Country Brief

Rwanda's Experience Scaling Real-time Monitoring Approaches Using Digital Solutions to Support COVID-19 Surveillance, COVID-19 Vaccination and Case Management

INTRODUCTION

Rwanda registered its first case of COVID-19 on 14 March 2020. By the end of 2021, over 110,000 people tested positive for COVID-19 in Rwanda.[1] The sharpest peak in cases was seen in late 2020 and early 2021, prompting stringent restrictions on movement and daily life.[2] The pandemic response is managed by the national Joint COVID-19 Task Force, comprised of multi-sectoral advisors from relevant ministries and external institutions. The task force is responsible for issuing strategic and operational guidance in relation to public health, the economy, education, international and domestic travel, and social restrictions.

1 World Health Organization, 'Rwanda: WHO Coronavirus Disease (COVID-19) Dashboard with Vaccination Data', WHO, 2022, <https://covid19.who.int/region/afro/country/rw>, accessed: January 2022.

2 Foundation for Innovative New Diagnostics, Use of Digital Tools to Strengthen COVID-19 Management: Rwanda Case Study 2021, FIND and the Rwanda Biomedical Centre, 2021, <https://www.finddx.org/wp-content/uploads/2021/05/FIND_Digital-Health-Report_RWANDA_v2.pdf>, accessed January 2022.

Gavi The Vaccine Alliance

World Health Organization

unicef for every child

To support the task force and the country's COVID-19 response, the Ministry of Health (MoH) utilized digital health solutions to enable real-time information, data collection and monitoring, including for case tracking, management, contact tracing and immunization. The task force was able to build on significant progress made in the implementation of real-time monitoring (RTM) activities and solutions over the past decade. In 2009, a long-term Digital Health Strategic Plan was endorsed, enabling the country to implement digital health technologies at a national scale.[3] Since then, the expansion of digital technologies to support service delivery has remained a 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.[4]

Through the leadership of the Government of Rwanda, real-time data and monitoring solutions for the COVID-19 response was expedited, allowing for a coordinated approach to adapting existing mature digital technologies and innovations, such as District Health Information Software 2 (DHIS2) with due consideration to scalability, interoperability, sustainability and long-term pricing implications. Stakeholders attributed the high vaccination rate in Rwanda, with more than half of the population fully vaccinated as of January 2022, to government strategies and real-time data and monitoring systems, which helped accurately deliver vaccinations on time to priority groups.

COVID-19 VACCINATION PROGRAMME

On 3 March 2021, Rwanda received 240,000 doses of the AstraZeneca vaccine through the COVAX Facility, the platform co-led by the Coalition for Epidemic Preparedness Innovations (CEPI), Gavi, the Vaccine Alliance, and the World Health Organization (WHO) in partnership with UNICEF. In the following days, all doses received had been dispatched to 50 referral and district hospitals across the country and were then further distributed to 508 health centres.[5] As of January 2022, Rwanda has administered over 13 million vaccination doses[6] with an estimated 55 per cent of the population fully vaccinated,[7] in line with the target set by the MoH of achieving 40 per cent coverage by end 2021. The COVAX facility and African Centre for Disease Control's Saving Lives and Livelihoods programme have facilitated the provision of vaccines to Rwanda.

Drawing on the country's positive experience using DHIS2 since 2011, Rwanda's MoH and partners adapted the platform and several other digital tools. This allows for the faster collection of quality COVID-19 case data, vaccine coverage data and the visualization of this data in an online dashboard, reducing manual error and enabling evidenced-based decision making.

This country brief details the structure and functions of the RTM systems and approaches that Rwanda is implementing to strengthen its COVID-19 response, with a specific focus on the national immunization programme. As the primary system used, this brief focuses predominantly on DHIS2's functions and impact. Rwanda has been selected as a case study for the technical brief due to its valuable experience in implementing national-level immunization programmes and its emergence as an RTM pathfinder in the East and Southern Africa regions. Rwanda provides a clear example of a country that has made significant progress since committing funding and resources to digital health systems.

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3 Republic of Rwanda Ministry of Health, *Feasibility Study For CHIS, EMR, HIMS Systems Development and Implementation,* May 2021.

4 Ibid.

5 Gavi, the Vaccine Alliance, 'COVAX Vaccine Roll-Out Rwanda'. <https://www.gavi.org/covax-vaccine-roll-out/rwanda>, accessed January 2022.

6 World Health Organization, 'Rwanda: WHO Coronavirus Disease (COVID-19) Dashboard with Vaccination Data', WHO, 2022, <https://covid19.who.int/region/afro/country/rw>, accessed: January 2022.

7 Johns Hopkins University, 'Coronavirus Resource Centre: Rwanda', <https://coronavirus.jhu.edu/region/rwanda>, accessed January 2022.

USE CASE 1

COVID-19 SURVEILLANCE

OVERVIEW

Significant progress has been made in RTM and surveillance in Rwanda over the past ten years. District Emergency Operations Centres, which analyse surveillance data, were established during preparedness activities following the large Ebola outbreak in West Africa in 2014-2016. The facilities and lessons learned from this period were utilized and built upon to respond to the COVID-19 pandemic, eventually leading to the development of the COVID-19 command posts and country surveillance structures.

To inform the planning and coordination of the COVID-19 response, the implementing arm of the MoH, the Rwanda Biomedical Centre (RBC), used aggregated real-time surveillance data to monitor the geographic distribution of COVID-19 cases and vaccinations. In the pandemic's early stages, the MoH/RBC initially considered and relied on data from various systems, including DHIS2, Open Data Kit (ODK), WelTel, Oracle and ArcGIS to support mapping of cluster cases, logistics and community reporting. However, with the onset of community transmission and the need to rapidly scale up surveillance in light of COVID-19, MoH/RBC adapted their systems to rely predominantly on DHIS2, which could easily be configured according to evolving use cases and align with the system used within their National Reference Laboratory. DHIS2 is operational across all public health hospitals and primary healthcare clinics in the country's 30 districts, making the platform the preferred choice of the MoH to be adapted to capture national COVID-19 surveillance data. This process was completed over the course of three days in March 2020 by the MoH/RBC, with technical support provided by the Health Information Systems Programme (HISP).

IMPLEMENTATION

The HISP Centre within the University of Oslo (UiO) provides expertise and deploys customized information systems to support health care deliveryglobally, with several centres throughout Africa. HISP Rwanda, one of the network groups of the HISP Centre, has partnered with Rwanda's MoH since the launch of DHIS2 in country. The primary role of HISP is to technically assess the use cases and data needs of the government and build and adapt DHIS2 to be fit for this purpose. Fortunately, by the onset of the COVID-19 pandemic, Rwanda was adept at disease surveillance and DHIS2 was relatively easy to customize. Training data managers and health workers on the system's new capabilities in regard to COVID-19 cases and vaccination was also relatively easy.

Following the initial wave of cases in country, the gradual opening of international borders led to the need to track those arriving in country. All travelers arriving by land or air were required to complete a passenger locator form including evidence of a negative COVID-19 test result and their quarantine location. On submission of the form, a passenger locator number is assigned to the traveler, which functions as a unique identifier for tracking their records once in Rwanda. HISP enabled interoperability between the passenger locator forms registry and DHIS2.

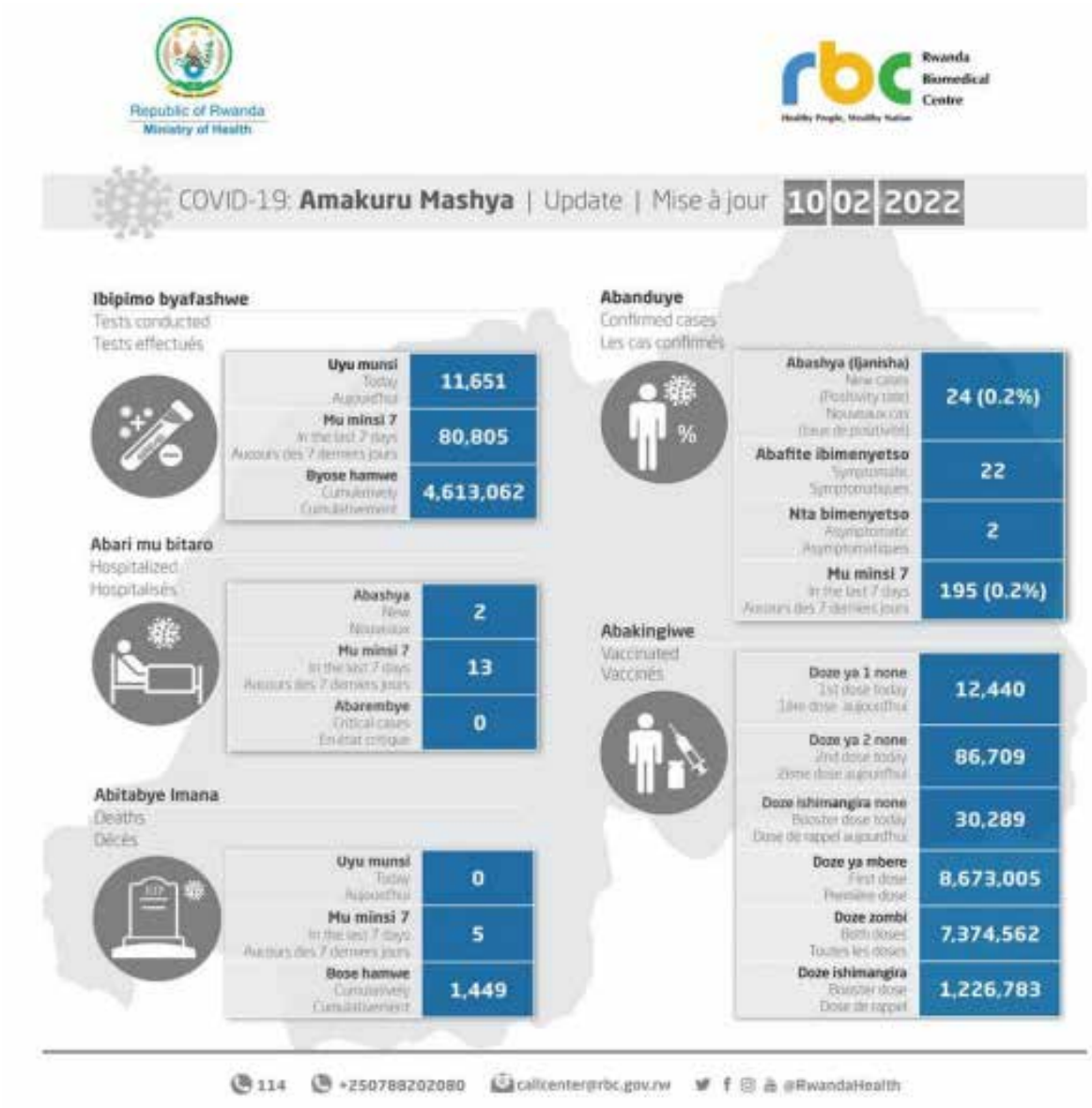
Upon arrival, all travelers receive a COVID-19 test at the airport or port of entry, at which point their data is incorporated into DHIS2 and allows for real-time surveillance tracking by the MoH. This system simplified and expedited the screening process at airports and allowed users to pay for testing, access results and receive other COVID-19 information on a single platform.

Real-time COVID-19 surveillance data is reviewed by the National Emergency Operations Centre, consisting of public health representatives from the MoH/RBC, other divisions within the MoH, HISP, UNICEF, WHO and partners every two weeks, utilizing two sources; case data linked to health facilities across the country; and randomized testing data. The same process is conducted at district level to ensure compliance with interventions and alert high case rates, low vaccine coverage or supply chain issues.

In support of Rwanda's surveillance system, COVID-19 command posts have been established at central and district levels to support all areas of the pandemic response (health, economic, social welfare, policing etc.) as an extension of the Emergency Operations Centre. The district command posts were first established in the districts along Rwanda's borders to monitor points of entry following several cases amongst international truck drivers. Also, during this initial stage, Rwanda's police force was tasked with contact tracing cases due to their resources and skillset. It was therefore decided that the command posts would incorporate all key stakeholders, including health, police, military and economic officials, whilst also expanding to one per district.

At the central level, the command post sits under the Prime Minister's office, with the Permanent Secretaries of the Ministries in attendance, and allows stakeholders to discuss all areas of the national response and vaccination programme. The command post provides guidance or directives to districts based on surveillance data. At district level, the command posts are chaired by each district's Vice Mayor and attended by the head of the district hospital, WHO advisors assigned to each district and security and administrative representatives. The District command posts are responsible for local decision making on all areas of the response. The district and national command posts share data on a daily basis with the COVID-19 task force. 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 home-based care or be linked to providers.

MOH/RBC DASHBOARD



National COVID-19 surveillance data is accessible by the public via the Rwanda Biomedical Centre website, which displays case and vaccination data in a dashboard format on a daily basis. The information is also publicly accessible via the MoH/RBC-C19 mobile application. The public's interest and engagement in public health decisions has grown throughout the pandemic with the availability of COVID-19 data and information. For example, there have been instances of the public calling for public health restrictions and local shutdowns in the face of spikes in transmission.

The COVID-19 surveillance system's implementation faced challenges. In the initial months of scaling up the uses of DHIS2, MoH/RBC, with the technical support of HISP, was required to change data variables and continually update the system. Further, to increase human resource capacity, medical students and volunteers in each district were recruited and trained in data entry and called upon during periods of high case rates and vaccination drives. During the second wave of cases in January 2021, over 1,000 students and volunteers supported with data collection and data entry.

In the early phases of the pandemic, Open Data Kit (ODK) was instrumental to support geographic mapping of the pandemic, capturing community-level data of cluster cases and informing situational reports. Yet, with the onset of community transmission the benefit of this form of tracking was minimal. However, ODK is still used at all ports of entry to the country to capture COVID-19 data from those entering the country.

OUTCOME AND DISCUSSION

Rwanda's MoH and supporting partners now seek to capitalize on the expansion and development of digital health information technologies and RTM solutions. They wish to use this knowledge base to collect surveillance data for all emerging diseases, including increasing the number of District Emergency Operations Centres to one in every province.

The partnership between HISP and the MoH has been crucial to the development of an integrated approach to strengthening national health information systems and surveillance and has greatly improved the sustainability of digital health systems within Rwanda. The functionality of the system and the services they provide are driven by programmatic needs. This allows the MoH and partners to plan and ask for the digital health information technology systems needed, knowing HISP's operational and technical support will work to find them an interoperable solution. For instance, HISP have developed an interface between the country's birth registration system (CRVS), managed by a national government contractor, and the routine immunization tracker used by the MoH, and each child registered at birth is included in the tracker. This allows the MoH to track routine immunization rates and make adjustments to the country's Expanded Programme on Immunization (EPI) strategy based on real-time information, where needed, whilst also alerting the child's caregivers to take their children to vaccination appointments. Looking ahead, the MoH intends to further streamline the real-time monitoring process by transferring the routine immunization tracker to the DHIS2 platform.

USE CASE 2

VACCINATION DELIVERY AND MONITORING

OVERVIEW

With the implementation of the COVID-19 vaccine roll out, Rwanda's MoH required a system for registering and monitoring individual vaccinations, to track the progress of the programme and respond in real-time to areas of low coverage. To facilitate this, the MoH/RBC and HISP further adapted DHIS2 to include the DHIS2 eTracker, referred to in Rwanda as the 'Electronic Immunization Registry (EIR) module'. The eTracker supports individual-level or case-based transactional data collection, case monitoring and follow up, analysis and reporting. By the time COVID-19 vaccines arrived in-country, the digital transformation of paper-based reporting and related processes was in place, helping to accelerate the digitization of real-time data for vaccination delivery and monitoring.

IMPLEMENTATION

At facility level, healthcare workers input vaccination data, including name, identification (ID) number, age, location, occupation, type of vaccine, batch number, dose number and date, into the EIR. For new users, the health worker creates a profile for the patient with their national ID number, automatically populating certain data fields. This was made possible by HISP interlinking DHIS2 with the National Population Registry. This issues a unique health code (UHC) allowing health workers to access patient medical history, and individuals to access their vaccination certificate and medical records (both COVID related and other), through the online results portal (see Use Case 3 for detail). Rwanda's vaccination certificates are digital, featuring name, passport number, type of vaccine, data, batch number, physician signature and stamp. The vaccination certificates also include a QR code that can be scanned and cross referenced with the national database. To encourage community engagement and take-up of the immunization programme, the platform also issues SMS messages informing people of their vaccination appointment details.

The EIR on DHIS2 is a centralized system; however, each district and health facility can view the data for their catchment area on a daily basis. There are several levels to the country's accountability and reporting structure.

At central level, the DHIS2 vaccination data is reviewed and analysed every evening, with the Minister of State for Health required to brief the Prime Minister's office on the latest vaccination data. These briefings include all relevant stakeholders involved in the planning and implementation of the vaccination roll out, including the MoH/RBC, police and army representatives, the COVID-19 command post, Minister of Finance and others.

Real-time Data Use Spotlight: Supply Chain Capacity and Vaccine Delivery

To manage the multiple vaccine products that Rwanda receives (Astrazeneca, Pfizer, Moderna etc.), DHIS2 data is used to assess supply chain capacity for each district and review which vaccine type was predominantly used in which district, to limit the public being offered two different vaccine types. This was critical in limiting vaccine hesitancy, by ensuring that the second dose of vaccines was the same as the first dose provided. The updated real-time information helped to encourage the public to attend their appointments and support efficient vaccination delivery in general.

On a weekly basis, the vaccination data is presented to a broader group, the Scientific Advisory Group (SAG), including high-level government officials in addition to UNICEF, WHO and other partners. The SAG is chaired by the Director General and national Centre for Disease Control, during which strategic decisions, issues and course corrections are discussed and real-time dashboards are extensively used to support consultations. As an example of efforts to improve service delivery through corrective action, the SAG makes decisions on how to redistribute vaccines from one district to another if an area is overstocked or understocked: taking into consideration population data, coverage rates, doses given and storage and distribution capacity. Based on daily data received through DHIS2, the MoH deploys staff to local health facilities, to supervise and support with implementation and encourage communication between national and sub-national levels. As with the surveillance data, the daily national vaccination data is also made publicly available on the MoH/RBC's website.

Rwanda received large numbers of vaccines, some with a very short shelf life, and without real-time tools the country would not have been able to deliver the vaccines efficiently and effectively in a timely manner to targeted people.

At the district level, each district COVID-19 command cost is responsible for monitoring coverage and reaching their weekly targets. If a district is unable to reach their targets, the district command post is required to identify why there is low coverage, looking at vaccine hesitancy challenges, a need for greater communication and outreach, or supply chain delays. This is reported to a focal point at the national level, responsible for overseeing and monitoring the district and ensuring challenges are assessed and responded to. Due to this close monitoring, the central level knows which districts and villages are experiencing challenges in implementing the vaccination programme or in other areas of the response, including increased numbers of new infections. and this information is accessible and discussed by all levels, with the MoH able to make rapid evidence-based interventions based on real-time data, including mobilizing resources for individual districts if needed. District command posts are also empowered to make local strategic decisions, including where to establish vaccination and testing centres, balancing the need to be near populous areas (such as markets, community halls and churches) to encourage engagement, whilst also not wanting to heighten the risk of transmission.

The scale up of DHIS2 for vaccination tracking was made easier by a previous project with Gavi, the Vaccine Alliance. Prior to the pandemic, Gavi distributed laptops, tablets and mobile phones to approximately half of Rwanda's health facilities, and with a reallocation of existing technology equipment this reduced operating challenges significantly. Each health facility has a data manager or focal point, however the medical students and volunteers that supported with data entry for cases were also asked to support data entry for the vaccination programme. Training was predominantly conducted virtually and included data managers using WhatsApp groups to share tutorial videos with trainees, which could be easily shared for refresher training, and for trainees to ask any questions.

OUTCOME AND DISCUSSION

Interviewees from Rwanda's MoH described clear benefits of utilizing DHIS2 for vaccination registration and monitoring, most notably that having one system for all main areas of the response significantly streamlined the information architecture. During the course of the pandemic, the public's use of open access data has also grown, with individuals more readily accessing their COVID-19 data as well as non-COVID related medical records. Without an RTM approach using DHIS2, vaccination data would have taken at least a week to be transferred from local health facilities to a centralized level, resulting in delayed decisions, supply chain and distribution challenges and reduced efficiency.

USE CASE 3

COVID-19 CASE MANAGEMENT

OVERVIEW

As detailed in Use Case 1, Rwanda's MoH utilized and expanded the existing real-time monitoring platform, DHIS2, to capture data and facilitate case management of COVID-19 cases. To support case management of those positive cases that are at higher risk of serious symptoms, the WelTel application was also adapted to facilitate remote monitoring and medical intervention if needed.

IMPLEMENTATION

DHIS2 captures data at all steps of the COVID-19 test-trace-isolate process. As with vaccination data, health workers enter patient data directly into DHIS2 at the point of testing, through a standardized form. Patient data included in the system are connected to their UHC as a permanent record, to allow patients and healthcare workers to view their data history and access results. DHIS2 is integrated with the laboratory information system, allowing for automated transmission of data in real-time. It also includes a referral function through which healthcare workers can connect patients to further health services as needed.

The case data inputted to DHIS2 is reviewed and analysed at both national and district levels. At the national level, aggregated data is reviewed daily by the COVID-19 command posts, to track case numbers, address challenges and propose actions. Aggregated COVID-19 case data is also available at district and sub-district level, allowing district command posts to make localized strategic decisions at the end of each day, using DHIS2 data that is accessible by all districts and the national level, in real-time. From this, they can produce aggregate case-based reports for accredited users. The command post's central data science team is in charge of technical solutions, data compilation and analysis. They develop physical reports and documents on COVID-19 case management.

The online results portal, hosted by the MoH/RBC, was also introduced during the pandemic to enable individuals to access their COVID-19 test results via SMS, as soon as these are available, including all certificates for previous tests, vaccination status and certificates. Patients access the portal using their UHC and mobile phone number.

The Electronic Medical Records (EMR) system also feeds data into DHIS2. This system was adapted during a three-day period in March 2020 to include COVID-19 data entry fields for monitoring outcomes of confirmed cases. The EMR is an electronic database that can be accessed by health workers and patients via mobile, tablet or desktop browser. It contains hospital and health centre data on COVID-19 cases.

In the early stages of the pandemic, Rwanda required all positive cases and contacts to quarantine in health facilities. However, with the increase in case numbers this was unsustainable. To enable remote monitoring, the MoH and RBC adapted WelTel, a patient-facing digital application previously used to monitor and support adherence to HIV anti- retroviral medication. Following a positive test, the clinical condition of the patient would be assessed by a health worker and if deemed eligible for home-based care the patient could be enrolled via WelTel. Once enrolled, patients would self-report their symptoms and any changes in severity via SMS, negating the need for wifi or network access. This data is transferred in real-time to the district COVID command cost to enable the rapid deployment of medical assistance if needed. The data is also accessible to RBC and included in data analysis for surveillance by the district and national emergency operations centres.

OUTCOME AND DISCUSSION

Through the support of real-time data and information approaches enabled by the integration of digital technologies, Rwanda's testing and case management process is entirely paperless and streamlined. The use of UHCs, linked to each users national ID has enabled data transfer between various platforms, significantly limiting the administrative burden at all levels of the health system. The adaptation of WelTel enabled a similar effect, allowing health facilities and hospitals to focus on admitted patients whilst still monitoring those at risk.

CONCLUSION

Rwanda's COVID-19 vaccination programme and overall pandemic response produced many strong and valuable practices while navigating a challenging context. By utilizing existing digital health information infrastructure, the MoH and partners were able to scale up all areas of the public health response efficiently, streamline data analysis to enable real-time decision making, and make the system interoperable with other platforms to support sustainability.

Most notably, this scale-up led to a reduction in the encumbrance on health workers due to several of the platform's functions. Firstly, DHIS2 is user friendly and intuitive at all levels, for those inputting and analysing the data. Data entry functions are available offline, allowing health workers and volunteers to input the data whilst working in locations without internet access. This information is later automatically uploaded to the central server once internet connectivity is restored, significantly reducing the administrative burden on data managers who would otherwise be required to input data collected on paper forms or another offline system. The real-time aspect of the data was critical, allowing data to be reviewed at national and district levels on a daily basis and inform decision makers should any intervention or course correction for the response be necessary.

"There is no possibility to go back to paper-based systems in country. Standards have now been set and even those people who are not data managers have understood the need for real-time data because the authorities are relying on the data on a daily basis, and this is a real achievement."

– WHO Rwanda

Despite the overall success of real-time data and monitoring systems in place, there were notable challenges. Medical students and volunteers were recruited to support with data entry; however, training largely took place virtually. Due to the strain on health workers and data mangers, it was not possible to train these volunteers in data analysis, which could have strengthened the monitoring capabilities of each health facility or district. Rwanda's laboratory service staff were initially reluctant to implement a digital system due to concerns that samples and data would be lost due to a lack of resources. However, following the success of the implementation, laboratory staff are now keen advocates for digitizing the health system.

In regard to the replicability of Rwanda's real-time monitoring approach, neighbouring countries can look to Rwanda's lessons on how they overcame certain challenges. However, one important consideration is the need to have reliable and consistent technical guidance and maintenance support, particularly during the early stages of planning and implementation Rwanda's MoH were able to depend on HISP to adapt existing digital tools and in turn make their response more agile, with the added benefit of funding from the University of Oslo. With this in mind, countries without this form of in-country partnership will need to consider how to access technical guidance and necessary funding before rolling out or scaling up real-time monitoring systems.

Rwanda's use of real-time monitoring approaches throughout the planning and implementation of their COVID-19 response is a valuable case study in the importance of such systems. The country's impressive coordination system linking the government, with UNICEF, WHO, health actors and the private sector enabled the rapid scale up of the use of RTM systems to support COVID-19 response. For example, telephone companies supported the response by improving the accessibility and affordability of various mobile services, encouraging use and limiting in-person contact where possible. This multisectoral collaboration enabled Rwanda's response to be relatively agile; clearly evident with the partnership between the RBC and HISP as any programmatic data requirement could be included within the system and rolled out in a timely manner.

Sustainability

The rapid scale-up of existing health information infrastructure by Rwanda's MoH and partners has enabled the COVID-19 response and immunization roll out to be dynamic, user-friendly, and led by evidence and programmatic need. The advances made in this field throughout the pandemic have facilitated the sustainability of real-time data and monitoring systems within Rwanda. Having one primary platform – DHIS2 – to support multiple areas of the COVID-19 response has demonstrated that the digitization of COVID-19 systems can advance the country's wider digital health services. This is most notable with the Ministry of Health's plans to transfer the routine immunization tracker, which is now interlinked with the country's birth registration system (CRVS), to DHIS2.

The open access nature of Rwanda's data, uploaded to the RBC's website on a daily basis has also led to increased trust and transparency between the public and health authorities, which is crucial when so much of a public health response relies on individuals attending their vaccination appointments.

In summary, with the country's recent experience and increased knowledge and capabilities regarding real-time monitoring approaches, Rwanda will continue to be seen as a pathfinder for digital health within the region. Countries are encouraged to look to Rwanda as a strong real time data monitoring case study to support COVID-19 response and vaccine delivery and the integration of RTM approaches into routine immunization and health systems.

GOOD PRACTICES

1. Build on existing national real-time monitoring approaches and health information systems

By utilizing existing national information systems, i.e., DHIS2, that were already in use at scale for the COVID-19 immunization programme, Rwanda's MoH could adapt and further scale up these tools rapidly and reliably, with the knowledge they are understood by health system staff throughout the country.

2. Implement nationally led accountability structures and clear coordination mechanisms

Rwanda's establishment of nationally led accountability structures and clear coordinating mechanisms to support communication and decision making has been critical. Communication channels between MoH and partners, including the COVID command post forum, regular meetings, reporting templates, dashboards and WhatsApp group messaging, enabled stakeholders to address issues in the planning and implementation phases of Rwanda's COVID-19 immunization programme in a timely manner.

3. Prioritize data management and monitoring

Data management as part of COVID-19 case management was prioritized by the government at the outset of the pandemic. This ensured planning and implementation strategies were evidence- based and contingent on available information. In certain countries, emphasis may be given to clinical aspects of the response, with data considerations being made at a later stage, and therefore not able to inform strategy.

4. Multi-stakeholder engagement for COVID-19 response

The government mobilized multiple ministries and stakeholders to support COVID-19 response, including a task force of health, military, police, transport and others. This multisectoral engagement and coordination helped to ensure coordination and coherence of the national response.

5. Use an open-source products to manage data and information

Often proprietary solutions do not respond to national data requirements and use cases. Attempting to reconfigure commercial solutions takes a great deal of time, and proprietary solutions do not provide the flexibility to make changes as needed. The use of the open-source solution, DHIS2, to support integrated data management and data use provided flexibility and helped Rwanda to scale its rapid response to COVID-19.

6. Ensure open access and publicly available data

With the increasing risk of misinformation, public trust and engagement in health programming is crucial. Rwanda's COVID-19 data is uploaded on a daily basis to the MoH/RBC's online platforms, including dedicated websites and Twitter allowing the public to easily view testing statistics, case numbers and vaccination progress. The public are also able to access their own personal medical data through the online results portal, on the MoH website, using their mobile number and UHC.

7. Strengthening sustainability of real-time monitoring approaches and routine immunization services

Rwanda has been able to utilize the experience developed during Ebola preparedness activities, RTM of routine immunization, and the COVID-19 pandemic to rapidly scale digital approaches and solutions. This knowledge base has accelerated and improved the use of RTM approaches and digital health information solutions. In turn, the progress made in this field throughout the pandemic has led to improvements for routine services, including the interface between the country's birth registration system (CRVS) and the routine immunization tracker, and the later transfer of this system to DHIS2; ultimately leading to stronger systems and practices for health services.

8. Technical advice and system maintenance support

Rwanda's MoH was supported by HISP to frequently adapt digital tools and innovative approaches to match the programmatic needs of the immunization roll out and response, including making small adjustments to data indicators once the module was already in use.

LESSONS LEARNED

1. Anticipate the need to scale up staffing rapidly in response to the pandemic

Significant numbers of additional health system staff and volunteers were needed at all levels to scale up COVID-19 immunization programmes and response. The Government of Rwanda was able to overcome challenges by engaging medical students and volunteers for data entry tasks, however the level of time and resources required to hire and train additional staff was challenging.

2. Ensure interoperability between digital tools from the outset

In the early stages of the pandemic response, different units of the MoH used different platforms, including ODK, DHIS2, WelTel, WhatsApp and paper-based systems, which were not interlinked with each other. This caused various delays as the systems were not meeting the response's programmatic needs. On reflection, the response could have benefitted from ensuring interoperability between systems, including the DHIS eTracker/EIR, and scaling up DHIS2 as the primary digital platform from the outset.

3. Include technical Information, communication and technology experts in early planning and decision making forums related to data management and data systems

It is important that information, communication and technology (ICT) staff are included in decision making on the effective management and use of COVID-19 data and information and related systems. This will help to ensure that real-time approaches and related digital solutions proposed by policy makers to meet programme and data use needs are feasible, in terms of national capabilities, interoperability, ownership and sustainability.

KEY STAKEHOLDERS INTERVIEWED AND CONTACT INFORMATION

Rwanda contacts interviewed

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- Country and Regional UNICEF Offices
- Digital Health Centre of Excellence (DICE): contact@digitalhealthcoe.org

For field-facing technology for development support, contact UNICEF Digital Centre of Excellence (DOE): dcoe@unicef.org

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