Using digital tools to strengthen COVID-19 diagnosis and case management

Case studies from Nigeria, India, and Rwanda

ASLM-FIND webinar

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FIND

Office of the Principal Scientific Adviser
to the Government of India

NCDC
NIGERIA CENTRE FOR DISEASE CONTROL

rbc Rwanda
Biomedical
Centre
Healthy People, Wealthy Nation

Today's session agenda

- **Introduction**
  - + Use of digital tools in the COVID-19 response
  - + Context and objectives for the case studies

- **Country experiences on the use of digital tools for COVID-19:**
  - + Case study 1: Insights from Nigeria
  - + Case study 2: Insights from India
  - **Interactive Q & A (1)**
  - + Case study 3: Insights from Rwanda

- **Key success factors identified by all three countries**

- **Interactive Q&A (2)**

Use of digital tools in the COVID-19 response

 Use cases

 Functions

Use cases	Functions
1 **Surveillance**	Collate and monitor real-time epidemiological data, identify hotspots, support contact tracing
2 **Prevention**	Prevent infection through education & community outreach
3 **Diagnosis**	Assess symptoms; track testing numbers and outcomes
4 **Delivery of care**	Provide clinical guidance to healthcare workers; provide patient services including referral, monitoring, and other information

As co-convener of the diagnostics pillar of the Access to COVID-19 Tools (ACT) Accelerator, FIND is working with partners to:

1. Generate evidence on the use of digital tools to strengthen COVID-19 diagnosis;

2. Support the design & implementation of digital solutions to facilitate decentralized testing.

Objective & context of the case studies

Objective: Promote knowledge exchange and highlight learnings and tools that may be useful for other countries.

Methods: Case studies were written by FIND in collaboration with government partners who provided inputs via interviews and questionnaires.

In this webinar, country representatives will present:

+ An overview of their digital systems for COVID-19 management
+ Operational approaches to implementing these systems
+ Key lessons learned, success factors & challenges

Nigeria's experience

Using a central, comprehensive digital platform to capture and consolidate data, and support case management

Lois Olajide

National Coordinator, SORMAS, Nigeria CDC

Nigeria's digital system for COVID-19 management is based on a pre-existing digital solution: SORMAS

- **SORMAS – the Surveillance, Outbreak Response Management and Analysis System** – is a comprehensive data management system integrating real-time surveillance and case management functions.

- Locally designed following the 2014 Ebola outbreak, it has been further expanded to respond to various epidemic outbreaks.

Nigeria's digital architecture for COVID-19
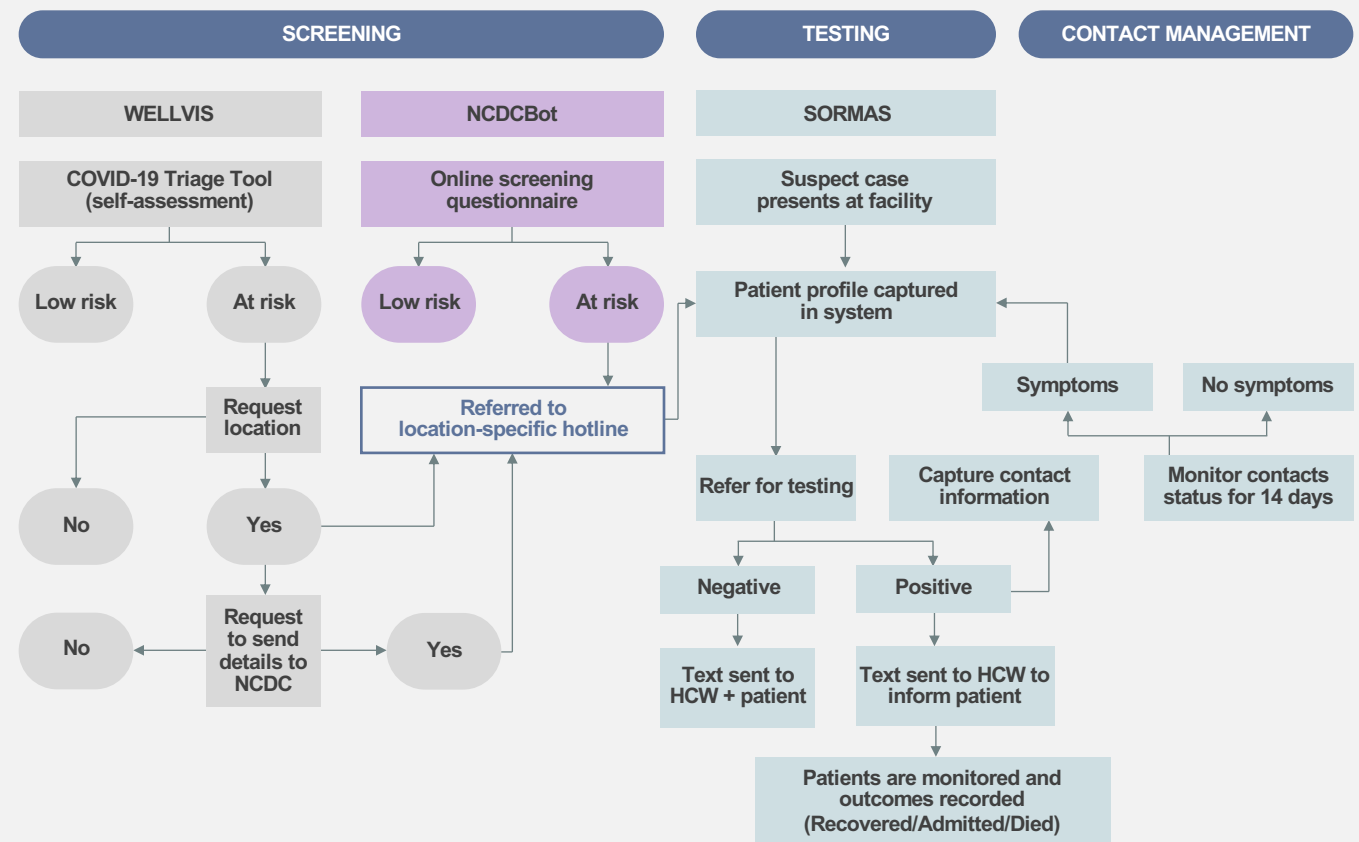
Key features of SORMAS

- **Widely accessible:** can be accessed by health workers at all levels of the system; works both online and offline.

- **End-to-end solution:** captures geocoded data across all steps of the Test-Trace-Isolate (TTI) cascade.

- **Process management support:** integrates feedback mechanisms to monitor if the care cascade is completed; enables real-time supervision.

- **Open-source** so can be adapted to other settings and countries (e.g. Ghana).

- **A module-based approach** allows for rapid addition of new data fields and case management functions.

Public-facing tools for COVID-19 linked to SORMAS

- **Self-assessment tools:** public-facing tools were developed for individuals to self-evaluate their risk factors for COVID-19 → all self-assessment data are captured in a central dashboard.

- **Referral system:** suspect cases are referred to the relevant disease control hotline based on their location for linkage to care → their details are then captured in SORMAS.

Connect center staff

Central self assessment dashboard

Web assessment solution

Health bot solution

WhatsApp bot

USSD/SMS solutions

End user

End user

End user

End user
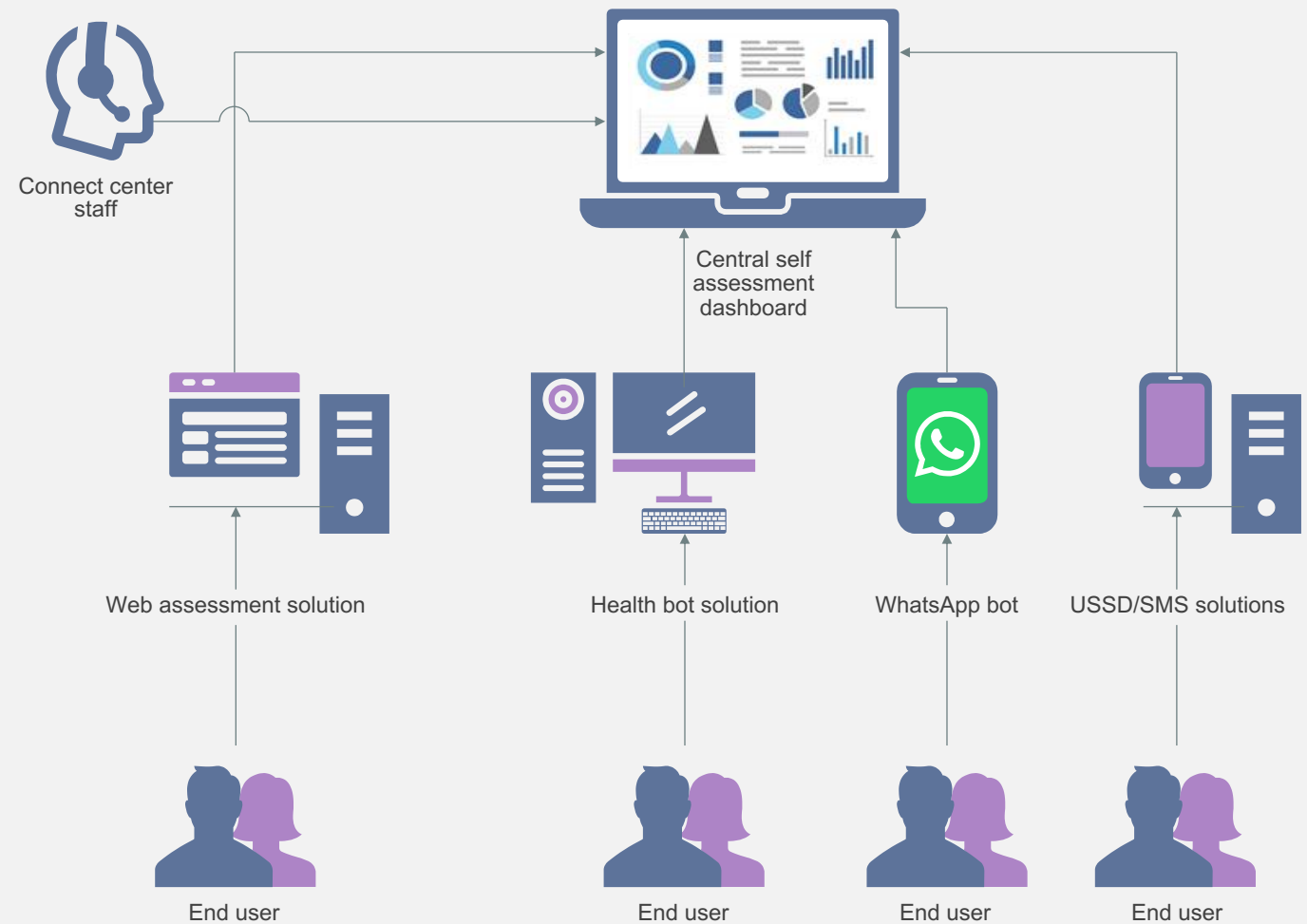
Real-time data is aggregated at national level and made publicly available via the NCDC website
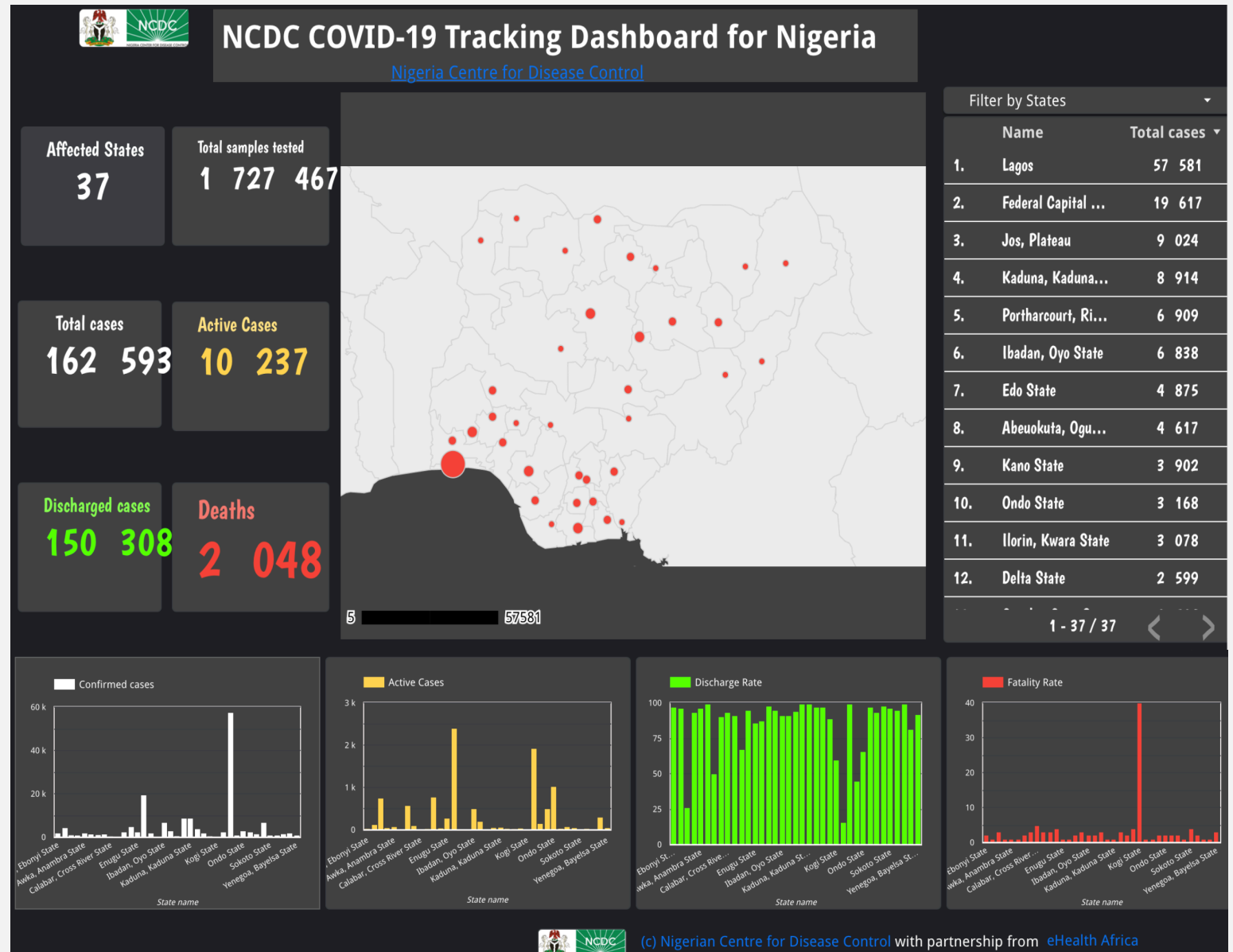
NCDC, Nigeria Centre for Disease Control

Practical steps to scale-up for COVID-19

Deployment of SORMAS before and after COVID-19

(source: NCDC 'One Year After' report)
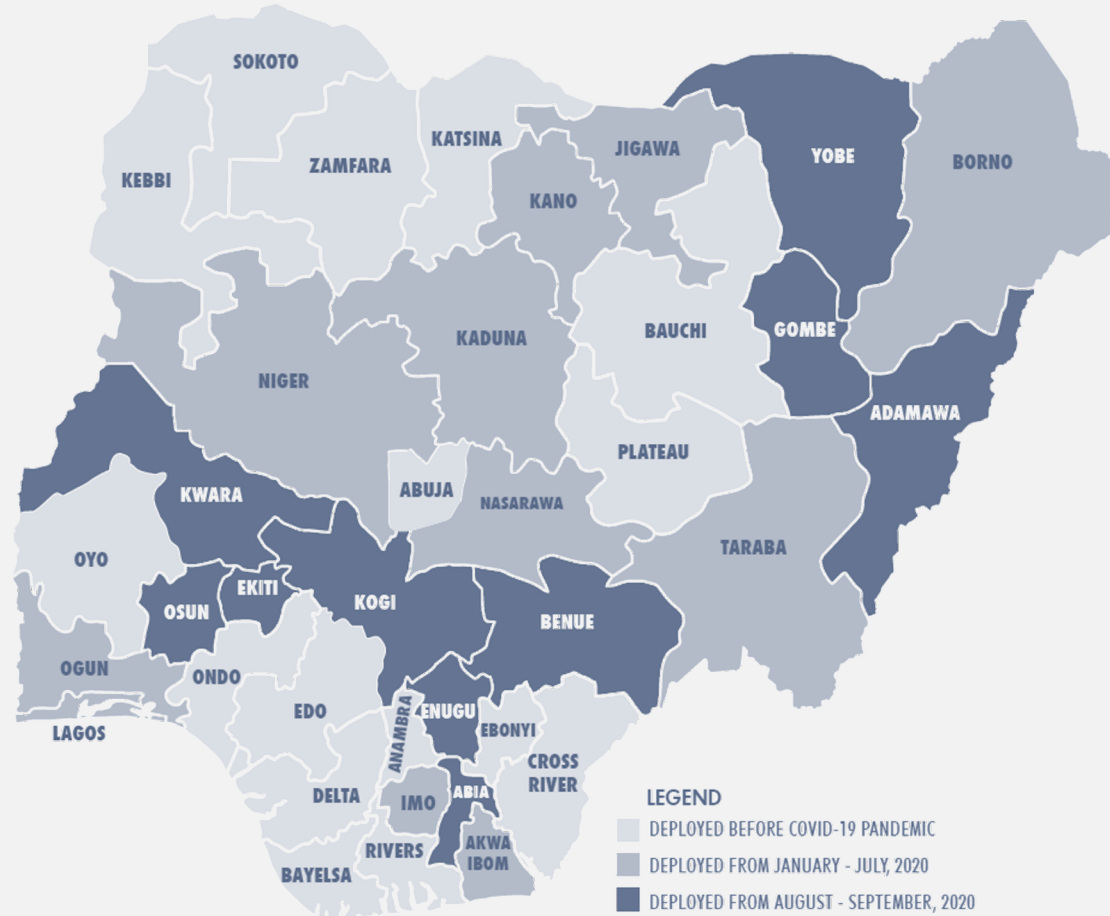
- **Rapid scale-up of SORMAS was prioritized** at the start of the pandemic to ensure a data-driven response.

- **Additional personnel were deployed** at subnational level to support digital implementation & data management.

- **Collaboration with private sector** facilitated development of digital tools and coordination of service delivery

- **System interoperability with DHIS-2** ensures COVID-19 data is fully integrated into broader health systems

Key learnings from Nigeria's experience

Success factors

- **Strong national ownership** and investment in the design and ongoing expansion of SORMAS have been important enablers.

- **Consolidating all data across the TTI cascade into one platform** has enabled a deeper understanding of the epidemic, e.g. symptom distribution among confirmed cases, and a more streamlined response.

Operational challenges

- **Underlying health system challenges**, such as inadequate human resource capacity for data entry, can reduce benefit of SORMAS.
  - NCDC is working to digitize and automate as many steps as possible, to reduce personnel time required.

- **Balancing software and hardware needs:** as SORMAS is updated, it may no longer function well on older devices.

India's experience

Using digital tools and data science to inform targeted testing strategies for more efficient and timely interventions

K. VijayRaghavan

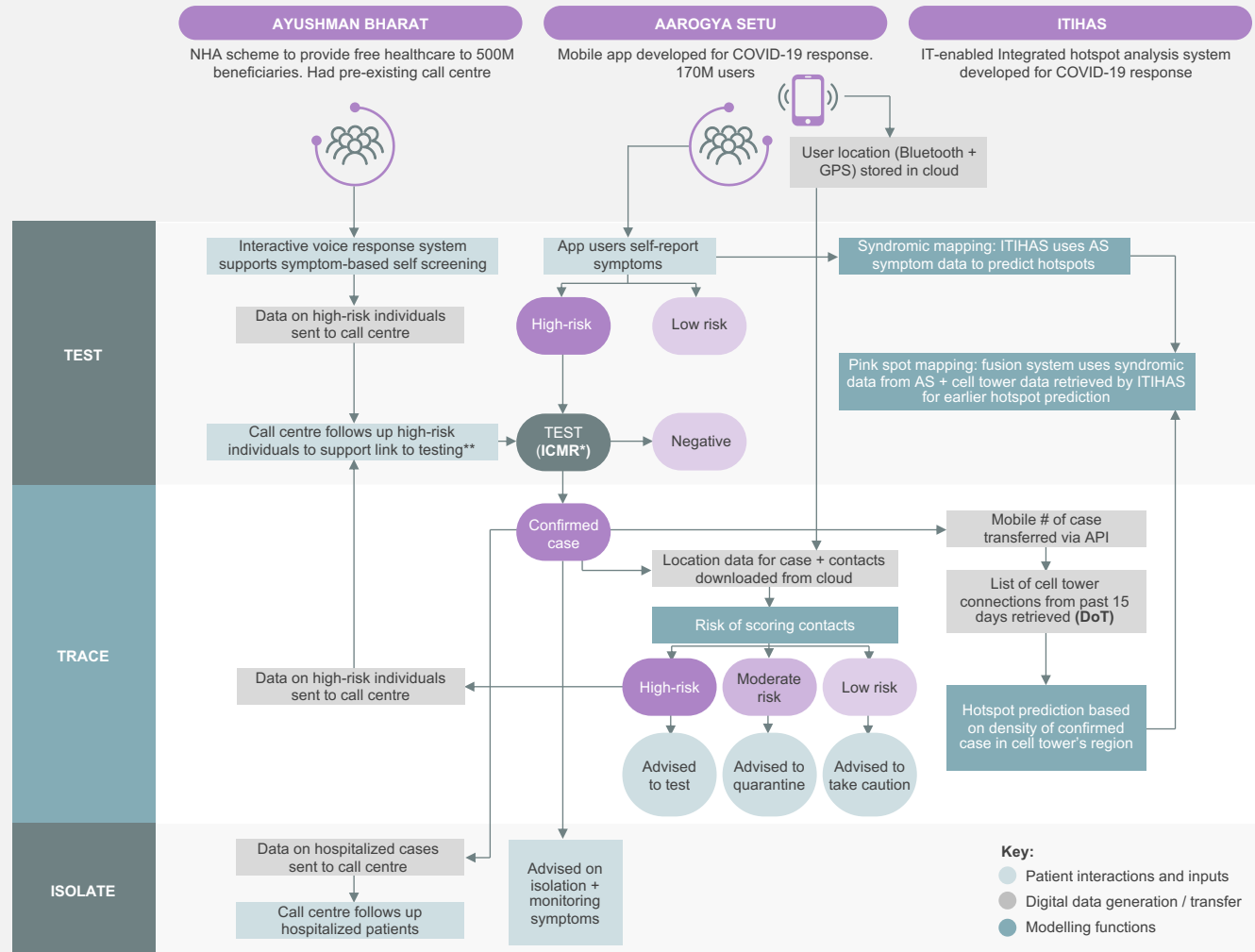Principal Scientific Adviser to the Government of India

Lalitesh Katraggada

Co-creator, Aarogya Setu

Office of the Principal Scientific Adviser
to the Government of India

India's digital system for COVID-19 management

AYUSHMAN BHARAT
NHA scheme to provide free healthcare to 500M beneficiaries. Had pre-existing call centre

AAROGYA SETU
Mobile app developed for COVID-19 response. 170M users

ITIHAS
IT-enabled Integrated hotspot analysis system developed for COVID-19 response

User location (Bluetooth + GPS) stored in cloud

TEST

Interactive voice response system supports symptom-based self screening

App users self-report symptoms

Syndromic mapping: ITIHAS uses AS symptom data to predict hotspots

Data on high-risk individuals sent to call centre

High-risk / Low risk

Pink spot mapping: fusion system uses syndromic data from AS + cell tower data retrieved by ITIHAS for earlier hotspot prediction

Call centre follows up high-risk individuals to support link to testing**

TEST (ICMR*)

Negative

TRACE

Confirmed case

Mobile # of case transferred via API

Location data for case + contacts downloaded from cloud

List of cell tower connections from past 15 days retrieved (DoT)

Risk of scoring contacts

Data on high-risk individuals sent to call centre

High-risk / Moderate risk / Low risk

Hotspot prediction based on density of confirmed case in cell tower's region

Advised to test / Advised to quarantine / Advised to take caution

ISOLATE

Data on hospitalized cases sent to call centre

Advised on isolation + monitoring symptoms

Call centre follows up hospitalized patients

Key:
- Patient interactions and inputs
- Digital data generation / transfer
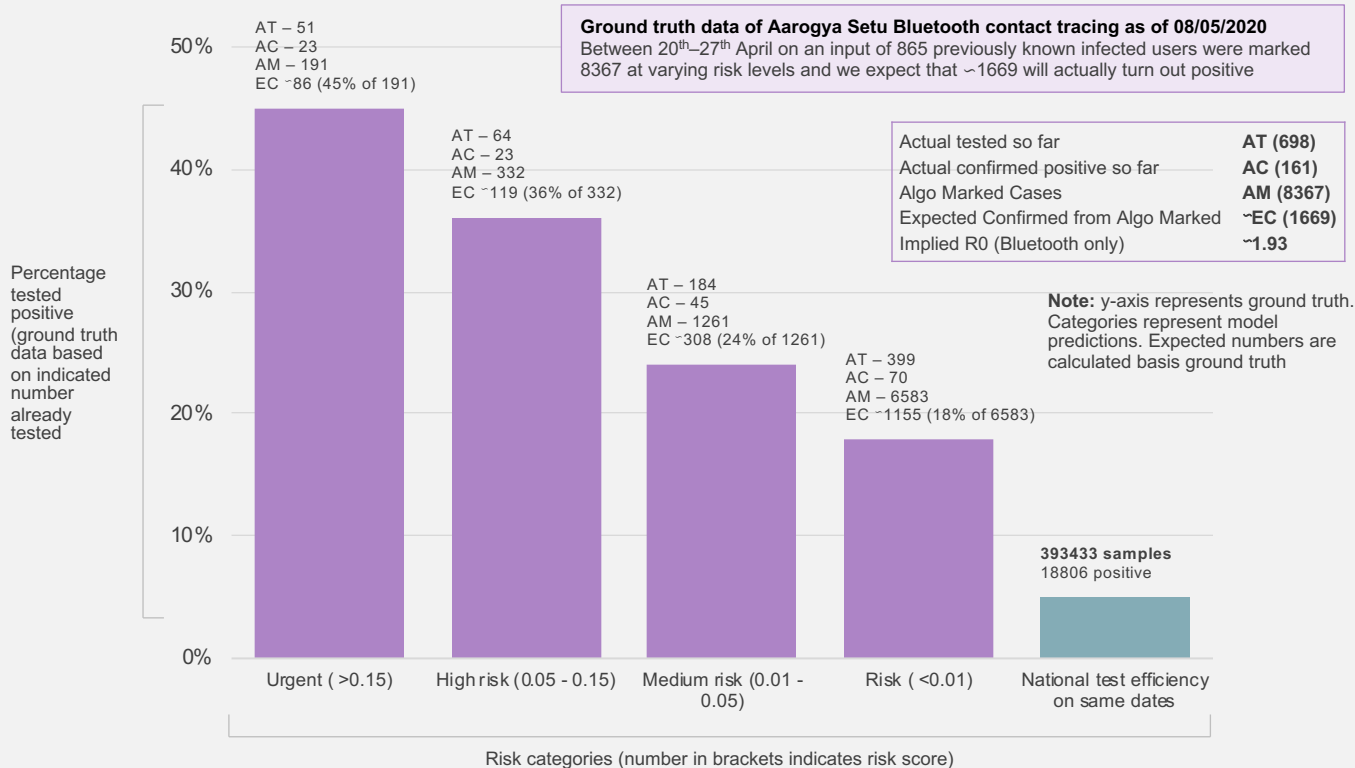- Modelling functions

API, application programming interface; AS, Aarogya Setu; DoT, Department of Technology; ICMR, Indian Council of Medical Research; ITIHAS, IT-enabled integrated Hotspot Analysis System; NHA, National Health Authority.

*ICMR has a database for all ICMR-verified laboratories, through which newly diagnosed COVID-19 cases can be tracked. Data transfer between these systems is automated.
**Ayushman Bharat's follow-up of high-risk individuals entails a more detailed workflow, outlined in section 2.2, to guide who should be prioritized for this intervention.

- **Aarogya Setu (Sanskrit for "Bridge to Health") is a public-facing mobile app** that collects self-reported symptoms and bluetooth proximity data **to identify high-risk individuals**.

- **The IT-enabled Integrated Hotspot Analysis System (ITIHAS)** integrates Setu data with additional geodata of confirmed cases **to predict hotspots**.

- To ensure that insights from Aarogya Setu are linked to **follow-up interventions**, India leveraged existing call center infrastructure at the National Health Authority's healthcare scheme (Ayushman Bharat).

Bluetooth algorithm predicts risk level for individuals

COVID-19 testing outcomes in the early days of Aarogya Setu

AT – 51
AC – 23
AM – 191
EC ⁻86 (45% of 191)

Ground truth data of Aarogya Setu Bluetooth contact tracing as of 08/05/2020
Between 20th–27th April on an input of 865 previously known infected users were marked 8367 at varying risk levels and we expect that ~1669 will actually turn out positive

AT – 64
AC – 23
AM – 332
EC ⁻119 (36% of 332)

Actual tested so far	**AT (698)**
Actual confirmed positive so far	**AC (161)**
Algo Marked Cases	**AM (8367)**
Expected Confirmed from Algo Marked	**~EC (1669)**
Implied R0 (Bluetooth only)	**~1.93**

AT – 184
AC – 45
AM – 1261
EC ⁻308 (24% of 1261)

Note: y-axis represents ground truth. Categories represent model predictions. Expected numbers are calculated basis ground truth

AT – 399
AC – 70
AM – 6583
EC ⁻1155 (18% of 6583)

Percentage tested positive (ground truth data based on indicated number already tested)

50%
40%
30%
20%
10%
0%

393433 samples
18806 positive

Urgent (>0.15) | High risk (0.05 - 0.15) | Medium risk (0.01 - 0.05) | Risk (<0.01) | National test efficiency on same dates

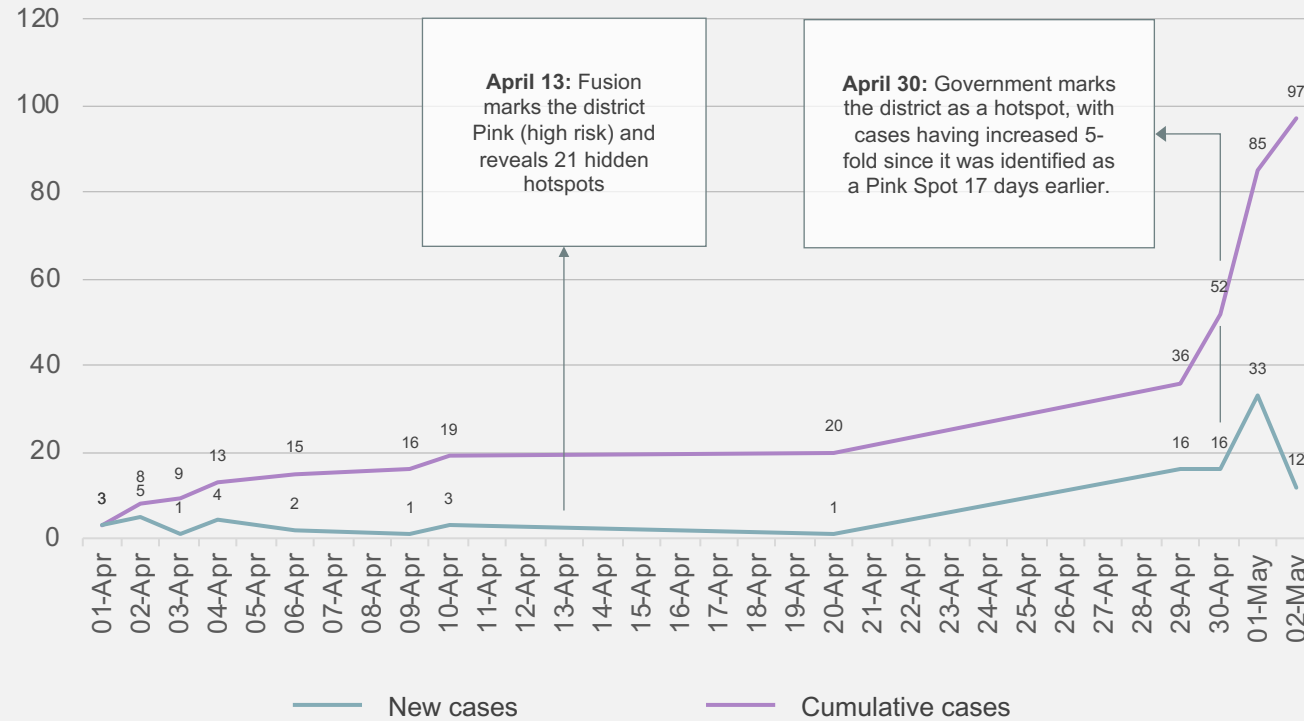Risk categories (number in brackets indicates risk score)

Targeted testing leads to efficiency gains: in the first few months of the pandemic, positivity rate in the highest risk category was ~10x national positivity rate.

Source: Aalekh Sharan / Lalitesh Katraggada

- Individuals are assigned to 1 of 4 risk categories based on degree of contact (time and proximity) with any positive case who is also an app user, and self-reported symptoms.

- The app provides individuals with updates on their COVID-19 exposure and risk level, without revealing details of positive cases.

- Information on high-risk individuals is transmitted to local health authorities for follow-up to support linkage to testing and care.

Integrated Hotspot Analysis System (ITIHAS) predicts hotspots before a surge in cases observed

COVID-19 incidence and hotspot prediction in Kanchipuram, Tamil Nadu

April 13: Fusion marks the district Pink (high risk) and reveals 21 hidden hotspots

April 30: Government marks the district as a hotspot, with cases having increased 5-fold since it was identified as a Pink Spot 17 days earlier.

— New cases   — Cumulative cases

- **Method:**
  Predictions are based on the fusion of data from Aarogya Setu, with historic location data (from cellphone tower signals) of confirmed positive cases, to determine concentration of risk in surrounding area

- **Prediction accuracy:**
  >90%

- **Targeted interventions:**
  This information is shared with local health authorities to proactively deploy targeted interventions, if resources are available.

Summary of key privacy measures

MEASURES TAKEN to protect user privacy in Aarogya Setu app

Each user is assigned a De-identified ID to which their symptom and location data are linked, allowing for **anonymized transmission of data**.	**Location data are stored in encrypted form** on the device, and only downloaded when the person becomes a confirmed case or is identified to be at high risk of infection by the algorithm (only 1.5% of users have had their data downloaded).	Location data are **automatically deleted after 15 days** if no interaction meeting the risk criteria has been logged.
When providing information on high-risk individuals for follow-up, **only mobile phone numbers, and not names, are used**.	When high-risk individuals are alerted that they have been in contact with a confirmed case, they do not receive details on who the index case was.	**The entire source code has been published online** to encourage citizens to actively engage with it to address their security and privacy issues. Financial incentives are awarded to anyone who can identify ways to strengthen the app.

Legal stipulation were put in place to explicitly limit the use of Aarogya Setu data to the COVID-19 response.

Key learnings from India's experience

- **The use of digital tools and data science can greatly increase the efficiency of a COVID-19 response** – if uptake is sufficient and linked to responsive, adequately-resourced health systems to implement data-driven interventions.

- **Citizen collaboration was key to rapid development** of India's digital architecture while maintaining technical rigor. Volunteer work by software engineers across the country supports ongoing maintenance and expansion of the software.

- **There is a need to address the limited capacity to use digital solutions at the lowest levels of care**, due to underlying health systems challenges such as inadequate technological infrastructure and/or scarcity of skilled personnel in the fields of digital tools and data.
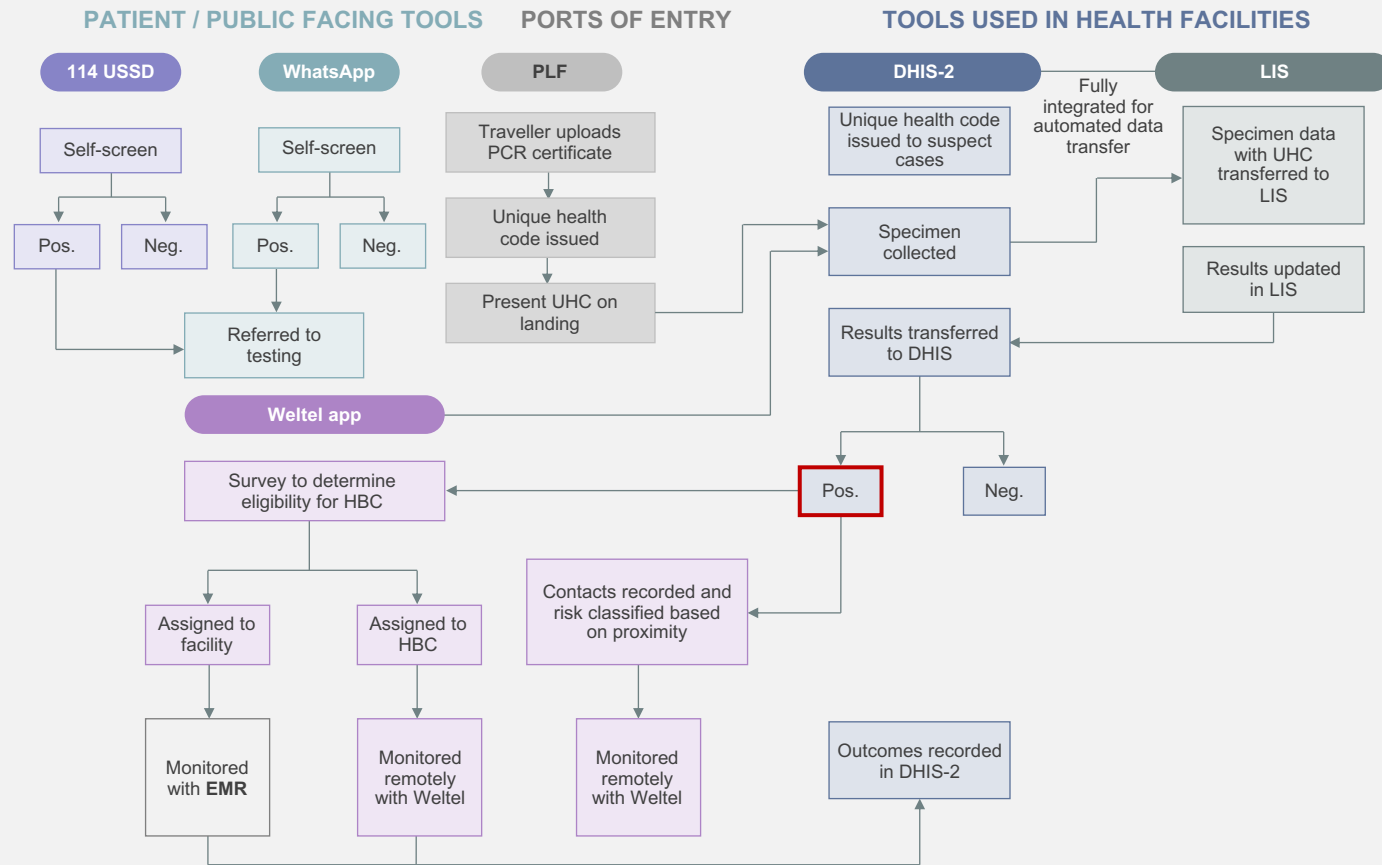
Rwanda's experience

Integrating data flow across multiple testing sites in public and private sector, and minimizing time required for data management and communication across the health system

Muhammed Semakula

Leader of Data Science & IT Solutions for COVID-19 Response, Rwanda Biomedical Centre

Rwanda
Biomedical
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Overview of national digital system for COVID-19

PATIENT / PUBLIC FACING TOOLS   **PORTS OF ENTRY**   **TOOLS USED IN HEALTH FACILITIES**

Diagram

114 USSD
- Self-screen
  - Pos.
  - Neg.

WhatsApp
- Self-screen
  - Pos.
  - Neg.

Referred to testing

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

Weltel app

Survey to determine eligibility for HBC
- Assigned to facility
  - Monitored with **EMR**
- Assigned to HBC
  - Monitored remotely with Weltel

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

Outcomes recorded in DHIS-2

DHIS-2
- Unique health code issued to suspect cases
- Specimen collected
- Results transferred to DHIS
  - Pos.
  - Neg.

Fully integrated for automated data transfer

LIS
- Specimen data with UHC transferred to LIS
- Results updated in LIS

Command Post
Facilities 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

Body

- In response to the pandemic, new tools were integrated into Rwanda's pre-existing digital health architecture, including:

  + Public-facing tools: for information and self-assessment

  + Passenger locator form (PLF): stores traveller data and issues their unique health code for use upon arrival

- Command Post connects patients and public with health providers

Integrated COVID-19 data management and flow
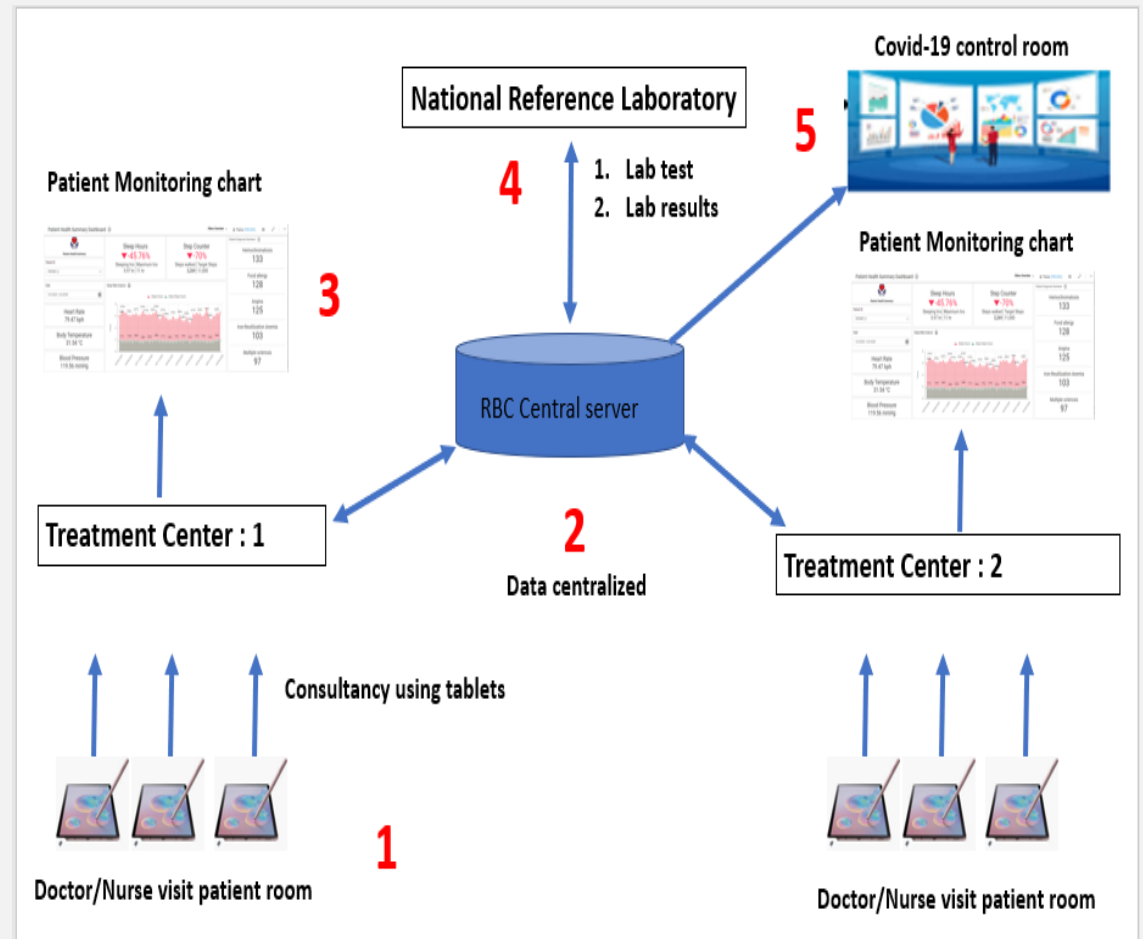
Minimizing time required to manage results

- With all tests registered in DHIS-2 and linked to the lab information system, results are uploaded in real-time.

- Using their unique ID and cellphone number, patients can directly access current and past results via an online portal.

- Negative results are sent to patients by an automated text message.
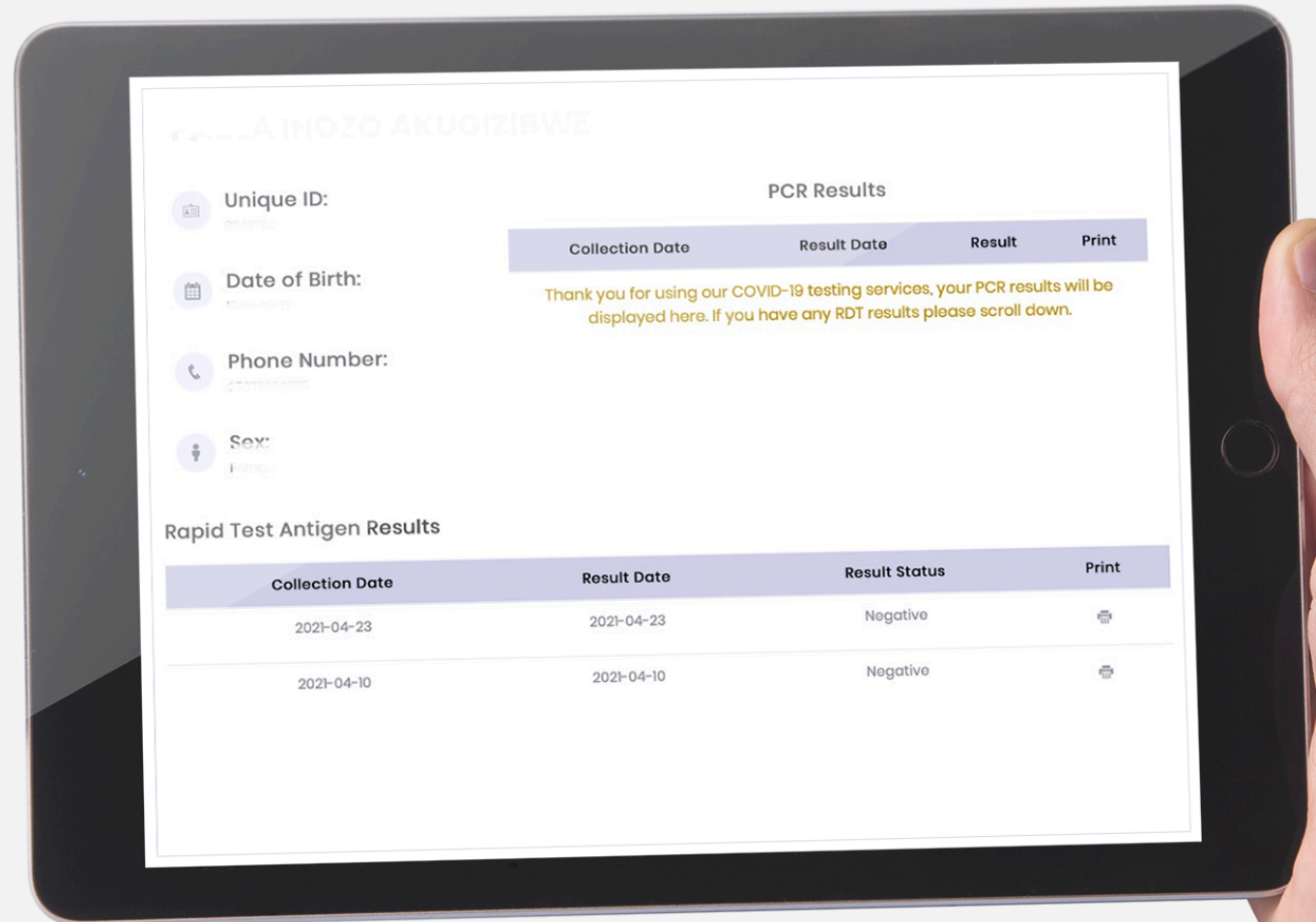
Expanding digital tools to support decentralized testing

- Community health workers (CHWs) are a key pillar of the national health system and have contributed substantially to active case finding in other disease areas such as tuberculosis and malaria.

- **e-ASCOV: a digital application developed locally to support CHWs in the screening and identification of suspect cases within the communities.**

  - + Provides clinical decision-making guidance (identifying who should be referred for testing), while offering real-time capture and transmission of data.

  - + Planned expansion of eASCov will support further decentralization of rapid testing outside of health facilities.

All COVID-19 data is aggregated and mapped at national level, and publicly accessible via RBC website

Key learnings from Rwanda's experience

- **Establishing an integrated digital system to capture all COVID-19 data in one place at the point of testing** minimizes fragmentation, and reduces the time spent by health personnel on data management and transfer.

- **Enabling patients to directly access their COVID-19 testing record** further reduces strain on the health system with regards to communicating results and verified certificates, which can all be accessed through an online portal.

- **Consistent investment in long-term strategies to improve digital health** is needed to establish digital infrastructure at all levels of the health system that can be rapidly adapted for emergency responses.

Conclusion

Summary of key learnings across all countries, and opportunities to expand in future

Key success factors identified across countries

- To achieve optimal benefit from the use of digital tools and data science, **health systems should be able to respond rapidly** to the insights they generate.

- **Availability of skilled personnel** is key for data capture, management and supervision, and to reduce the impact of personnel shortages, data transfer should be automated to the greatest extent possible.

- **Existing local infrastructures and capacity should be leveraged**, including through public-private sector collaborations.

- **Long-term investment in digital health infrastructure**, especially at the lowest levels of care, is key to rapid deployment of digital tools in an emergency context.

The full case study reports are available on FIND's website: https://www.finddx.org/covid-19/digital-health/

Several repositories of digital tools available for COVID-19 can be accessed online

- Longlist of solutions compiled via ICTworks – available here

- WHO Digital Health Atlas – available here

- BMGF/Johns Hopkins University – Digital Solutions for COVID-19 Response – available here

- CDC – Guide to Global Digital Tools for COVID-19 Response – available here

- European Investment Bank and others –"Africa's digital solutions to tackle COVID-19"- available here

- Digital Square - Global Good Adaptations to COVID-19 - available here

- World Bank- Leveraging Digital Solutions to Fight COVID-19: Lessons from ASEAN Countries - available here

Opportunities for countries seeking operational support for deployment of digital tools

- The case studies illustrate that digital technologies are not in themselves a solution, but require robust and context-specific implementation strategies.

- For country partners seeking additional information on implementation of digital technologies in the COVID-19 response, please contact: digitalhealth@finddx.org

- Complete case study reports are available on FIND's website: https://www.finddx.org/covid-19/digital-health/