USE OF
DIGITAL TOOLS
TO STRENGTHEN
COVID-19 MANAGEMENT

NIGERIA
CASE STUDY

APRIL 2021

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INTRODUCTION

Nigeria registered its **first case of COVID-19** on February 27, 2020

As of March 29, 2021, over **160,000 cases** in total had been diagnosed, out of over **1,7 million tests**

The national COVID-19 response was led by **Nigeria Centre for Disease Control (NCDC)**, working closely with state health teams and partners

FEBRUARY 27, 2020

MARCH 29, 2021
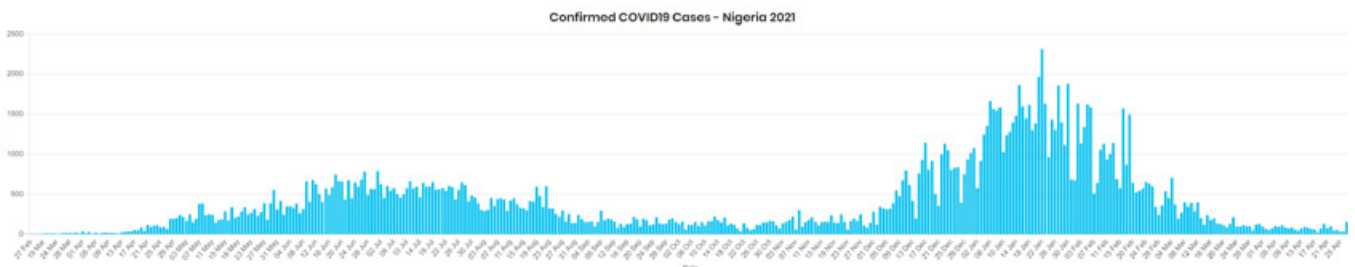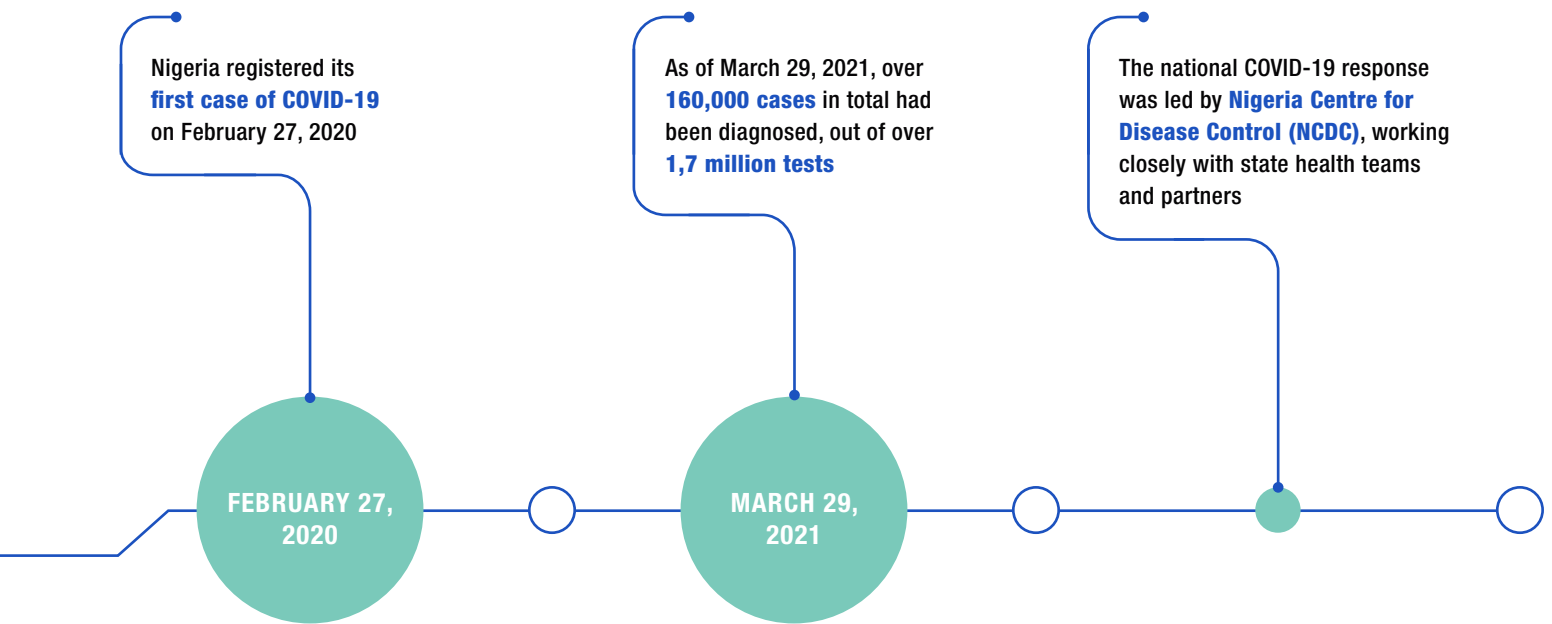
Confirmed COVID19 Cases - Nigeria 2021

Figure 1. Nigeria's COVID-19 Epidemic Curve, March 2021 (source: covid19.ncdc.gov.ng)

From the start of the response, NCDC prioritized 'putting data at the heart of the response'[1] – an approach which was enabled through its **use of digital tools for real-time data collection, transmission and analysis.**

In 2014, Nigeria's experience with containing the Ebola epidemic had highlighted the need for a comprehensive data management system, integrating real-time surveillance and case management functions, to enable more agile and efficient outbreak responses in future.

This led to the **development of SORMAS** – the Surveillance, Outbreak Response Management and Analysis System – by the Nigerian Centre for Disease Control (NCDC) and partners. SORMAS was expanded in subsequent years to support management of other priority diseases, including integration of a COVID-19 module in 2020 that was rapidly scaled up across all states. This has ensured from the start of the pandemic, end-to-end data is captured, at multiple levels of the health system, in SORMAS – which is then used to guide policy and program interventions.

1. NDCD (2021) One Year After: Nigeria's COVID-19 Public Health Response

# STRUCTURE AND DATA FLOW OF NIGERIA'S DIGITAL BACKBONE FOR COVID-19

SORMAS is an end-to-end digital solution that captures data on all steps in the **Test-Trace-Isolate** cascade of COVID-19 management.

As it is intended for use by healthcare personnel, additional patient-facing tools have been introduced to facilitate public engagement, screening and entry into the cascade of care. These include the **NCDC ChatBot** accessed via the NCDC's website, the self-assessment web application developed by Wellvis with NCDC, the Interactive Voice Response solution available as a call back service, the USSD self-assessment solution ad well as the **Disease Control Hotlines** that have been established in multiple states. The diagram below shows the various public-facing channels and how they feed in data to the dashboard and eventually to SORMAS. These tools are illustrated in **Figure 1** and explained further below.

Figure 2. Nigeria's digital architecture for COVID-19

The Case Data from the dashboard is analyzed by a second responder at NCDC and suspected cases are forwarded to the State Epidemiologist for follow-up and contact tracing (for confirmed cases).
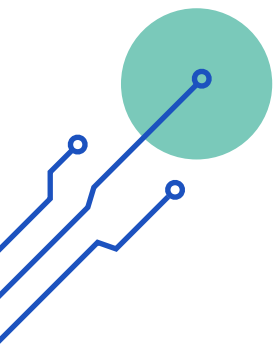
NCDCBot

Accessed via the NCDC's website, this self-assessment tool enables members of the public to complete a short screening questionnaire administered by a chatbot.

The questionnaire captures demographic details, location, travel history, and any symptoms relevant to COVID-19. Where the individual has had known contact with a confirmed case of COVID-19, additional details on the type of exposure – for example, duration and proximity – are also captured. Regardless of whether the individual has been in contact with a confirmed case, the tool also records details on recent interactions with health facilities or providers, as well as public/ social interactions.

Once individuals have completed the questionnaire, the tool informs them if they are at low risk (in which case they are advised to keep taking preventive measures) or at high risk. For individuals who are at risk of COVID-19 based on their symptoms or other exposure history, further personal details are requested and they are connected to the relevant state hotline based on their location, from which they can be linked to the next steps in the diagnostic cascade.
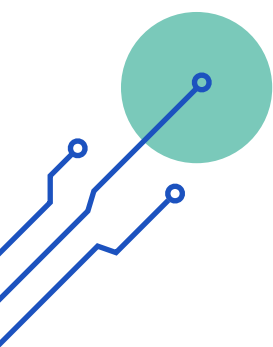
WELLVIS

Wellvis (Web Assessment Solution), a telemedicine company that works closely with NCDC, has also introduced a **COVID-19 Triage Tool** that can be accessed by any member of the public to conduct a rapid self-assessment in line with NCDC guidance, and thereafter be connected to services as needed. This was developed in collaboration with NCDC and is hosted on the NCDC website and server. The tool provides a screening questionnaire to assess an individual's risk for COVID-19 and provides location-specific recommendations on accessing further healthcare, if needed.

The platform also includes a referral form through which individuals who have reported risk factors for COVID-19 are referred to the relevant state hotline for linkage to care.

Figure 3. Nigeria's digital architecture for COVID-19
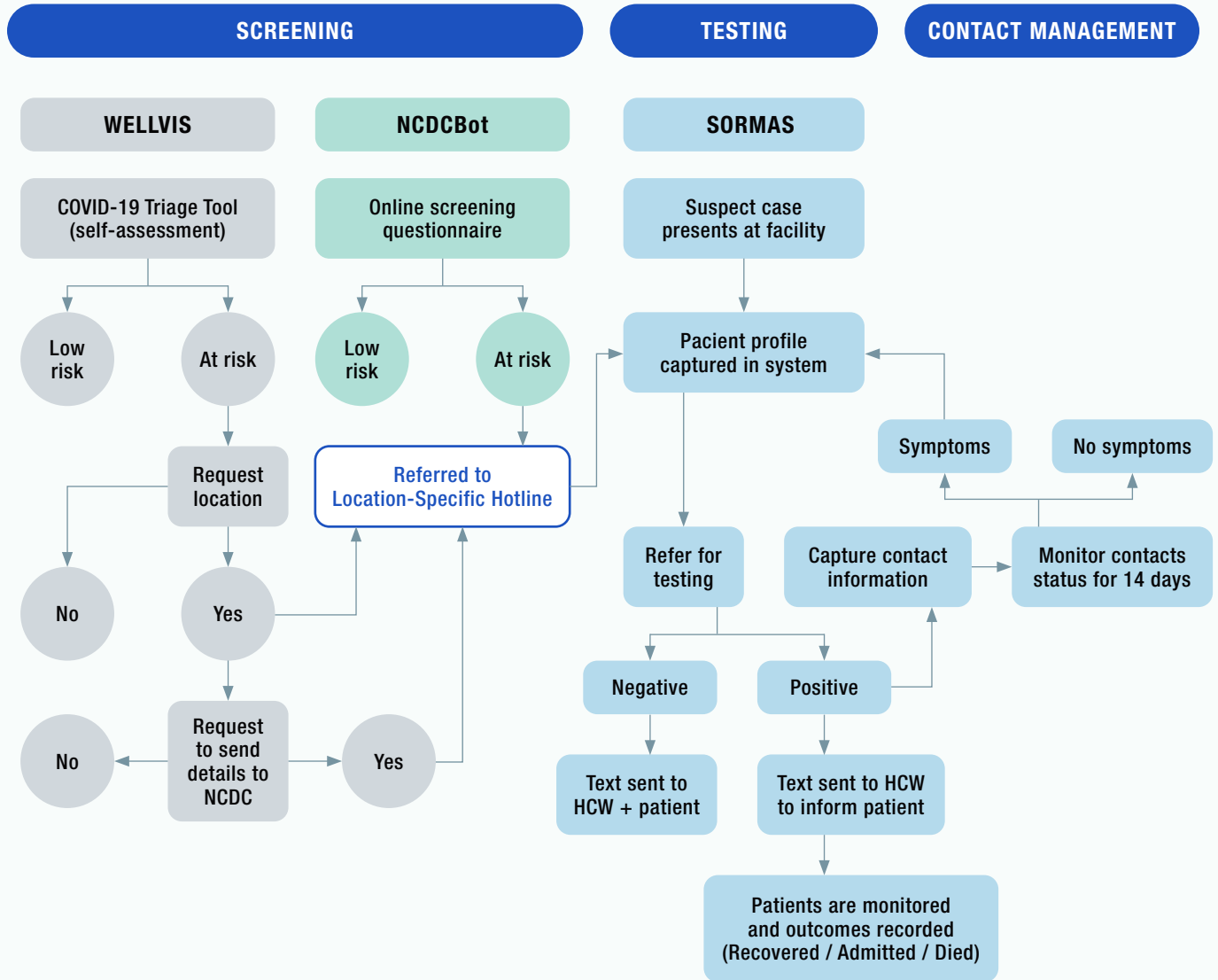
INTERACTIVE VOICE RESPONSE (IVR)

This **interactive voice response solution** is a COVID-19 self-assessment triage tool leveraging on voice auto-response technology to allow telecom users dial a **designated number (01-700-6232 or 01-700-6233)** to use the service. Members of the public would dial the designated number to answer questions in their preferred language (Hausa, Igbo, Yoruba and English) after which an assessment would be made based on their answers and the necessary steps taken.

UNSTRUCTURED SUPPLEMENTARY SERVICE DATA (USSD)

The **USSD Solution** is also a COVID-19 self-assessment triage tool that uses GSM USSD messaging technology to allow users **dial the quick code *258*258#** to report their symptoms and get a risk assessment response. The system typically allows the user report their phone number and state of residence which could be used to effectively follow up and refer appropriately.

SORMAS

SORMAS captures geocoded data across the test-trace-isolate cascade, from the moment that an individual is identified as a suspect case through to their final case outcome.

It also functions as a process management tool, automatically prompting the next step in the cascade in order to make case management standardized and efficient. Feedback mechanisms are also built into the platform to ensure that the cascade is completed within a prescribed period of time.

It can be accessed by health care workers at all levels of care – including Community Health Extension Workers – via tablet, desktop or smartphone. While internet connectivity of 2G or above is required to transmit data, the tool can also be used offline. The COVID-19 module is currently being used in health facilities, laboratories, ports of entry, and by the ministries of health and local government.

As of December 2020, there were **3,000 users** across all **774 local government areas** of the country.

Flow of data from the screening tools (Wellvis and NCDC ChatBot) to SORMAS is not automated, but an operational process. All patients who meet the case definition requiring COVID-19 testing are redirected to the relevant hotlines where they can be linked to services and followed up, at which point their data is stored in SORMAS for further investigation.

Once an individual has been referred for COVID-19 testing, their screening and contacts data are captured in SORMAS, along with their specimen tracking code, in an electronic case investigation form (CIF). Data on suspect cases are also transmitted to NCDC for inclusion in national surveillance.

Figure 4. Data flow at laboratory level (source: ncdc.gov.ng)

SAMPLE RECEPTION

Receive samples with accompanied case investigation forms – all hours of the day

Sort forms and review sample quality

If issues with sample or CIF, share feedback with relevant State immediately
Document process

Assign laboratory number on sample tube adn CIF
Input information on CIF into sample reception data base
Share CIF with data team and send sample to aliquoting unit

DATA TEAM

Cross check CIFs

Enter CIFs into database:
Cobas 8800 system – LIM
Open platform/GeneXpert – Line List

Enter reviewed results into database and share with Data Manager

Data Manager performs data quality checks, sorts results by States and shares with COVID-19 Laboratory Manager and SORMAS Team

COVID-19 Laboratory Manager performs final result review and shares with States

States communicate issues regarding reported results

LABORATORY TEAM

Aliquot samples into 2 pre-labelled cryovial tubes "A" and "B"

Cryovial tube "B" sample for storage

Cryovial tube "A" sample for analysis

Cobas high through-put

GeneXpert

Open system platform

Create barecode/worksheet

Sample analysis

Nucleic acid purification

Sample analysis

RT-rtPCR

Result analysis and documentation

COVID-19 Laboratory Manager performs Quality Control on results and sends to Data Team

Note: The Director of Laboratory Services NRL oversees all processes of this workflow

Completion of this step triggers a notification to the health worker responsible for the next step, namely sample processing and testing. As Laboratory Information Management Systems are also in place, designated data teams enter CIFs into these systems – a process that is currently manual, with efforts underway to automate it – then ensure that results are also transmitted back to SORMAS which connects states, LGAs and HFs and to the states.

Beyond government-affiliated laboratories, there are also 41 private laboratories accredited by NCDC to provide COVID-19 testing, based on their meeting specific criteria for quality and capacity.[1]

These labs are to report regularly via established communication channels for the national COVID testing laboratory network. Daily results are submitted to NCDC using a standardized laboratory reporting template that is available online, through which entries can be automatically imported into SORMAS, or CIFs entered manually by designated data teams.[2]

Once a result has been uploaded into SORMAS, the health worker receives an in-app prompt. The patient receives a text message if the result is negative: if positive, they are contacted by the HCW to receive their results over a phone call or in person to ensure appropriate counselling. Confirmed cases subsequently have their outcomes monitored and recorded in the tool, which includes sub-sections to record any further medical procedures done. Health care workers registered on SORMAS receive an in-app prompt or notifications regarding any entries related to a patient under their jurisdiction, and are responsible for registering the final outcomes: recoveries, admissions and deaths.

1. NCDC (2020) Integration of private labs into national COVID-19 response
2. NCDC (2020) Guidance for private sector medical laboratories that seek to provide testing through completely private arrangements

Diagnosis of a COVID-19 case also triggers a notification to HCWs responsible for contact investigation, who follow up with the contacts that were recorded for that patient and monitor them for the duration of the incubation period. Designated contact tracers visit the case contact and record their data in SORMAS, including referral for testing if needed. Follow up during the incubation period is done in person or telephonically, with all information entered into SORMAS. Additionally, SORMAS is used to record when contacts have been alerted, if they report symptoms, and when they are tested. Contact data is also captured by the state and the local government response teams for follow-up.

In addition to its case management functions, SORMAS also generates aggregate data for surveillance and epidemiological analysis.

This is transmitted to health authorities to support strategic decision making, with different dashboards tailored to users at various levels of the health system. This data is also transmitted to the NCDC website to provide up-to-date information on COVID-19 to the public, as illustrate in the national dashboard below. In addition, algorithms built into the platform generate early warnings for outbreaks.

**Figure 5.** NCDC Public Dashboard (source: covid19.ncdc.gov)
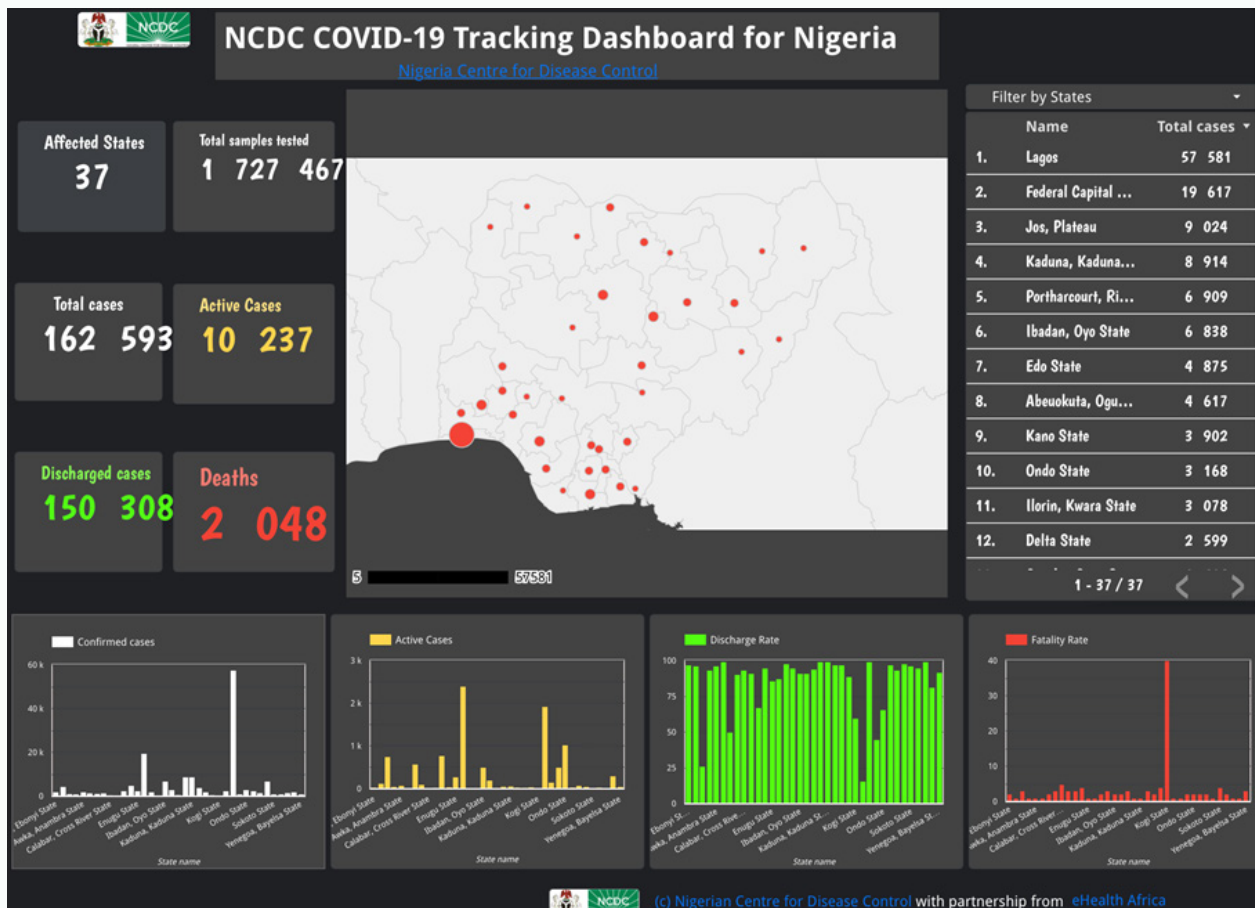
DEMONSTRATED BENEFITS
FROM USE OF DIGITAL TOOLS FOR COVID-19 MANAGEMENT
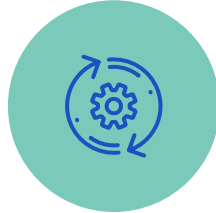
An improvement in data quality and hence decision-making has been noted by NCDC, as SORMAS ensures that all key demographic, epidemiological, and clinical variables are recorded. If any key variable is missing or incorrectly filled, the system triggers a notification to the user and prevents them from proceeding to the next step, thus ensuring completeness and sufficient detail in patient data.
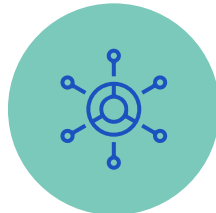
Routine recording of metrics at all steps of the TTI-cascade in one central platform allows for a deeper understanding of the epidemic and gaps, as well as of the performance of the digital tool itself, without the need for additional data collection. This can yield insights that lead to more effective responses if strategies are adapted accordingly. For example, by analyzing screening data (which is not systematically captured in many settings), NCDC was able to establish within the first three months of the country's pandemic that two thirds of confirmed cases were asymptomatic, which has implications for testing algorithms that were predominantly symptom-based. Ultimately, the programmatic impact of such insights is influenced by the extent to which programs can adapt, which is in turn influenced by broader factors such as availability of resources and infrastructure.
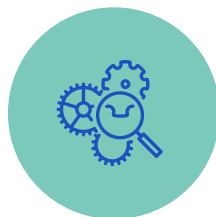
Complete visibility across the cascade of care enables real-time supervision for all cadres of health workers which, as documented in a previous case study on the broader SORMAS platform, motivates improved performance and compliance to guidelines.[1] The SORMAS process management function detects if a certain activity in the cascade has not been completed, which can contribute to improved performance or a clearer understanding of gaps in the delivery model. Multidirectional feedback loops facilitate communication and real-time information flow between all users in the ecosystem.

1. GIZ (2020) A software for disease surveillance and outbreak response: Insights from implementing SORMAS in Nigeria and Ghana

PRACTICAL STEPS
TO SCALE UP

SORMAS was developed in 2014 through a multi-institutional collaboration led by NCDC, the HZI, the African Field Epidemiology Network and German IT institutions.

To ensure that it adequately addressed the complexities of deploying digital technology for epidemic management, a wide range of consultations were held with stakeholders with expertise in this area. Thereafter multiple iterations were developed, tested and fine-tuned over a period of 9 months, before the prototype was launched in 2015. In line with the requirements of GIZ, which funded the development process, as well as in agreement with the Government of Nigeria through NCDC, SORMAS transitioned from proprietary to open-source software in 2016. Its source code is accessible to software developers through the GitHub website, who are free to use and modify it as needed, with oversight from HZI to ensure that modifications do not excessively depart from the original design and purpose of the software.

In rolling out SORMAS, a training-of-trainers approach was used to cascade knowledge and skills from central level to the end users. As new disease modules are added, this same approach is used to sensitize health workers.

The COVID-19 disease module was added in January 2020. At the time, less than half of states had begun to use SORMAS. NCDC prioritized its uptake as a key pillar of the response, and by the end of the year it was being used across all 36 states and the Federal Capital Territory in Nigeria. This process, as well as all customization and maintenance of the platform, is managed by the NCDC's SORMAS IT team.

Figure 6. Deployment of SORMAS before and after COVID-19 (source: NCDC 'One YearAfter' report)
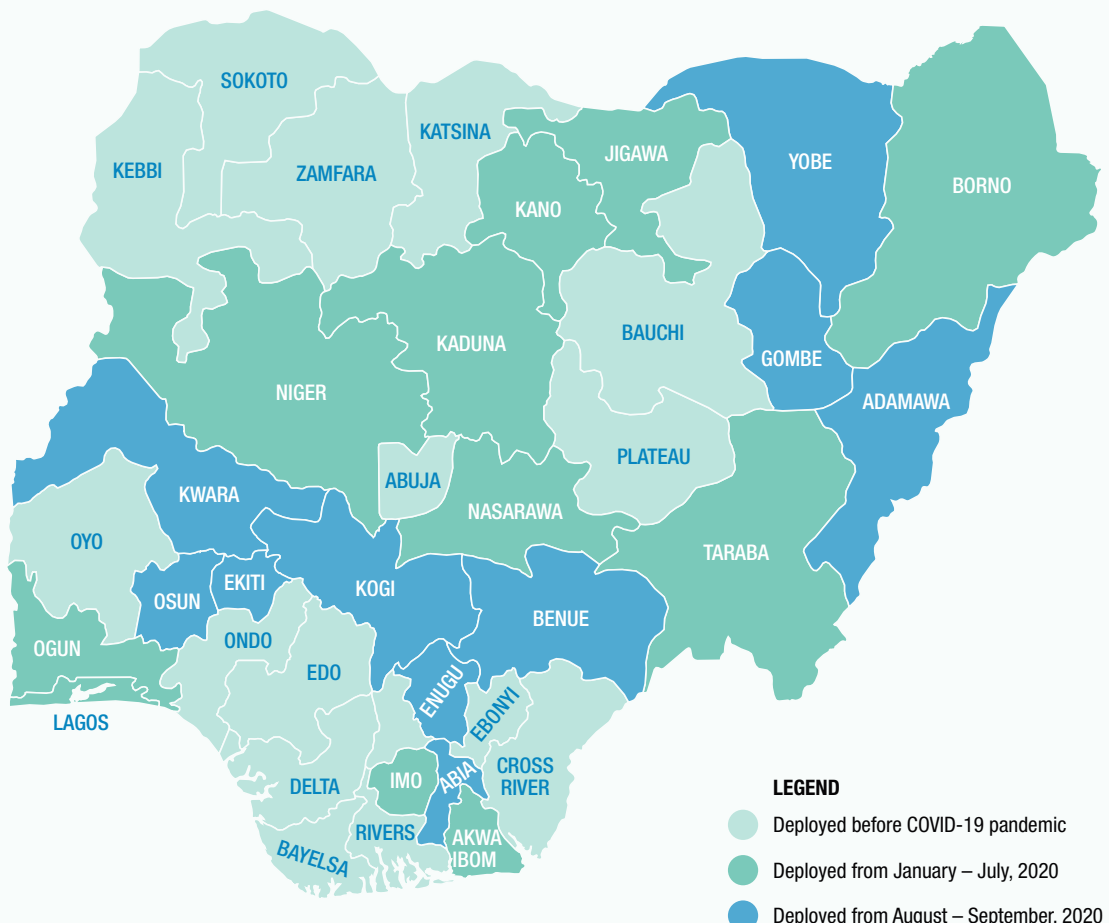
KEY SUCCESS FACTORS IN NIGERIA'S EXPERIENCE

Strong national ownership has been a characteristic of SORMAS from its inception,

due to the **NCDC's central role** in its development, the inclusive design process, and later the investment of domestic financing into the system. With the NCDC actively promoting use of SORMAS as the preferred digital solution for COVID-19 management, this has reduced the risk of multiple overlapping digital tools that can sometimes pose challenges to data management and coordination of interventions.

Integration into the broader health system has been key to the success of SORMAS.

As it pre-dated the pandemic, it was already in use for a range of other diseases, and has previously been used to coordinate and streamline the response to multiple simultaneous outbreaks. SORMAS is interoperable with DHIS-2 via a third party tool – Fast HealthCare Interoperability Resources (FHIR) Adapter – which facilitates exchange of data. Application Programming Interfaces (APIs) are being developed to ensure more seamless transmission of data between SORMAS and DHIS-2 and other necessary identified systems .

The development of SORMAS used a "design thinking" approach that was responsive to the context in which the app would be deployed,

and built on practical insights from the Ebola response. This reduces the risk of the app's success being limited by broader contextual factors, as has been observed with some other digital technologies.

Because SORMAS can be used on or offline, facilities are not required to have constant internet connectivity.

Data is stored in the platform and automatically uploaded as soon as a connection is reestablished. While this may compromise the timeliness of data transmission, it ensures that indicators can be consistently recorded regardless of broader infrastructural challenges.

The module-based approach adds flexibility to the design of SORMAS,

as new disease modules can be rapidly added without requiring substantial systems-wide changes: as was the case with COVID-19.

Coordination with private sector facilitated the development of screening tools,

including the Wellvis triage tool as well as the NCDCBot that was built in collaboration with GloEpid. It also ensured that the screening and reporting protocols used were closely aligned with NCDC guidance, and that suspect cases captured in the private sector were linked to the national surveillance and case management system.

OPERATIONAL CHALLENGES

Specifications of mobile devices earlier deployed have been a challenge, as the SORMAS application is improved with modern technological advancements, devices with old operating systems are unable to optimally support the SORMAS software.
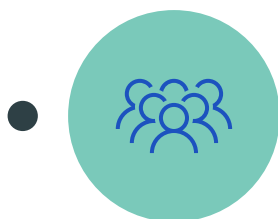
Inadequate human resource capacity at implementation level can result in delays in entering data into SORMAS, negating the benefit of having a real-time data capture system. However, with the development of the E-CIF for the public's direct use, the need for manual data entry by health workers would be drastically minimized.

KEY LEARNING
FOR OTHER
COUNTRIES

The introduction of SORMAS for the management of COVID-19 led to **improved data management and containment** of the epidemic.

Nigeria's experience demonstrates that **integrating all response management data into one platform** enables stronger analysis of the cascade of care and patient population; and facilitates communication and referral between multiple players at different levels of the health system.

While many countries have already deployed multiple digital tools for COVID-19, **ensuring automated data transmission** between these tools, and consolidation using unique patient IDs, is key to comprehensive management of the pandemic.

Agility in the development of digital tools is also key: from inception of SORMAS till date, this system continues to undergo major changes to better serve and suit the need for which it was created. It has immensely strengthened the understanding of and response to outbreaks – not only for COVID-19, but other disease areas – and the rapid scale-up across new states that was catalyzed by the pandemic has thus contributed to longer-term health systems strengthening beyond this specific disease response.