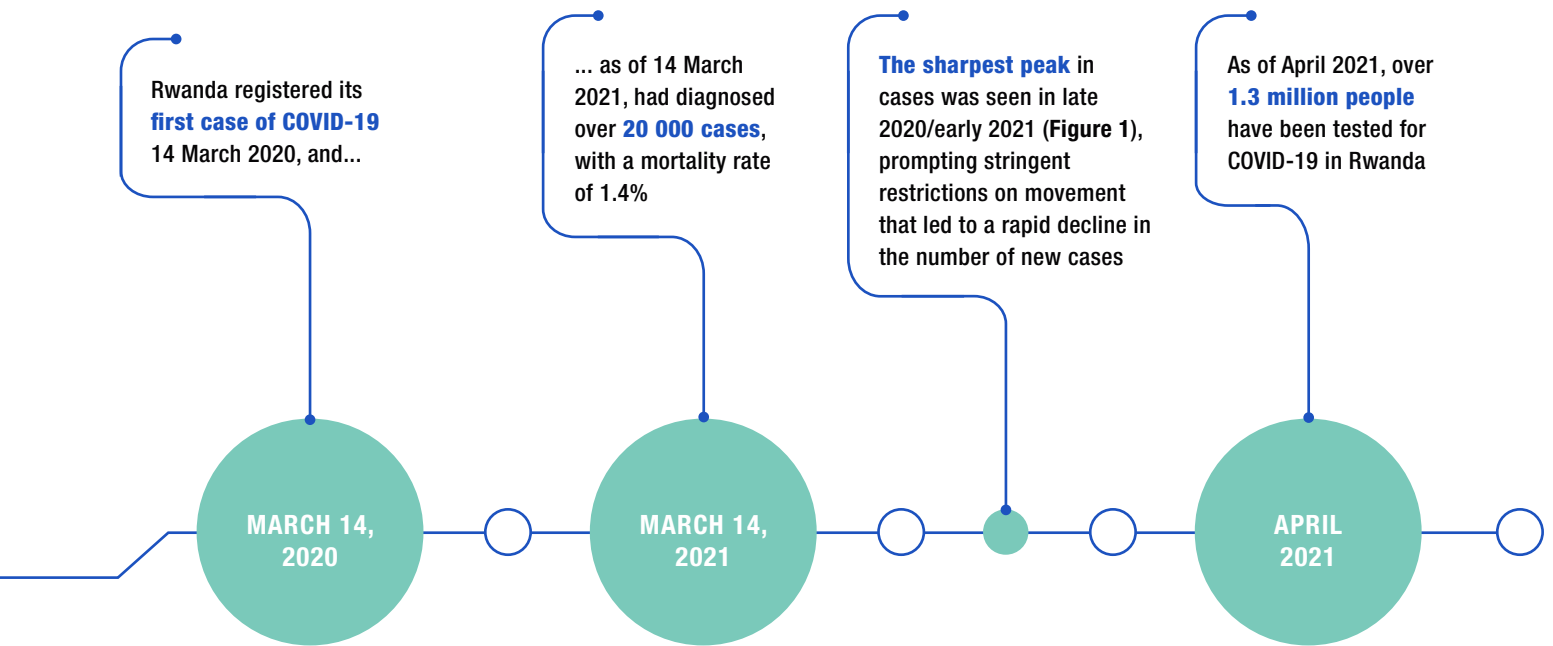**MARCH 14, 2020**

MARCH 14, 2021

APRIL 2021

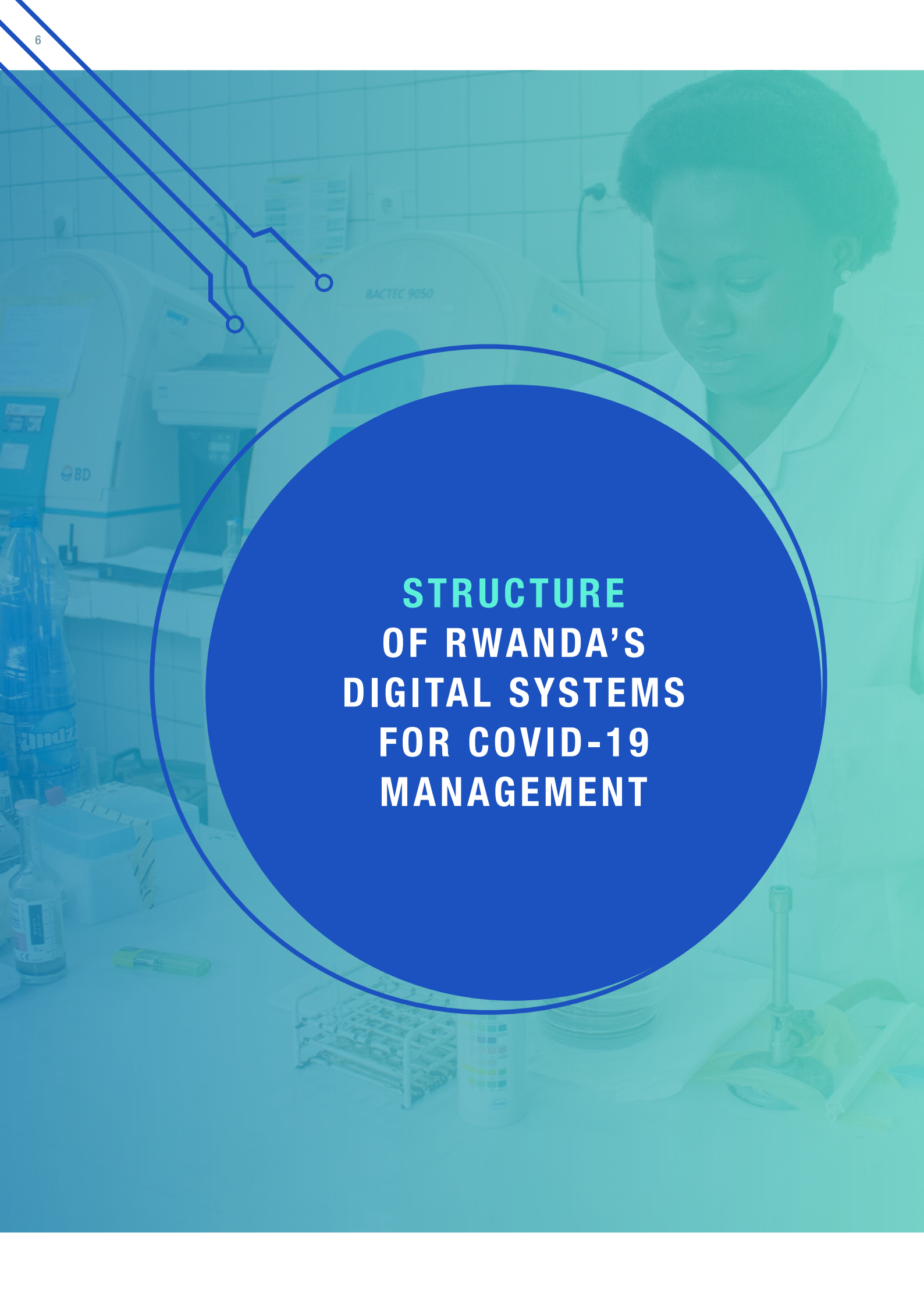**Figure 1.** COVID-19 cases in Rwanda between March 2020 and April 2021

The pandemic response is led by a national Joint COVID Task Force, which was established in February 2020, prior to detection of the first confirmed case.

This task force included subject matter experts from a range of ministries and institutions. It was responsible for providing both high-level strategic guidance for the pandemic response, and day-to-day operational support. Adopting a multi-sectoral approach from the start of the pandemic allowed for rapid deployment of interventions and more efficient troubleshooting, as institutions could combine their resources and capacities to respond to emerging problems.

The use of digital tools in Rwanda's COVID-19 response was preceded by years of investment in the broader digital health infrastructure. Expansion of digital technologies to support service delivery has been a longstanding government priority, across all sectors including health, where it is a core pillar of the national health strategic plan with a focus on improving access to patient-centred care.

Following the identification of the first case of COVID-19 in Rwanda, this pre-existing digital infrastructure offered a conducive foundation on which COVID-specific digital systems could be built to strengthen testing, contact tracing, patient support and surveillance.

This case study outlines the structure and functions of the digital solutions that Rwanda is implementing to strengthen its COVID-19 response, and emerging initiatives to scale up community-based testing using digital tools and rapid antigen tests.

STRUCTURE
OF RWANDA'S DIGITAL SYSTEMS FOR COVID-19 MANAGEMENT

District Health Information Software (DHIS-2) has been used in Rwanda since 2011 for disease surveillance and monitoring. As of 2016, it is operating at scale in all health facilities across the country, in both the public and private sectors. In early 2020, this system was adapted to capture data on COVID-19 diagnosis and case management. At the point of testing, patient data are entered directly into DHIS-2, which also issues a unique health code (UHC) to patients that they can use to access results. Additionally, **DHIS-2 is integrated with the laboratory information system**, allowing for automated transmission of data.

Several patient-facing tools have also been introduced including a **WhatsApp help line** and an **unstructured supplementary service data (USSD) platform**, which are accessible to all members of the public. For confirmed cases who are referred for home-based care (HBC), their outcomes are monitored remotely using the **WelTel app**, which is also used for remote monitoring of contacts. If patients are hospitalized, outcomes are monitored through the **standard electronic medical record (EMR) system** that routinely stores digitized patient data in facilities and transmits them automatically to DHIS-2 through an application programming interface.

Patients can also access their COVID-19 test results and certificates through an **online results portal**. In addition, the **Open Data Kit (ODK) application** is used to capture data for targeted surveillance activities outside of health facilities, particularly in hotspots. For travellers to Rwanda, a passenger locator form was introduced to capture pre-arrival testing certification and integrate it with testing and quarantine at points of entry.
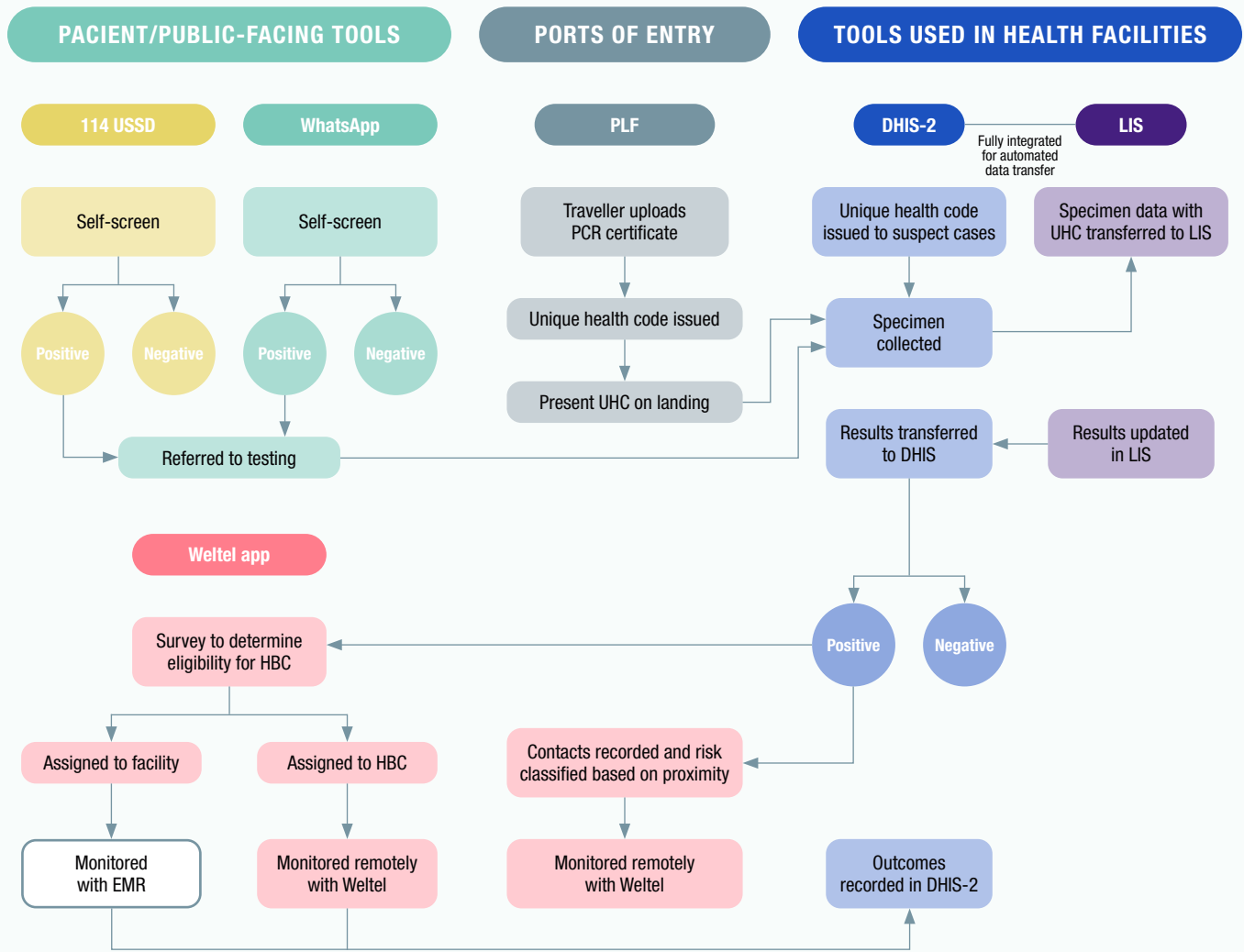
These tools, and the corresponding workflows and data flows, are outlined in **Figure 2**.

Table 1. Functions of digital tools in Rwanda's test-trace-isolate model of care

	TEST	TRACE	ISOLATE
114 USSD	Self-screening		
WhatsApp	Self-screening		Provides information to public
DHIS-2	Records testing data		Records patient outcomes
ODK	Screening questionnaire	Contact management	
PLF	Records pre- and post-arrival testing data		
WelTel app		Remote monitoring of contacts	Remote monitoring of confirmed cases

DHIS-2, District Health Information Software 2; ODK, Open Data Kit; PLF, passenger locator form; USSD, unstructured supplementary service data.

Figure 2. Nxxxxxxxxxxxxxxxxxxxxx

PACIENT/PUBLIC-FACING TOOLS	PORTS OF ENTRY	TOOLS USED IN HEALTH FACILITIES

114 USSD — Self-screen → Positive / Negative
WhatsApp — Self-screen → Positive / Negative
Positive → Referred to testing

PLF
Traveller uploads PCR certificate → Unique health code issued → Present UHC on landing

DHIS-2 — **LIS** (Fully integrated for automated data transfer)
Unique health code issued to suspect cases → Specimen collected → Specimen data with UHC transferred to LIS
Specimen collected → Results transferred to DHIS ← Results updated in LIS
Results transferred to DHIS → Positive / Negative

Weltel app
Survey to determine eligibility for HBC
→ Assigned to facility → Monitored with EMR
→ Assigned to HBC → Monitored remotely with Weltel

Positive → Contacts recorded and risk classified based on proximity → Monitored remotely with Weltel

Outcomes recorded in DHIS-2

DHIS-2, District Health Information Software 2; EMR, electronic medical record; HBC, home-based care; HCW, healthcare worker; ODK, Open Data Kit; PCR, polymerase chain reaction; PLF, passenger locator form; UHC, unique health code; USSD, unstructured supplementary service data.

Command Posts:
Facilitates interaction between patients and providers
- All public-facing tools include phone numbers for individuals to contact the Command Post
- Weltel back-end is accessed by Command Post to supervise remote monitoring and identify where rapid deployment of interventions is needed

COVID-19 Command Posts, the subnational operational centres of the Joint COVID task force, receive and analyse surveillance data from these different systems to inform policy and programme decisions. In addition, the Command Posts are accessible by telephone to members of the public who require additional guidance related to COVID-19 management.

USSD FOR SELF-SCREENING

To make information on COVID-19 available as widely as possible, a USSD was introduced that **can be used on any phone with no data or airtime requirements.**

This platform provides basic information on COVID-19 symptoms and prevention, including a self-screening form through which individuals can report any symptoms or contact exposure, and receive advice tailored to their responses.

Individuals whose responses indicate that they are at risk of COVID-19 are advised on symptom monitoring and testing, and provided with contact information for their local **COVID-19 Command Centre** should they need further guidance.

WhatsApp HELPLINE

Similar to the USSD, the WhatsApp helpline is a public-facing tool that provides basic information, a self-screening function and guidance on follow-up steps. The WhatsApp helpline also provides support for patients who have been diagnosed with COVID-19, for example, on monitoring and managing symptoms, and guidance on who to contact in case additional support is needed.
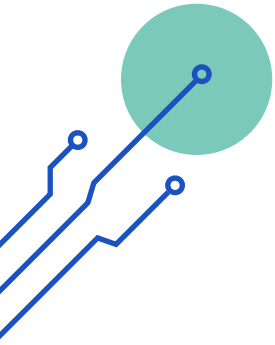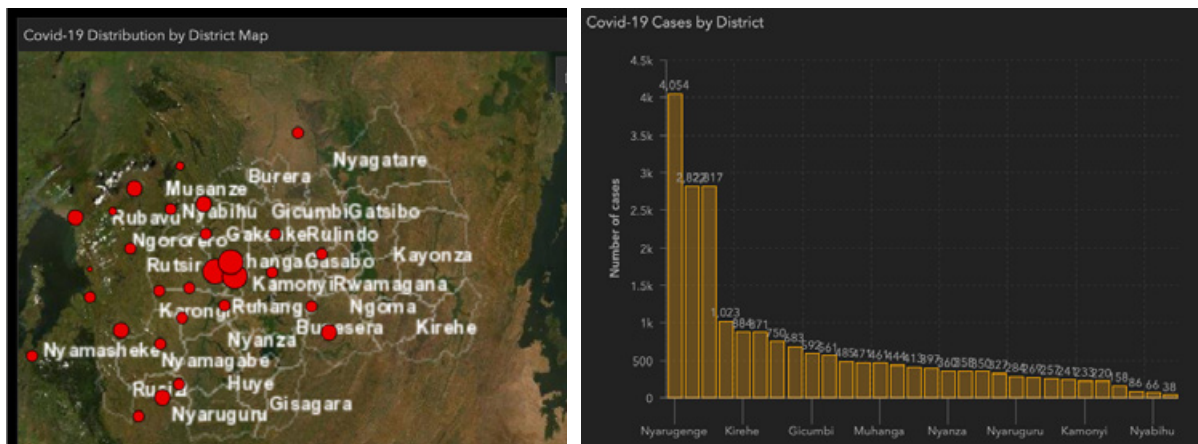
DHIS-2

Prior to the pandemic, DHIS-2 was operational in all 30 districts of the country. It is used across 1524 sites country-wide, which includes all public health hospitals and primary healthcare clinics, as well as private sector hospitals.

Servers are hosted by the pre-existing National Data Centre under the Ministry of ICT, while maintenance of the system is done by the Rwanda Biomedical Centre's (RBC's) in-house technical team. With this strong infrastructure already in place, RBC was able to rapidly adapt the existing system to support COVID-19 data capture and case management, a process that took three days in March 2020.

DHIS-2 now captures data at all steps of the COVID-19 test-trace-isolate cascade. It includes a form, used at all COVID-19 testing sites, to standardize data capture and streamline patient records using a unique health code. Patient data inputted in the system are connected to their UHC, to avoid healthcare workers (HCWs) having to re-enter these data for future tests and vaccinations.

DHIS-2 also includes a referral function through which HCWs can connect patients to further healthcare services as needed, while outcomes of confirmed cases are fed back into DHIS-2 from EMR or WelTel. In addition to supporting case management, DHIS-2 generates aggregate data for real-time surveillance to guide the pandemic response. Data from DHIS-2 are also used to map the geographic distribution of COVID-19 cases (**Figure 3**).

Figure 3. Dashboard produced by RBC with data from DHIS-2 and GIS

DHIS-2, District Health Information Software 2; GIS, geographic information system; RBC, Rwanda Biomedical Centre.
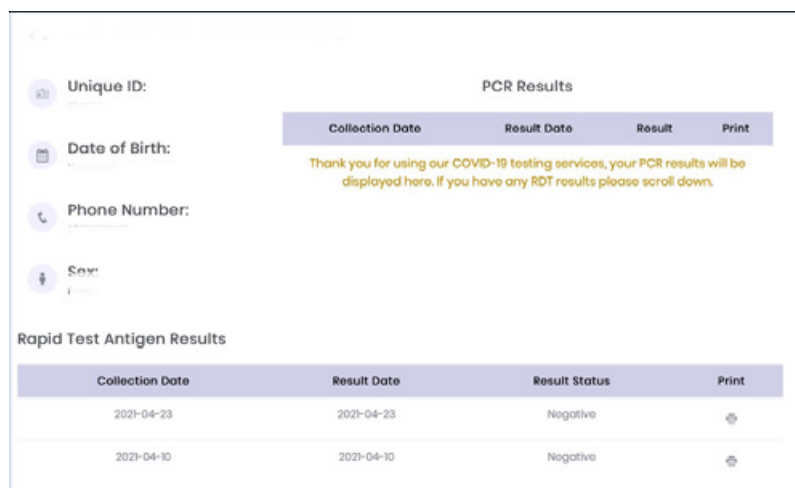
ELECTRONIC MEDICAL RECORD

The introduction of an EMR enables seamless transfer of patient data between facilities. The EMR is an electronic database that can be accessed via mobile, tablet or desktop browser. It contains data on COVID-19 screening and symptoms, as well as tests and results, for patients treated in both public and private sectors. All facilities using DHIS-2 can also make use of the EMR, which was similarly adapted during a three-day period in March 2020 to include COVID-19 data entry fields for monitoring outcomes of confirmed cases.

ONLINE RESULTS PORTAL

Linked to the health management information system, an online results portal was introduced to enable individuals to access their COVID-19 test results as soon as these are available, including all certificates for previous tests as well as vaccinations. **Figure 4** shows the patient dashboard accessible through this online portal. Patients access the online portal using their UHC and mobile phone number. As the portal is linked to the national health management information system, results are automatically updated once they become available. In addition, automated SMS is used to provide results to those who test negative, reducing the time demand on HCWs to communicate this information.
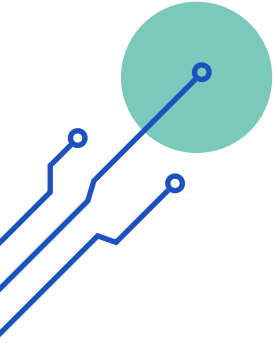
Figure 4. Patient dashboard on the online portal

PCR, polymerase chain reaction; RDT, rapid diagnostic test.

WelTel APPLICATION

WelTel is a patient-facing application that was previously used to monitor and support adherence to anti-retroviral medication for HIV.
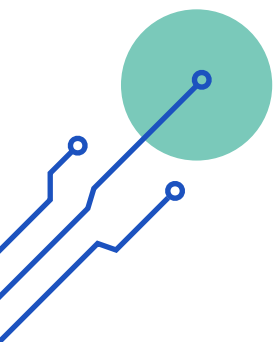
As the number of COVID-19 infections rose in 2020, it became clear that all cases and contacts could not be quarantined in health facilities for in-person monitoring as had initially been done. WelTel was therefore adapted to enable remote monitoring of confirmed cases.

When an individual tests positive, their clinical condition is assessed and if they are deemed eligible for HBC, HCWs in facilities can enrol them on HBC via WelTel. Enrolment on WelTel is not automated due to concerns around consent and confidentiality, as patients need to provide permission to be registered on the app.

The WelTel tool is used to monitor the status of confirmed cases over the duration of illness, with HBC patients self-reporting their symptoms and any changes in the severity of these symptoms. The back end of WelTel is connected to the Command Post, enabling rapid deployment of assistance as needed: for example, evacuation to health facilities if HBC patients report any deterioration, or facilitating access to essential supplies for HBC such as personal protective equipment.

Over 10 000 patients have been successfully monitored on HBC through WelTel to date, around half of the cumulative number of cases.

Contacts of confirmed cases are also registered in WelTel and assigned to different "rings" of risk based on their reported duration and proximity of exposure to the confirmed case. Those assigned to the red risk ring are those at highest risk of infection who would be prioritized for monitoring and follow-up interventions. This tool is used to monitor their status over a two-week period.

OPEN DATA KIT APP

The ODK application is used for mobile data capture on all interventions delivered outside of health facilities. Different questionnaires are developed depending on the intervention being delivered, with use cases including screening of travellers at ports of entry, tracking of clusters, and outbreak investigations. As an active internet connection is not required, data can be captured and stored offline if there is no connectivity, then synced with the servers once the device (phone or tablet) is back online. Because GPS coordinates are captured for every completed form, ODK has also been instrumental to geographic information system mapping of the pandemic, with the community-level data captured in the tool (particularly from hotspots) feeding into national-level dashboards to inform situational reports and decision-making.

PASSENGER LOCATOR FORM

Rwanda has devised a **stringent port of entry system** to avoid importation of COVID-19 cases.

Prior to travel to Rwanda, all travellers are required to complete an online passenger locator form that includes key details about their trip and any risk factors for COVID-19. Travellers also upload an electronic copy of the results certificate for the pre-travel COVID-19 test conducted in their country of departure, and the reservation for the hotel where they will quarantine.

Once all required information and documents have been submitted, a passenger locator number is assigned to the traveller, which functions as a unique identifier for seamless tracking of their record once in Rwanda. Possession of an RBC-issued passenger locator number is now a requirement for all passengers travelling to Rwanda by plane.
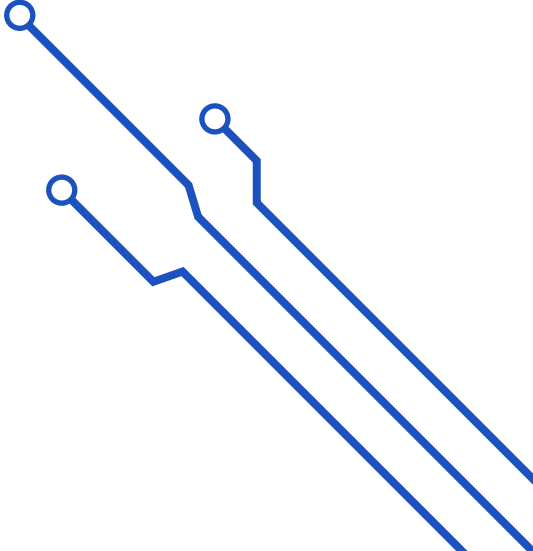
Upon arrival, all travellers receive a COVID-19 test at the airport, at which point their data are incorporated into the regular information management systems for COVID-19 testing. They subsequently remain in quarantine facilities for 24 hours until their results are available.

COVID COMMAND POST

The Command Post is responsible for **overall planning, coordination and implementation** of the COVID-19 response.

This includes the use of surveillance data from DHIS-2 and other systems to develop epidemiological models that are used to predict outbreaks and supply needs.[1] The Command Post also has a call centre through which any member of the public can access more detailed guidance related to COVID-19 testing and HBC, or be linked to providers.

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1. Habinshuti M *et al.* Covid-19 Rwanda Response Updates. *Rw. Public Health Bul.* 2020; 2(2):18–23.

SMALL-SCALE DIGITAL INITIATIVES

In addition to the previously mentioned digital solutions that are being implemented at national scale, other technologies have been deployed in selected settings to enhance COVID-19 management or generate evidence to guide future policies and programming, including the Visitor Tracking Record and the e-ASCOV pilot.
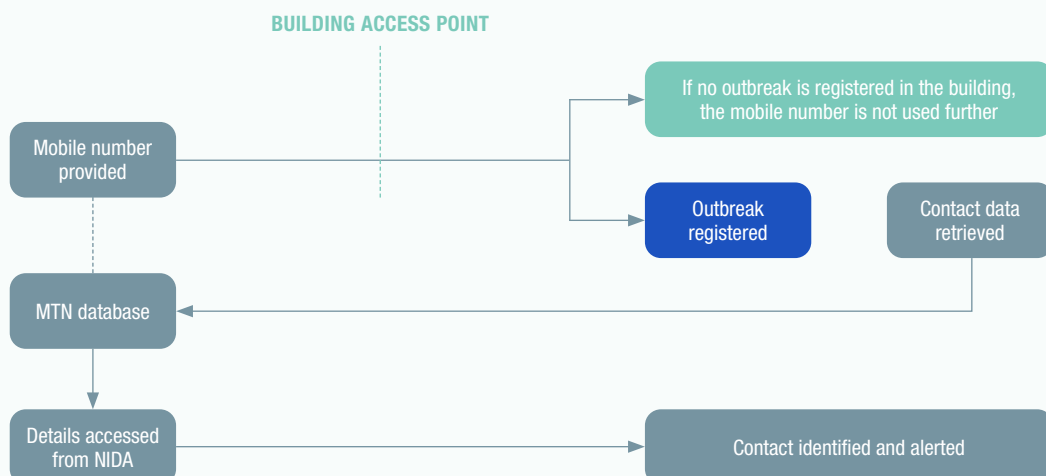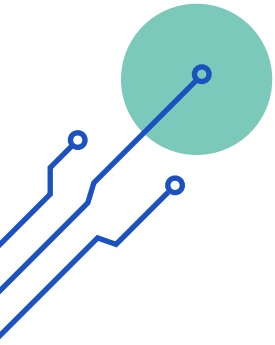
VISITOR TRACKING RECORD

Visitor tracking technology is being used by security companies in Rwanda at office buildings with a large number of occupants and visitors, to rapidly capture visitor information that can be used for contact tracing while eliminating the need for paper-based records. It leverages the database of the largest telecoms provider in the country, MTN, and the National Identification Agency (NIDA). **Figure 5** shows how visitor tracking is used for contact tracing in Rwanda.

All people entering the building are asked to provide their mobile number to a security guard who captures it in the visitor tracking application. This information is not used further unless a confirmed case is detected in the building. If so, mobile numbers of other individuals who were present at the same time and may have therefore been exposed to infection are retrieved.

As mobile SIM registration is mandatory in Rwanda, **the MTN database is linked to NIDA,** through which the contact tracer can access details of everyone who was exposed to COVID-19 infection via the confirmed case.

Figure 5. Visitor tracking system

BUILDING ACCESS POINT

Mobile number provided

If no outbreak is registered in the building, the mobile number is not used further

Outbreak registered

Contact data retrieved

MTN database

Details accessed from NIDA

Contact identified and alerted

NIDA, National Identification Agency.

e-ASCOV

e-ASCOV is a locally developed application that is being used to support the **expansion of access to rapid antigen testing for COVID-19** through the country's well-established network of community health workers (CHWs).

The app contains **a screening questionnaire, comprising 24 questions, which is administered by the CHW,** with an inbuilt algorithm to identify high-risk individuals who should be referred for testing.

In late 2020, a pilot study was conducted in four districts, through which 400 CHWs were trained to use the app, resulting in increased detection of COVID-19 cases.

The pilot led to around 8000 screenings, which detected **1300 suspect cases** who were referred for testing.

However, follow up of those cases within the digital system was not possible as e ASCOV was not integrated with other platforms operating at the national scale. In 2021, RBC plans to integrate these systems and to expand the workflow of CHWs to include administration of rapid antigen tests at the household level.

IMPACT OF DIGITAL TOOLS ON COVID-19 MANAGEMENT

Through integration of digital solutions (specifically, the laboratory and health management information systems) across the cascade of COVID-19 diagnosis, the entire testing process is now paperless, with all facilities capturing data in the same central system. The use of patient UHCs also allows for the seamless transfer of data between the different digital solutions. In addition to preventing fragmentation, this also minimizes the time required by HCWs to record and report data, as it is captured in real-time at the point of care. Application programming interfaces have also been developed for a number of the tools (ODK, the geographic information system and DHIS-2) to enable interoperability.

Mobile data collection tools for community-based surveillance generated valuable insights to inform timely responses to outbreaks. This has been particularly useful in emerging hotspots, where syndromic and geospatial data are collected from households and combined with data on new infections, to allow for real-time situational mapping. This has enabled decision-makers to identify clusters of COVID-19 infection, as well as to track the geographic origin and spread of new cases. This in turn guides policy and programming decisions on the deployment of interventions and measures to limit transmission.

Remote monitoring of cases and contacts using digital tools has reduced the burden on the health system. The WelTel app allows patients to self-report their symptoms and based on this, the app generates alerts where urgent action is needed, meaning the tool enables the automated triaging of patients. This has allowed the country to focus their limited capacity on delivering services to the most at-risk individuals, while maintaining consistent monitoring of other patients.

KEY SUCCESS FACTORS IN RWANDA'S EXPERIENCE

Pre-existing **digital infrastructure** and political will

The rapid deployment of digital solutions in Rwanda's COVID-19 response was made possible by the prior existence of a national digital strategy and infrastructure for the health system, bolstered by political commitment at the highest levels of government.

National ownership of these systems ensures that they are accorded the resources and prioritization required. Further, it encourages a strategic and coordinated approach to introducing new digital initiatives, with due consideration for scalability, interoperability and long-term pricing implications. This minimizes the challenge of isolated pilots, duplicative interventions and "data fog" that can be caused by multiple overlapping mobile health initiatives if they are not well planned and coordinated.

As a reflection of this political will, the establishment of a unit focused on Innovation and Data Science at RBC has made it possible for the country to not only customize and maintain imported digital health solutions, but to also develop local solutions that address context-specific needs.

Building on existing tools

By adapting WelTel, which had already demonstrated success in supporting HIV treatment, for COVID-19 management, Rwanda was able to rapidly respond to the need for remote monitoring of cases and contacts without having to develop new tools. Connecting the back end of this app directly to the Command Post also ensured that self-reported patient data prompted interventions where needed, and provided patients with a central place to get further information.

Multisectoral collaboration

The collaboration between multiple arms of government and the private sector (such as security and telephone companies), as well as other national institutions such as NIDA, has facilitated the deployment of digital solutions for COVID-19, by enabling the health sector to leverage existing data systems. Beyond the direct delivery of health services, telephone companies have also supported the COVID 19 response by improving the accessibility and affordability of various digitized services to encourage use and minimize face-to-face contact during the pandemic.

Providing patients with **direct access to results**

Rwanda's digital solutions for COVID-19 emphasize patient access, for example, by enabling individuals to directly receive or track their own test results. This may contribute to the short turnaround time observed for testing, with PCR results typically received the following day. It also minimizes the strain on the health sector to communicate results (especially if negative and no further action is required) and to issue COVID-19 test result certificates where needed.
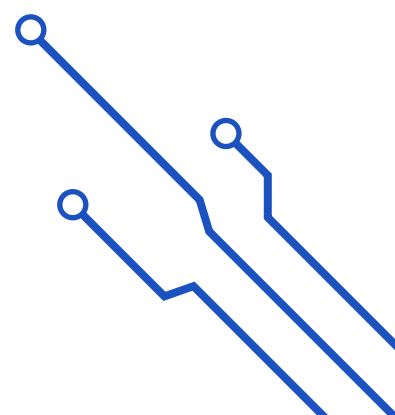
CHALLENGES FACED

Lack of readiness from HCWs to adopt new digital tools can be a barrier to successful implementation, particularly in the context of a crisis response where systems are already overwhelmed with new protocols and interventions. One of the approaches to this was ensuring that implementers were not only trained on how to use the tool, but also understood the bigger picture regarding the value that the tool in question would add to their processes and to the broader health response.

Resource requirements were unpredictable due to the rapidly evolving COVID-19 situation. While Rwanda's COVID-19 response has benefited from a long history of investment in digital health infrastructure, which minimized the need for additional resources when rolling out digital solutions for COVID-19, the unpredictable nature of the pandemic requires constant adjustments in strategy and approach, which can require more financial and technical resources than would otherwise be necessary. Close collaboration with partners has been key to filling these gaps and ensuring that the response remains agile.

Ensuring coordinated decision-making on the selection of digital tools. With numerous vendors offering tools for COVID-19 management, determining the best digital approach requires careful consideration, especially given the preference to minimize the number of new tools. Where possible, efforts have been made to build on the functionalities of existing tools. Strong national coordination through the joint task force has helped to rationalize this process, and the development of standard evaluation criteria has been proposed to determine which digital tools should be selected.

KEY INSIGHTS
FOR OTHER COUNTRIES

1. **Ensuring integration of all national COVID-19 data** (including from the public and private sector) into one platform enhances both understanding of the pandemic and the ability to coordinate and monitor the response to it. It also simplifies data management, as all patients, regardless of where they are tested, receive their tracking number and results via the same platform.

2. **Leveraging databases that exist in other areas** – for example, mobile companies' records of patient national identification numbers and other key biodata – can minimize the amount of time and effort required for individual data capture.

3. **Digital tools, particularly those that can be used on mobile devices, play a key role in the decentralized provision of testing services,** for example, community-based testing. While Rwanda is still in the early stages of rolling out this approach, early findings show potential to expand and standardize testing outside of health facilities, by using digital tools to provide guidance to CHWs, manage workflows and capture data in line with national indicators.