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DIPC

Report:

DPPA

Digital Pandemic Preparedness Assessment

Nigeria

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The Authors apologize to any individuals or organizations inadvertently omitted from this list.

CONTENTS

Figures and Tables

Acronyms

BMZ	Federal Ministry for Economic Cooperation and Development
CDC	Centre for Disease Control and Prevention
DHIS2	District Health Information System version 2
DICE	Digital Centre of Excellence
DPP	Digital Pandemic Preparedness
DPPA	Digital Pandemic Preparedness Assessment
DPRS	Directorate for Planning Research and Statistics
ECOWAS	Economic Community of West African States
EDIT	Early-Stage Digital Health Investment Tool
EHA	E-Health Africa
FMoH	Federal Ministry of Health
GFA	GFA Consulting Group
GIZ	German Agency for International Development Cooperation
HIE	Health Information Exchange
HL7FHIR	Health Level Seven Fast Healthcare Interoperability Resources
HISP	Health Information System Program
NCDC	Nigerian Centre for Disease Control
NPHCDA	National Primary Healthcare Development Agency
RPPP	Regional Program Support to Pandemic Prevention
SFTEHIN	Society for Telemedicine and eHealth
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organisation

How to read this report

This report aims to provide an overview of the digital landscape, a narrative and recommendations on the Nigerian digital health preparedness in the event of an epidemic in Nigeria.

The **Executive Summary** provides an overview of the key findings and conclusions of the report. The **Methodology** section explains the configuration of the prototype Digital Pandemic Preparedness Assessment (DPPA) tool and the processes that key actors need to follow to generate the results.

The **results of the evaluation** are elaborated in the country-specific results sections, which are subdivided into five (5) work packages (WP):

- **WP1: Preliminary work** gives an overview of the key actors involved in this evaluation and to whom the report might be of interest.
- **WP2: Digital Health Ecosystem** provides an overview of the digital health ecosystem in Nigeria, along six key dimensions: human capacity, investment and financing, data capture and use, infrastructure, standards and interoperability, and governance and policy.
- **WP3: Opportunities** presents all potential digital tools, including digital global public goods, which could be relevant to prepare the country for a pandemic at national and sub-national level.
- **WP4: Gaps** outlines the gaps identified by the DPPA with regard to health system functionalities that can be served by digital tools.
- **WP5: Recommendations** is a set of preliminary recommendations regarding the digital health ecosystem, pandemic preparedness and selected global goods that could be considered when prioritizing recommendations for possible actions by the Government of Nigeria and other key stakeholders.

The last section is the **conclusion**, which summarises the evaluation and gives a first overview of how the results have been adapted by the stakeholders.

Executive Summary

The advent of Covid-19 has highlighted the usefulness of digital tools in public health and epidemiology. In this context, the German Agency for International Development Cooperation (GIZ) Global Health and Digitalisation Programme and other international stakeholders have sought to identify and map the gaps in the digital health ecosystem of partner countries. The first version of the Digital Pandemic Preparedness Assessment framework was finalised in October 2021. It is being piloted in five member countries of the Economic Community of West African States (ECOWAS): Cote d'Ivoire, Nigeria, Togo, Ghana, and Sierra Leone. The DPPA was conducted from September 2021 to June 2022 in Nigeria.

Objective
The objective was to identify the need for digital tools that fit into Nigeria's existing digital health ecosystem that can modernise overall pandemic preparedness. More specifically, it was to i) assess the different functionalities of the digital health ecosystem in the country's health system; ii) identify gaps and opportunities by functionality and iii) make recommendations for action based on the analysis of each identified gap/opportunity.

Methodology
A literature review and stakeholder interviews based on the DPPA were conducted. The Map & Match database was used as a starting point to identify a set of existing digital tools in the country. In addition, an important part of the DPPA was an analysis of the status and digital health ecosystem in the country. To complement this aspect of the DPPA, the Initial Stage Digital Health Investment Tool (EDIT) was integrated as an essential part of the process of assessing the country's digital health readiness (infrastructure, strategy).

Results
The analysis of the Digital Ecosystem with respect to a number of initial and essential parameters (infrastructure, human capacity, standards and interoperability etc.) showed that Nigeria demonstrates a surprisingly poor readiness to conduct digital health activities at the national level. The

overall impression is that, at the national level, despite all the good work that has gone on, there is still a considerable way to go. Common themes that emerged were the need for improved co-ordination and implementation. The review of the Map and Match database shows that out of hundred and fifty-nine (159) tools, more than sixty (60) digital tools are deployed in Nigeria in the context of pandemics. The remaining tools either are no longer in use or have not been used to respond to pandemics. Digital tools are mainly used for surveillance purposes, case management and management of the supply chain and health facility logistics. A few packages are deployed for contact and proximity tracing. There are no single tools for One Health and no interoperability engines exist currently in the ecosystem.

Recommendations

Twelve recommendations were made to address the gaps and deficiencies identified at the ecosystem level, as well as towards improving digital pandemic preparedness. With these recommendations, the Federal Ministry of Health will be able to prioritise the most urgent or important items for the country and engage partners to obtain technical or financial support. The list of recommendations is provided below.

[1]https://digitalsquare.org/covid19-map-match
[2]Tools — Kati Collective

Recommendations

Improving the Digital Health Ecosystem

R1.1 Leadership and Coordination
R1.2 Digital Health Landscape Analysis
R1.3 Accelerate the Release and Implementation of the Nigerian Health ICT Framework (2022-2027)
R1.4 Upscaling Digital Skills of Health Workers
R1.5 Improving Political Will and Leadership
R1.6 Strengthening Indigenous private sector participation in Digital Health

Digital Pandemic Preparedness

R2.1 Strengthen Bi-directional client communication
R2.2 Develop Appropriate Proximity Tracing Solutions
R2.3 Strengthen One Health Initiative
R2.4 Strengthen and scale up a health workforce training platform
R2.5 Develop Healthcare Resource Discovery tool
R2.6 Strengthen Interoperability and Interoperability engines

01 BACKGROUND AND OBJECTIVES

Digital Pandemic Preparedness (DPP) is becoming crucial not only because paper-based methods have shown their limitations in the face of increasing numbers of cases, but also because epidemics require adequate national, regional and international control measures, strategies and optimal allocation of available resources. Digital tools allow the generation of granular data to identify and model trends in disease evolution and guide policy changes and response strategies. This is becoming increasingly important, especially since the advent of Covid-19, which has highlighted the usefulness of digital tools in public health and epidemiology.

However, there has been an atypical explosion in the digitalisation of the health sector in partner countries, leading to an uncoordinated multiplication of digital tools, sometimes on a very large scale. This phenomenon hinders the consistency of the data collected and reveals major gaps in the capacity to manage and guide informed decision-making in pandemic prevention. Good governance and a shared strategy are therefore needed to enable the alignment of multilateral partners and integrated digital tools. This in turn will support public health administration and effectively help partner countries to better manage the current COVID-19 pandemic, as well as potential future outbreaks.

It is in this context that the German Agency for International Development Cooperation (GIZ) Global Health and Digitalisation Programme and other international stakeholders have sought to identify and map the gaps in the digital health ecosystem of partner countries. By mid-2020, the Programme had successfully defined a DPP context and a prototype digital tool for conducting local assessments. Meanwhile, USAID, in collaboration with Digital Square, has also succeeded in establishing the Map & Match (M&M) database which provides a good illustration of the digital tools implemented by a large number of stakeholders in the field of public health.

The objective of the Digital Pandemic Preparedness Assessment (DPPA) is to assess the current digital health landscape for pandemic preparedness and response, identify opportunities to further develop this landscape and propose activities to explore these opportunities.

1.1 DPPA

The development of the prototype DPPA tool was commissioned by GIZ to the GFA Consulting Group (GFA). The concept was developed as a framework that provides a digital tool and a systematic methodology to identify gaps and opportunities in existing digital tools in a given country to enable the national health system to be prepared to respond to a pandemic.

The DPPA digital tool integrates and builds on the important work of other partners, including USAID's Map and Match database, feedback from various stakeholders such as the Centers for Disease Control and Prevention (CDC), the World Bank, and the UNICEF/WHO-led Digital Center of Excellence (DICE). In addition, the DPPA digital tool has integrated the Early Stage Digital Health Investment Tool (EDIT), a digital global asset developed by the Kati Collective.

The results of the DPPA digital tool are assessed and interpreted to formulate scenarios for integrating or enhancing interoperability within an existing digital health ecosystem. With the DPPA reports, partner countries and Multilateral Organisations have relevant insights on how to address these gaps or opportunities through digital applications and appropriate measures to modernise public health pandemic preparedness and decision-making.

The first version of the DPPA was finalised in October 2021. It is being piloted in five member countries of the Economic Community of West African States (ECOWAS): Cote d'Ivoire, Nigeria, Nigeria, Nigeria and Sierra Leone.

1.2 Nigeria as a pilot country

Nigeria has three tiers of government. The healthcare structure is handled across the three tiers:

- Federal Government: Tertiary Care
- State Government: Secondary care
- Local Government: Primary Healthcare

According to global standards, Nigeria's health system has been experiencing low health-care investments resulting in high individual out-of-pocket expenditure, which has limited access to health care services. Primary healthcare is underdeveloped and shortage and/or misdistribution of skilled health workers as well as absenteeism further restrict access to quality health care to the larger population. The country is highly prone to rapid spread of infections, and there have been persistent disease outbreaks in the region over recent decades, including meningitis, Lassa fever, and Ebola, along with COVID-19. Susceptibility to epidemics as well as civil unrest around border communities in Nigeria put a burden on the healthcare costs, as well as continuity and quality of services .

Nigeria states (36)

Nigeria regions (6)

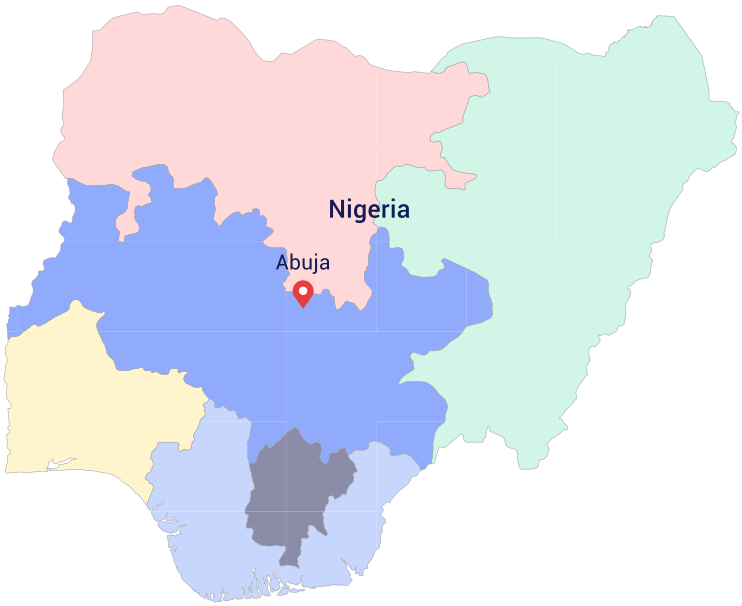

Figure 1 *Map of Nigeria showing states (36+Federal Capital Territory) and regions (6)*

[3]Angell et al. Population Health Outcomes in Nigeria compared with other South West African countries, 1998-2019: a systematic analysis for the Global Burden of Disease Study. The Lancet. March 15. 2022. Vol 399: No 10330

02 DPPA TOOLKIT AND METHODS

The DPPA data collection process can be described in five (5) steps or Work Packages (WP). 1) Preliminary work, 2) a qualitative assessment of the digital health ecosystem, 3) validation of digital health tools within the local context using the Map and Match data as a starting point, 4) mapping of the landscape of existing digital tools, 5) interpretation of results to identify opportunities, gaps and make recommendations.

2.1 WP1: Preliminary Work with Stakeholders

Before starting the DPPA process, it is crucial to obtain the support and approval of the country's Ministry of Health and key stakeholders in the health sector. To do this, a few meetings are necessary to present the DPPA concept, its objectives and, most importantly, the benefits that the results could bring to digital health strategies and donor-supported activities during the different phases of an epidemic.

For the stakeholder mapping, a simple coding was defined. The aim is to represent key actors who can contribute to decision-making processes that are very important for the collection of information and the implementation of recommendations.

Primary: key actors for information gathering and support with the assessment process or decision making: For example, national governmental stakeholders

Secondary: key actors for information dissemination. For example, multilateral stakeholders who might be interested in funding some of the recommendations as part of their programme.

2.2 WP2: Digital Health Ecosystem Analysis and EDIT tool

An important part of the DPPA is to analyse the status of the digital health ecosystem in countries. This should identify key elements of the system that can be reused, exploited and built upon to improve a country's health system before, during and after a pandemic. The tool allows for the capture of basic epidemiological data, qualitative information on the country's digital health preparedness and data sources for potential aggregate data indicators collected and monitored centrally by the country's health authorities.

To complement this aspect of the DPPA, the EDIT tool has been integrated as an essential part of the process of assessing the country's readiness (infrastructure, strategy) for digital health. It is a digital public good developed by the Kati collective. It defines a set of 79 indicators that help describe the digital health landscape at the national level and identify areas that require specific improvements or digital tools. The EDIT indicators are divided into six (6) key blocks: human capacity, investment and financing, data capture and use, infrastructure, standards and interoperability, and governance and policy. EDIT has labelled each indicator as either informative, enabling or critical. In a further process, EDIT allows indicators to be scored according to the country context with a number between 1 (non-existent) and 5 (functional at the optimal level). A minimum score of three (3) as the final score in the overall EDIT assessment should be a good indicator of a country's digital health readiness to conduct activities at the national level.

2.3 WP3: Map and Match data and existing digital tools

Map & Match is a USAID-funded project that provides a landscape of existing and adaptable digital tools used at the country level. These digital tools are then mapped to potential use cases for COVID-19 and broader pandemic management.

In this context, the Map & Match database is used as a baseline to obtain a set of existing digital tools in the country. Therefore, the first step is to validate the Map & Match data locally, in order to assess use cases and deployment status.

The second step, in cases where there is a national database or knowledge of other digital tools in the health sector, is to expand the list of available digital tools before starting the assessment.

Having completed this assignment, the DPPA digital tool automatically generates a table with all the functional DPP opportunities available in the country. The following information is the minimum information that must be validated in the country before starting the assessment.

Table 1 *Information to be validated in the country*

Name of Column in DPPA Tool	Description
Project/Tool	The software or project name under which the software was implemented.
Software Name (incl. package, module etc)	The given name to the software, to be used to identify and describe the solution.
Primary purpose of tool	A short description of the tool and the status in the country. In case this information is not available, a comment on the efforts to get this information will suffice.
Funder	Organization(s) involved in tool funding
Implementer	Organization(s) involved in tool implementation
Government Contributions	(1) Yes (2) Yes, MOH is fully funding the project (3) Yes, there is a financial contribution through MOH budget (4) Yes, they are contributing in-kind people or time (5) No, they have not yet contributed (6) Unknown In case this status is unknown, a simple text describing what effort has been done to get this information will suffice.

Tool proprietary /Open source	(1) Freemium (2) Non protective free and open-source software (e.g., Apache) (3) Open source (4) Proprietary (5) Protective free and open-source software (6) Public domain (7) Unknown In case this status is unknown, a simple text describing what effort has been done to get this information will suffice.
Scale: National or Sub-National	(1) National (2) Sub-National (3) Unknown In case this status is unknown, a simple text describing what effort has been done to get this information will suffice.
Scale: Scope	A description of the scale at which the tool is being used
Link	Website, GitHub, or Developer - Organization(s) involved in tool development
Scale: Regions	# of regions the tool is being used in
GIZ DPP Categories	This refers to the 14 DPP use cases. In case a tool is added to the list, the corresponding and validated DPP use case(s) if existing need to be listed: 1. Surveillance 2. Laboratory systems 3. Case management 4. Contact tracing 5. Proximity tracing 6. Coordination & operations 7. Supply chain & health facility logistics 8. Health facility administration 9. Health worker training 10. Risk communication & community engagement 11. One Health 12. Interoperability 13. Vaccine delivery 14. Data analytics, visualization & use

2.4 WP4: DPP Uses Cases and Mapping Process

The use cases and functionalities of the DPP were developed in alignment with USAID's Map & Match use cases, which were defined in a framework describing how digital tools can be adapted and used during different phases of an epidemic (Digital Applications and Tools across an Epidemiological Curve). The DPP use cases were further broken down into 64 sub-features.

For the pilot phase of the DPPA, the mapping process consists of validating locally with national key stakeholders the use cases of the DPPA against the existing landscape. The process has been documented in an e-learning format to enable stakeholders to understand the process.

For the evaluation, a simple coding was defined:

- **(1) Deployed:** If a digital tool is deployed, and the functionality is used in the country.
- **(2) Existing functionality in the software package, but NOT deployed:** If not used.
- **( ) Unknown / NA:** Empty boxes indicate that the status is unknown or not available.

DPP CATEGORIES
1. SURVEILLANCE
2. LABORATORY SYSTEMS
3. CASE MANAGEMENT
4. CONTACT TRACING
5. PROXIMITY TRACING
6. CORDINATION & OPERATIONS
7. SUPPLE CHAIN & HEATH FACILITY LOGISTICS
8. HEALTH FACILITY ADMINISTRATION
9. HEALTH WORKER TRAINING
10. RISK COMMUNICATION & COMMUNITY ENGAGEMENT
11. ONE HEALTH
12. INTEROPERABILITY
13. VACCINE DELIVERY
14. DATA ANALYTICS, VISUALIZATION & USE

14 DPP Categories — Broken down into 64 DPP functionalitites

2.0 LABORATORY SYSTEMS	
2.1	Link patient and healthcare workers to the patient sample sent to the laboratory for testing
2.2	Guidance (to health workers) on the methos to collect a sample
2.3	Notifications when results are available (to patient, to healthcare facility for contact tracing etc.)
2.4	Integration with case management application and surveillance tools (to confirm suspected cases are positive or not)

Figure 2: *List of use cases and functionalities of digital tools assesed by the DPPA*

[4]https://digital-square.squarespace.com/s/Map-and-Match_Executive-Summary.pdf
[5]https://digitalsquare.org/s/DATEC-FINAL.pdf

2.5 WP5: Recommendations

The results of the EDIT and the DPP assessments should inform two types of recommendations:

2.5.1 Recommendations towards the digital health ecosystem

Based on the analysis of the Digital Health Ecosystem and the EDIT assessment, a set of recommendations should be formulated to support coordinated donor activities targeted at country-level Digital Health strategies and to improve basic Digital Health infrastructure and country-specific digital health readiness.

2.5.2 Concerning pandemic preparedness

Based on the available DPP opportunities, which ideally display all existing digital tools in the country, and the validated table of DPP functionalities deployed or not deployed in the country context, an assessment can be made to provide an analysis-based recommendation for each gap based on use cases, opportunities and the digital health ecosystem. Recommendations can suggest two actions:

- Leverage an existing software package: if a software is available as identified by the validation of the Map & Match data, and the contextual viability analysis is positive. In this case, we recommend exploring the use of that specific software package currently operated by government stakeholders to fill in the identified gap.
- Deploy a new software package: if no existing software is available for an identified gap in the partner country DPP context. Based on the stakeholders and the analysis of the digital landscape, we recommend exploring options for new software to meet this functionality requirement.

03 DPPA RESULTS IN NIGERIA

3.1 WP1: Preliminary Work and Stakeholders

As first step, the expert team with the support of the GIZ at the headquarters and the GIZ Regional Program Support to Pandemic Prevention (RPPP) in Nigeria obtained the informed support and approval of the Federal Ministry of Health and other key stakeholders. This led to the identification and appointment of a focal point for the DPPA process by the Ministry of Health. The Directorate for Planning Research and Statistics (DPRS) was the anchor for the project and with the Monitoring and Evaluation unit as the focal lead.

Afterwards the training of the short -term consultant took place and a kick-off engagement meeting was held with various stakeholders in attendance. It provided an opportunity to introduce the DPPA process and the local consultant to obtain their commitment to support and facilitate data collection, a crucial step in the implementation of this assessment.

The team reviewed one hundred and fifty-nine software packages from the Map and Match dataset to ascertain their current status first and foremost and then, for the active packages, to examine their feature sets as well as their classification according to the DPPA thematic areas. Subsequently the local consultant held key informant interviews with the software implementation teams as well as with ecosystem stakeholders to further understand and clarify the insights derived.

To summarize the actor landscaping, the following **PRIMARY ACTORS** were exclusively identified as follows:

Federal Ministry of Health (FMoH) Nigeria:
responsible for policy direction, standards development and enforcement. It supervises the delivery of projects across multiple health institutions, and it ensures the mobilisation of resources and provides strategic direction.

National Primary Healthcare Development Agency (NPHCDA):
provides a network of services, benefits, and resources to empower the healthcare community in Nigeria to improve the effectiveness and efficiency of primary health care delivery. It aims to create healthy communities across Nigeria and make health and wellbeing a priority for everyone, especially the most vulnerable. It is responsible for the implementation of COVID-19 vaccination programme.

Nigerian Center for Disease Control (NCDC):
The agency's goal is to protect Nigerians from the impact of communicable diseases through the coordination of public health preparedness, surveillance, laboratory, and response functions for all infectious diseases. The NCDC targets its activities towards the prevention and control of diseases of public health importance. This includes the preparedness, detection and response to public health emergencies, research, training and knowledge management, health promotion and other activities to protect the health of Nigerians.

Directorate of Planning, Research and Statistics (DPRS):
The Division leads the technical process for formulating plans and carrying out trends assessment for Nigeria Ministry of Health by drawing on relevant sources of information to analyse the overall performance of the Service and monitor progress in implementing key policies. DPRS directorate also ensures the development of comprehensive operational policies, sustainable strategic plans, systems, programmes, and budgets to cover all activities of the Ministry of Health and its partners. It supports the development of an integrated Health Information System for decision-making performance monitoring.

E-Health Africa (EHA):
EHA's mission is to build stronger health systems through the design and implementation of data-driven solutions that respond to local needs and provide underserved communities with tools to lead healthier lives.

Society for Telemedicine and eHealth (SFTEHIN):
non-governmental and not-for-profit society. It serves primarily to support telemedicine and eHealth development in Nigeria.

The team identified the following **SECONDARY ACTORS** from several multilateral organizations:

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH:
is a technical partner. GIZ advises in other fields of international cooperation for sustainable development such as international education work. In the Health sector the Regional Program Support to Pandemic Prevention has the goal to strengthen the capacity of the FMOH to prevent and manage future disease outbreaks e.g., through SORMAS.

United State Agency for International Development:
supports breakthrough innovations, applies market-based approaches, and advances efforts in digital health, private sector engagement, and human-centred design in order to maximize the impact of its global health work.

United Nations Children's Fund (UNICEF):
leverages digital health to strengthen health systems and enhance the reach and quality of care for maternal and children's health. In Nigeria UNICEF is partnering young start-ups in the development of innovative, open-source, market-driven products and solutions that help address complex problems impacting the well-being of children and young people, especially the most vulnerable.

World Bank Group
supports the economic and social development policies of the Government of Nigeria by supporting the creation of a competitive environment for the private sector to flourish and play a greater role in job creation. It also supports policies and programs that aim to strengthen digital transformation for improved service delivery and productivity, improve governance, and promotes greater inclusion, including strengthening women's economic empowerment.

World Health Organisation (WHO)
promotes evidence-based health policymaking through a comprehensive and rigorous analysis of the dynamics of the health situation and health system in Nigeria. It also provides trends of priority health problems and the health systems profile, including a description of institutional frameworks, trends in the national response, key issues and challenges.

The list of organisations and persons consulted is provided in **Annex 1.**

University of Oslo

The University of Oslo and the Research Council of Norway have the goal of strengthening health systems in the Global South. They are the developers and lead technical advisors for DHIS2 platform. They provide stable funding that has enabled the DHIS2 project to expand and sustain over time, to have the flexibility to explore the latest technologies. To develop a network of experts across countries and regions, and to continue delivering a stable and generic open-source platform — provided for download at no cost, with no licensing fees — that can be adapted to meet new challenges and local demands.

3.2 WP2: Digital Health Eco-System in Nigeria and EDIT results

Based on the critical indicators of the EDIT tool and additional qualitative information, the country was assessed with respect to the state of the digital health system. The assessment included a review of infrastructure, governance and regulation, data quality and use, and human resources as well as technology adoption. The EDIT assessment also looked at the national architectural framework for digital health and/or health information exchange (HIE) and existing health information standards. This assessment was conducted in collaboration with six identified assessors drawn from technical advisers at the FMoH and representatives of regional, donors and civil society organisations. The team sent the assessors the EDIT data collection tool, which contained the questions and the criteria for scoring the indicators. Having returned their scores, these were then aggregated and averaged. Their overall assessments are summarised below.

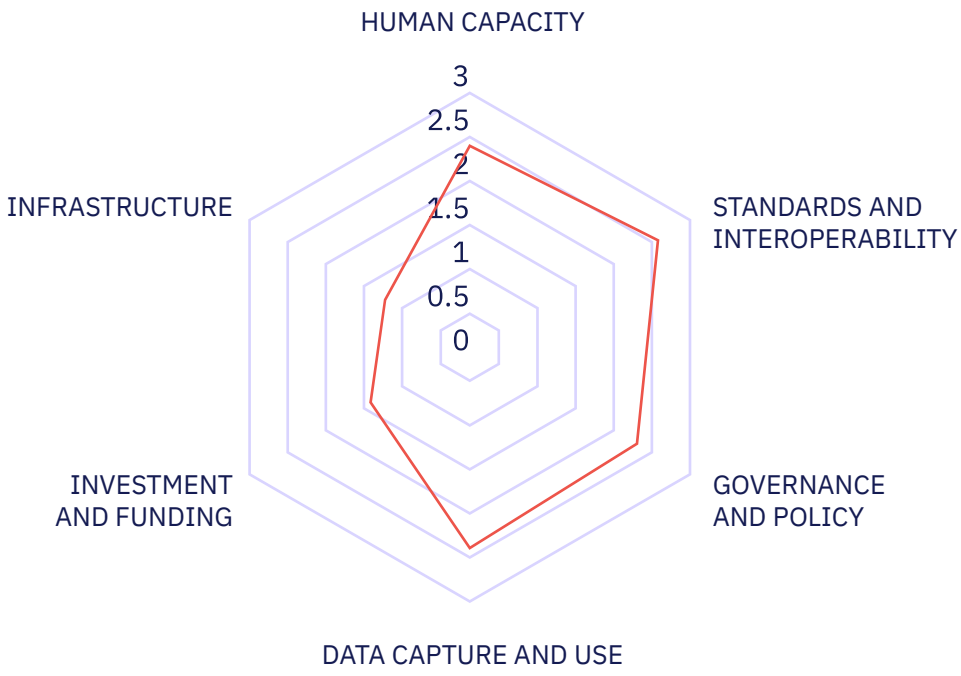

***Figure 3** EDIT evaluation*

With an overall average score of 2.00 out of 5 for the 17 critical indicators of the EDIT, Nigeria demonstrates a surprisingly poor readiness to conduct digital health activities at the national level. Countries are expected to achieve a minimum score of level 3 or higher for all critical indicators to show readiness for digital health activities at the national level. While there are a few bright spots, there is considerable work to be done in improving digital health services. Whilst these are overall assessments of the national digital health landscape, there is a variation in the provision of digital health services between and within the States of Nigeria. **Table 2** below shows a summary of the results, and Table 3 shows the scores given by each of the assessors.

Table 2 *EDIT assessment of critical indicators for digital health*

Area	Indicator	Score
Human Capacity	Mechanisms for capacity development and information sharing	3
	Specialized knowledge to support and maintain system	3
	Regular supportive staff supervision	2
Standards and Interop-erability	Master facility list	4
	Ability to unambiguously identify an individual	1
Governance and Policy	Leadership and political will	2
	Existence of institutionalized digital health governance structures	2
	Existence of a digital health strategy	2
Data Capture and Use	Geographic data for the country	4
	Standardized Logistics Management Information System (LMIS)	2
	Community Health Worker Registry	2
	Standardized Immunization Registers	3
	Demographic Data Availability	3
	Data entry workload	1
	Data improvement plan	2
Investments and Funding	Costed, long-term plan to operate, maintain and support digital health systems	1
	Political interest and support in investing in ICT for service improve-ment	2
	Existence of sufficient funding to support infrastructure strengthening	1
Infrastructure	Proportion of facilities with functionable and accessible computers	1
	Proportion of facilities with functionable and accessible mobile devices	1
	National level capacity of maintaining hardware in the data storage cen-ters	1
	Ability to maintain and troubleshoot both hardware and software at district level	1
AVERAGE		**2**

Table 3 *EDIT assessment scores by assessor*

Area	Indicator	Assessors						Average per indicator	Average per area
		1	2	3	4	5	6		
Human Capacity	Mechanisms for capacity development and information sharing	3	2	2	4	2	4	3.0	2.4
	Specialized knowledge to support and maintain system	3	3	1	3	3	3	2.7	
	Regular supportive staff supervision	1	1	2	2	1	2	1.6	
Standards and Interoperability	Master facility list	4	5	4	4	4	2	3.6	2.4
	Ability to unambiguously identify an individual	2	1	1	2	1	1	1.3	
Governance and Policy	Leadership and political will	2	2	2	4	2	2	2.3	2.0
	Existence of institutionalized digital health governance structures	2	2	2	5	2	1	2.1	
	Existence of a digital health strategy	1	3	3	2	1	1	1.7	
Data Capture and Use	Geographic data for the country	4	4	2	4		4	3.7	2.3
	Standardized Logistics Management Information System (LMIS)	2	2	2	2		2	2.0	
	Community Health Worker Registry	1	2	1	4		1	1.7	
	Standardized Immunization Registers	2	2	1	5		5	3.3	
	Demographic Data Availability	2	2	1	5		3	2.7	
	Data entry workload	1	1	1	1		1	1.0	
	Data improvement plan	1	2	2	2		2	1.8	

Invest-ments and Funding	Costed, long-term plan to operate, maintain and support digital health systems	1	1	1	1	1	1	1.0	1.5
	Political interest and support in investing in ICT for service improve-ment	2	1	3	3	1	4	2.6	
	Existence of sufficient funding to support infra-structure strengthening	1	1	1	1	1	1	1.0	
Infra-structure	Proportion of facilities with functionable and accessible computers	1		1	1	1	2	1.3	1.2
	Proportion of facilities with functionable and accessible mobile devic-es	1		1	2	1	2	1.5	
	National level capacity of maintaining hardware in the data storage centers	1		1	1	1	1	1.0	
	Ability to maintain and troubleshoot both hard-ware and software at dis-trict level	1		1	1	1	1	1.0	
TOTAL		**39**	**37**	**36**	**59**	**23**	**46**	**40.9**	**2.0**
AVERAGE		**1.8**	**1.7**	**1.6**	**2.7**	**1.0**	**2.1**	**1.9**	**1.9**

As can be seen from **Table 3**, with one or two exceptions (such as for standardized immunisation registries, or demographic data availability), there was little variation in the assessments given by the six assessors. Of course, other criteria could have been chosen as well as other key building blocks for digital health than the six used, but these were the ones that the wide consultations of EDIT development process produced[4].

The EDIT analysis is subjective in nature, and it is based on the knowledge of the assessors. Perhaps with other assessors and/or meeting together to debate their collective views a different set of findings could have emerged. However, steps were taken to cross-check the findings. To validate these quantitative findings the local consultant held a further round of interviews with different assessors to get a more qualitative assessment. The list of organisations consulted is provided in

[4]https://www.katicollective.com/approach

Annex 1. This cross-checking process produced some valuable insights concerning some of the specific criteria, as well as some more general observations and suggestions (which are all detailed in **Annex 2).** Essentially the quantitative findings were re-confirmed. The overall impression is that, at the national level, despite all the good work that has gone on, there is still a considerable way to go. Common themes that emerged were the need for improved co-ordination and implementation. For example, the lack of costed, long-term plans to operate, maintain and support digital health systems is mirrored by a perceived lack of funding to support infrastructure spending. These issues require alignment between government and development partners, and that in turn requires investment in leadership and coordination (as **Recommendation 1.1** makes clear). The poor scores for managing data entry workload, and the ability to maintain and trouble shoot both hardware and software at district level also point to key issues in implementing digital health solutions, and these require coordinated investment and training (see **Recommendation 1.4**)

3.3 WP3: Opportunities

The team of experts evaluated one hundred and fifty-nine (159) digital health tools from the Map and Match dataset from USAID. In addition, to test the practicality and benefits of locally developed and administered surveys, the team also developed a short questionnaire on the digital health tools that might have arisen during the pandemic and post pandemic period. The online questionnaire was sent to the Nigerian digital health community, as well as to the 37 Directors of Planning Research and Statistics, State Ministry of Health. We received 26 responses. The vast majority presented overlaps with tools already in the Map and Match dataset. **Annex 6** presents the results as additional supplementary information to our assessment.

It is noted that the Map and Match dataset leaned heavily on the WHO-Digital Health Atlas (WHO-DHA) project and on voluntary contributions from local development partners. This context is important considering that when we validated whether the tool was still in use or no longer in use, 42% of the tools in the database was defunct (see **Table 4**). The validation was based on online research to collect up to date information on the tools and user interviews relying on the DPPA tool. Sixty-four (64) tools were applicable[5] for the DPPA assessment representing 40% of the Map and Match dataset. 18% of the tools were deemed not relevant for our assessment. This means that the tool does not have a direct bearing on pandemic preparedness either because it is a service and not a platform or a platform that is used in house to provide service but not available for external use.

Status for the DPP assessment	Number of tools	Percent
Applicable	64	40%
Not relevant	28	18%
Defunct	67	42%
Total	159	100%

Table 4 *Summary of the validation process*

[5]Applicable means that the tool is in used and has been assessed as part of one or more programmes, or not assessed because of information was not available.

Out of 64 applicable tools, 59 tools are deployed in one or multiple programmes ("duplicated" in **Table 5** below) and have been assessed. For five tools, there was no information available to make any meaningful assessment of the tool.

The digital tools, and whether or not they were assessed, are summarised in the table below.

Table 5 *Overview of Map and Match Dataset and summary of validation results*

S/NO	CATEGORY	TOOL
1	**Assessed**	Ada Health App
2		AVADAR: Auto-Visual AFP Detection and Reporting
3		CHAIN
4		Chekkit
5		ColdTrace
6		CommCare
7		Community Health Insurance Enrolment and Authentication System (CHIEASY)
8		COVIDConnect / Luscii
9		Distributed Electronic Clinical System
10		Doctoora
11		DrugStoc
12		Elasticsearch/Kibana
13		Emergency Operations Center (EOC) Web portal
14		End-Use Verification Activity surveys
15		eTB Manager
16		Field Supply
17		GloEpid
18		gricd
19		GxAlert
20		Health Network Quality Improvement System (HNQIS)
21		healthsites.io
22		iHRIS
23		iHRIS Qualify
24		iHRIS Train
25		IHVN and CDC EMR
26		ISS: Integrated Supportive Supervision
27		KompleteCare

28		Lafiya Management Information System (LAMIS®)
29		LAMIS Plus
30		Life Bank
31		LoMIS
32		Mango
33		Mobenzi
34		MobiDoc
35		mSupply
36		mVaccination
37		MyServiceAgent
38		National HMIS
39		ODK
40		ODK (Kobo and OnaData)
41		OpenMRS
42		Otrac
43		OVC data reporting system
44		QGIS
45		RapidPro
46		RapidSMS Bednets Distribution
47		Safe Delivery App
48		SENAITE
49		SORMAS
50		Odoo
51		Tableau
52	**Assessed: Duplicated Tools**	OpenMRS
53		OpenMRS
54		OpenMRS - Haitian Health Foundation
55		RapidSMS Birth Registration
56		RapidSMS for Maternal and Child Health Weeks (MNCHWs)
57		RapidSMS Vaccines Logistics Management
58		SIDHAS ODK-based Continuous Quality Improvement System
59		Strengthening Integrated Delivery of HIV AIDS Services (SIDHAS)
60	**Lack of Information**	LIMS
61		NaijaCare
62		PocketPatient MD
63		SMART
64		Telerivet

65	**Defunct**	A Second Chance: A new radio drama series / Get it Together campaign
66		Abiye Safe Motherhood Mobile Project
67		Africa Health Markets for Equity: MoTECH
68		Africa Indoor Residual Spraying (AIRS)
69		ALMANACH
70		APMIS
71		Audio Job Aids
72		CAD4COVID: One for X-ray (CAD4COVID-Xray) and one for CT (CAD4COVID-CT)
73		CliniPAK360
74		Community Surveillance System (CSS)
75		COVID-19 Contact Tracing App
76		COVID-19 Triage Tool
77		Cross River Health and Demographic Surveillance System
78		Expanded Social Marketing Project in Nigeria (ESMPIN)
79		FrontlineSMS
80		Global Mobile Project
81		Global Trachoma Mapping Project (GTMP)
82		healthfolk.net
83		Healthy Moms, Healthy Babies: Safe Motherhood Alliance
84		HelloMAMA
85		HelloMama
86		HMIS Mobile
87		Interactive Distance Education Application iDEA
88		iDEA
89		Infodemics
90		Interactive Health Education (iHED) system
91		IQCare
92		IQSMS
93		IQTools
94		K4Health/Nigeria Web-Based Con-tinuing Medical Laboratory Education (CMLE) Program
95		Learning about Living
96		Logistics Management Information Systems for MNCH Commodities
97		m4change
98		MADEX

99		Mailafiya Project
100		Medexperts
101		mediFIX
102		MEDSINC
103		mHealth
104		Millennium Villages Global Network (MVG-Net)
105		Mobile Baby – Polio Immunization
106		Mobile Baby Program
107		Mobile Community Based Surveillance (mCBS)
108		Mobile Interactions bringing Hope (MI Hope)
109		Mobile Midwife Nigeria
110		Monitoring Supplies with RapidSMS
111		MOTECH
112		MTN Foundation (MTNF) Partners Against AIDS in the Community (MTNF PAAC)
113		mTrain
114		mWoman
115		My Voice
116		National MDGs Information System
117		NURHI
118		OMOMI
119		Polio Campaign using Smartphones
120		Premise Data
121		PRRINN-MNCH Nahuche Health and Demographic System
122		Quality TB Care
123		Quantimed
124		RapidSMS as part of PPFN/JPAL RCT
125		Routine Immunization Tracking Tool
126		Smart phones for Tuberculosis Support Supervision
127		SMS for Life
128		Stock Visibility Solution (SVS)
129		SURE-P MCH Mobile Conditional Cash Transfer (CommCare)
130		Tuberculosis Smart Phone Support Supervision
131		UN MGDs Reporting
132	Not Relevant for Assessment	54gene
133		Airtel Insurance/MicroEnsure
134		APPR II

135		Avon Flex
136		Babymigo
137		Cadasta platform
138		Carbon/Axa Mansard
139		Extract, Transform, Load (ETL) Application
140		Facility Activation Status Tracker (FAST®)
141		Helping Babies Breathe (HBB / eHBB)
142		Honey and Banana Connect
143		iCycleBeads™Smartphone Apps
144		IHVN: mHealth
145		Leadership Development Program Plus (LDP+)
146		Maisha Medik
147		Mobile Product Authentication
148		mPedigree
149		mPharma
150		National OVC Management Information System (NOMIS)
151		Newborn Care Series
152		Nomadic and eHealth Program
153		Omowunmi
154		OpenHDS
155		Reveal
156		SafeCare
157		Supportive Supervision (SS) for TB in Nigeria
158		The Edge of Joy
159		Truppr

Focusing on the 14 DPP categories where tools have been assessed, **Table 6** below summarises the number of available digital tools that are being used.

DPP CATEGORIES	Matching Software packages deployed
1. SURVEILLANCE	10
2. LABORATORY SYSTEMS	5
3. CASE MANAGEMENT	15
4. CONTACT TRACING	2
5. PROXIMITY TRACING	1
6. CORDINATION & OPERATIONS	7
7. SUPPLY CHAIN & HEATH FACILITY LOGISTICS	10
8. HEALTH FACILITY ADMINISTRATION	3
9. HEALTH WORKER TRAINING	3
10. RISK COMMUNICATION & COMMUNITY ENGAGEMENT	6
11. ONE HEALTH	
12. INTEROPERABILITY	
13. VACCINE DELIVERY	3
14. DATA ANALYTICS, VISUALIZATION & USE	8
Total	73

Notes: The total is 73 because some tools are deployed for more than one use case.

Table 6
Number of available digital tools that are being used by DPP category

Table 6 suggests where there are opportunities for digital tools to be reused. Only for One Health and Interoperability are there no software packages deployed, and for proximity tracing only one tool is available. But for surveillance, case management and supply chain there are at least ten.

The same findings are presented as percentages in the diagram in **Figure 4.**

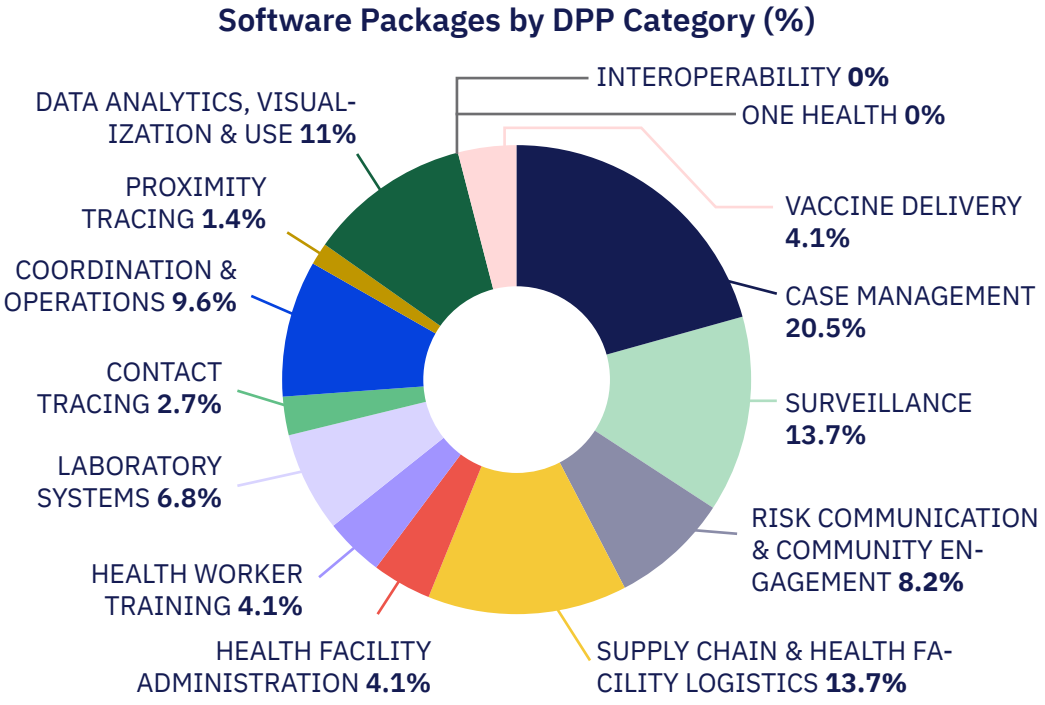

Figure 4 *Distribution of digital health tools by DPP categories.*

The specific tools assessed which support each DPP category are shown in **Table 7** below and **Annex 5.**

Table 7 *Available Digital Tools in each DPP Category*

DPP CATEGORIES	Digital Tools
1. SURVEILLANCE	AVADAR, CommCare, eSURV, Mango, Mobenzi, DHIS2, ODK, RapidPro, SORMAS
2. LABORATORY SYSTEMS	Xpert, Mobenzi,mSupply, SENAITE, SORMAS
3. CASE MANAGEMENT	Ada Health App, CommCare, CHIEASY, OpenMRS, eTB Manager, KompleteCare, LAMIS, Mobenzi,MobiDoc, DHIS2, SORMAS
4. CONTACT TRACING	GloEpid, SORMAS
5. PROXIMITY TRACING	GloEpid
6. CORDINATION & OPERATIONS	OpenMRS, Doctoora, Emergency Operations Center (EOC) Web portal, MagPi, Mobenzi, mSupply,
7. SUPPLY CHAIN & HEATH FACILITY LOGISTICS	Ishango, DrugStoc, Field Supply, Gricd, Life Bank , LoMIS, Mango, Mobenzi, RapidPro, SORMAS
8. HEALTH FACILITY ADMINISTRATION	Health Network Quality Improvement System (HNQIS), iHRIS, iHRIS Qualify,
9. HEALTH WORKER TRAINING	iHRIS Train, Otrac, Safe Delivery App
10. RISK COMMUNICATION & COMMUNITY ENGAGEMENT	Chekkit, CommCare, COVIDConnect / Luscii, GloEpid, MyServiceAgent, Rapidpro
11. ONE HEALTH	
12. INTEROPERABILITY	
13. VACCINE DELIVERY	Ishango,ColdTrace, mVaccination
14. DATA ANALYTICS, VISUALIZATION & USE	Elasticsearch/Kibana, healthsites.io, DHIS2, ODK, QGIS, RapidPro, RapidSMS, Tableau

3.4 WP4: Gaps analysis

As outlined above, the assessment found two gaps at DPP category level, which are not supported by any tool: One health and Interoperability.

The lack of a single tool for One Health is understandable, considering that One health encompasses three different domains, Human health, Animal health and Environment. In Nigeria these three domains are over seen by three different ministries, the Ministry of Health (Human Health), Ministry of Agriculture (Animal Health) and the Ministry of Environment (environment). It thus difficult to have a single tool that works across the three domains and their respective ministries. It is worth noting that the various domains and their ministries each have their predominant data aggregating tool. Human Health (Ministry of Health) has DHIS2, Animal Health (Ministry of Agriculture) has NADIS while Environment (Ministry of Environment) has various GIS tools. So, whilst it might be challenging to have one single solution that replaces them for One Health data, a more feasible scenario will be a platform that provides interoperability and data analytics with the three data aggregating tool as primary source of data. It is heartening to know that the One Health unit of the NCDC is

championing this course of action with support from development partners.

Interoperability is one the thematic areas that lacks the presence of a digital health tool. A distinction must be made between digital tools being interoperable and a tool whose main functionality is interoperability. These interoperability tools are otherwise called Interoperability engines. HL7 FHIR (Fast Healthcare Interoperability Resources) is fast becoming the gold standard for interoperability. No interoperability engines exist currently in the ecosystem.

At functionality level there also exist gaps even for categories that have tools that cover that thematic area. A comprehensive overview of the gaps based on how the existing tools match against the categories and functionalities is in **Annex 4. Figure 5** below shows that there are gaps in 22 functionalities across 9 DPP categories. Even if tools for these functionalities were available, the necessary enabling policy and regulatory frameworks will also be needed before there can be effective implementation.

S/N	DPP Functionalities
1.3	Early warning surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)
3.8	Bidirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp, email)
3.12	Enrolment of travellers who have visited high-risk locations at ports of entry for monitoring and follow-up (Port of Entry Screening and Follow-Up)
4.4	Communication with contact via phone call (through app)
4.5	Undirectional communication with contact via messaging (e.g. SMS, social media, in-app. WhatsApp)
4.11	Compatibility with country public health management information system (HMIS)
5.1	Automated mass contact tracing of anonymous contacts via smartphone (or bracelet) Bluetooth signals
5.2	Optional notification of positive infection diagnosis with high-risk contacts via user's smartphone app
5.3	Functionality adapted to generalised epidemic response (not stricktly COVID-19)
6.4	Modelling of epidemic impact scenarios to prepare response (simulations)
6.5	Clear visualisation of risk factors (risk index) at subnational level
6.6	Monitoring of response capacities (relevant health personnel, hospital beds, equipment, national or internal Emergency Medical Teams)
6.7	Big Data analysis (e.g. mobility monitoring based on mobile phone data, rumour monitoring based on social media analysis)
7.3	Collection and reporting of data on epidemic-specific equipment(x-ray machines, critical care beds, ventilators, etc)
7.4	Collection and reporting of data on epidemic-specific operational metrics (e.g. available ICU capacity, current staffing levels etc)

8.1	Fiscal managment
8.2	Donor compliance reporting (Fraud prevention, transparent monitoring, etc)
11.1	Tracking of infectious disease outbreaks in domesticated animals (livestock etc)
11.2	Tracking of infectious disease outbreaks in wildlife
11.3	Ecological surveillance of environment for changes that could increase risk of zoonotic infection
12.1	Standardised interface (IHE, OpenHIE, REST, API, HL7, HL7-FHIR, supporting the OpenHIE architecture and workflows)
12.2	Support for healthcare Coding Standars (e.g. ICD-9, ICD-10, LOINC, SNOMED)

Figure 5 *Identified gaps in DPP functionalities*

3.5 WP5: Recommendations

The main objective of this assessment was to gain an overview of the digital public health ecosystem and to formulate recommendations and action plans that could contribute to modernising overall digital pandemic preparedness. The data gathered, and the conversations held (see **Annex 1**), have been valuable in generating insights that apply both to the digital health ecosystem in general terms as well as more specifically to digital preparedness for pandemics. These guide the following recommendations.

3.5.1 Recommendations towards the improvement of the digital health ecosystem

Qualitative analysis of Digital Health Ecosystem and the EDIT assessment highlighted several opportunities for improvement that could help advance the digital health ecosystem. The following recommendations are provided:

R1.1 Centralized Governance and Coordination of Digital Health matters.
There is need to centralize governance and coordination for digital health at both the Federal level and State levels. Considering the current structure of the Ministries of Health, we recommend that as a priority, a Digital Health Unit be instituted within the DPRS at the FMoH. Initially, this unit will act as the single source of truth concerning digital health at both the state and federal level and should work harmoniously and in consonance with the States. But it is expected that they may also soon see the benefits of investing in their own equivalent units. The units (both Federal and State) will be responsible for ensuring that resources are used and maintained in a manner that avoids duplication of efforts as well as coordinating and maintain an inventory of digital health resources. The unit(s) should also have an input in the budgeting of resources for digital health programmes so as

to ensure efficient utilization of scarce resources whether it is a national programme or a donor-led programme.

R1.2 Routine Digital Health Landscape Analysis

One of the highlights of ecosystem analysis is the fact that there are quite a number of critical "unknowns" that exist within the digital health fabric of Nigeria. The validation of the Map and Match dataset which revealed a high number of projects that are no longer operational also brought this to fore. There is need to routinely conduct a nationwide digital health landscape analysis to update the information around the digital health tools resources that currently exist. This information will go a long way in helping the planning and deployment of resources and in achieving the goals of both pandemic preparedness and universal health coverage for the populace of the country. This analysis can then be used to jumpstart the inventory maintenance by the Federal and State Digital Health Units. A short survey has been developed for the purpose of this pilot as part of our validation of the Map and Match dataset (see **Annex 6**).

It is recommended to feed back the validated dataset in to the WHO-DHA. To this end the FMOH would need to designate a focal person that will manage the Nigerian account and conduct together with WHO a regular update with the needs and specificities of the Nigerian ecosystem.

R1.3 Accelerate the release and implementation of the Nigerian Health ICT Framework (2022-2027)

There is an urgent need to fast track the release and implementation of a costed Nigerian ICT Framework (2022-2027). This framework is currently in draft mode, and informed by the WHO global digital health strategy, is meant to provide policy guidance for digital health in the country. It is important that necessary support is provided (both internally and externally) for the release of a costed version of the document and the required funding be secured for the implementations required at both national and state levels. For the policy document to be effective, it is important that subnational government have a strong buy in as well.

R1.4 Upscaling digital skills of health workers

There is a critical need to upscale the digital skillset of healthcare workers. Frontline workers are or will be required to perform tasks using the various digital health tools while providing services. It is thus important that there is a concerted effort to upgrade their generic digital skill set across the board. Most training received is geared towards specific digital health tools. As the use of digital health platforms extends across the country and the skills required become more generic it becomes increasingly important that the basic ICT skill set of all healthcare workers be enhanced. This is even more important when we consider the dwindling number of healthcare professionals, and the drive to upscale digital skills enables technology to be leveraged to enable scarce resources to do much more and close the healthcare provision deficit currently being experienced.

R1.5 Advocacy and Training for Digital Health at political and leadership level
Conversation around the importance of digital health, and thus the strengthening of the digital health ecosystem, must be had across all tiers of government. The necessity to bring various stakeholders to the table to discuss the role of digital health in changing the healthcare landscape of the country cannot be over emphasized. There must be a mechanism in place to engage the leadership of the various arms of government such as the Federal Executive Council, Governor's Forum, the legislative arm of government and even the judiciary. These conversations (e.g., in the setting of a retreat, or workshops etc.,) will go a long a long way in facilitating the political will and leadership required to drive the strengthening of the digital health ecosystem.

R1.6 Strengthening indigenous private sector participation in digital health
Learning from the Fintech boom in the country (and the local content initiative in the oil and gas sector) it is important to strengthen indigenous private sector participation in digital health. For long term viability and growth of the digital health ecosystem, it is important that private enterprise with an understanding of local context and nuances are strengthened to become significant players in digital health in the country as well as across the continent. Strengthening their role has both long-term digital health security and economic benefits. It will also curb the tendency for digital health platform dying out because of closure of vertical programmes.

3.5.2 Recommendations towards digital tools for Pandemic Preparedness

R2.1 Strengthen bi-directional client communication
It is important and necessary for case management systems to have a patient-centred care approach. The ability for the patient to be able to send notification into the system in a machine-readable manner is critical. Most existing systems have a means of sending out notification but no mean of receiving notification from the patient. These deficiencies need to be remedied.

R2.2 Develop appropriate proximity tracing solutions
Proximity tracing is a sophisticated technological approach that has great benefits but predominantly where there is high penetration of smartphones and strong network connectivity. However, in circumstances where this is not the case, Bluetooth technology could be used. Proximity tracing solutions allow for early notification of contact or potential contact with confirmed cases, while anonymizing the identity of the case, in most instances. Such solutions must carefully take into consideration the local context and nuances of culture in developing appropriate proximity tracing solutions.

R2.3 Strengthen One Health initiative
The One Health unit of the NCDC is already spearheading the initiative around One Health and some State governments, such as Lagos, are officially committed to the One Health agenda, by developing strategies to address biosecurity, and fostering capacity building on the One Health paradigm. These initiatives could be further developed and expanded. And digital tools that allow for the interoperability and harmonization of the existing data infrastructures amongst relevant ministries,

departments and agencies could be developed or strengthened to help in tackling pandemics from the One Health perspective.

R2.4 Strengthen and scale up a health workforce training platform

It is important to have a healthcare workforce training platform that is operating at scale. This will help get adequate and timely training and educational information to the frontline workers. It will also enable easy retraining and updating of the workforce knowledge base. Individualized curricula and team-based curricula will help improve the efficiency and productivity of the workforce. Progress through this curricula can be incentivised or gamified as the case maybe.

R2.5 Developing healthcare resource discovery tool

The ability to track allocation of resources is critical. This came to fore during the Covid-19 pandemic where the issue of distribution of ICU beds, oxygen tanks, and even ambulances was suddenly a matter of life and death. There is need to invest in an integrated tool that can provide real time information on the availability and distribution of resources within the health care system.

R2.6 Strengthening interoperability and interoperability engines

There is no question about the fact that multiple systems exist in the country at various levels of maturity and scale. It is however important and critical that we move beyond the digital silos that currently exist to an ecosystem where tools can communicate and exchange data easily. The HL7 FHIR standard has become the protocol of choice for data exchange. Strengthening and encouraging digital tools to use this protocol will go a long way to ensure interoperability. It is also important to highlight the issue of terminology datasets or dictionaries in this light. SNOMED CT is currently the root dictionary of medical terminology and should be embraced nationally. The ISO TC215 domestication work from the Standards Organisation of Nigeria should be leveraged in achieving this recommendation.

R2.7 Integrate SORMAS and DHIS2 Functionalities

SORMAS and DHIS are the leading digital health platforms focused on the pandemic and public health informatics operating at a national scale. It is therefore imperative that these platforms are integrated and interoperable so that the relative strengths and features of each platform are in synergy. This synergy will play a great role in the future of pandemic management in the country. Given that these platforms are operational at both subnational and national levels, the impact of this integration will improve surveillance activities across the multi-layered structure of healthcare delivery in the country as well as help provide an effective foothold for the One Health initiative.

04 SUMMARY

ANNEX 1: List of persons consulted

Name stakeholder by affiliation (institutional)	Name of stakeholder (individual): focal point, key contact, potential informant - if any	Sector	Level of involvement	Role in (Digital) Health System/ exposure to tools/ level of technical engagement
EHEALTH AFRICA	Jamil Aliyu Galadanchi	Implementing Partner	national	technical advisor - IT
FCTA E-HEALTH DIVISION	Ini obong	Public Sector	regional	technical advisor - Public Health
FEDERAL MINISTRY OF HEALTH	Dr. Charles Nzelu	Public Sector	national	strategic/decision-making
FEDERAL MINISTRY OF HEALTH	Timothy M. Dasa	Public Sector	national	technical advisor - IT
GIZ-RPPP	Damien Bishop	Donor	international	project/programme manager
GIZ-RPPP	Maureen Odochi Anyanwu	Donor	international	tool/software developer
GRICD	Oghenetega Iortim	Private Sector	national	strategic/decision-making
GX-ALERT	Dr. Kehinde Jimoh	Public Sector	national	technical advisor - IT
HEALTH ENABLE	Emeka Chukwu	International Organisation	international	technical advisor - Public Health
HISP	Dr. Aluka Terpase	International Organisation	national	technical advisor - IT
MINISTRY OF HEALTH LAGOS STATE	Dr Akin Abayomi	Public Sector	regional	public (health) official
NATIONAL PRIMARY HEALTHCARE DEVELOPMENT AGENCY	Abdullahi Garba	Public Sector	national	project/programme manager

NIGERIAN CENTER FOR DISEASE CONTROL	Usman Yashe	Public Sector	national	technical advisor - IT
PHI	Gibril Gomez	Civil Society	national	project/programme manager
SOCIETY FOR TELEMEDICINE AND EHEALTH IN NIGERIA	Olajide Adebola	Civil Society	national	technical advisor - IT
UNICEF	Ismail Mohammed	International Organisation	international	strategic/decision-making
UNICEF- Immunization	Patrick Akor	International Organisation	international	technical advisor - Public Health
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT	Justus Uzim	Donor	international	strategic/decision-making
UNIVERSITY COLLEGE HOSPITAL, IBADAN	Dr. Pelumi Adebiyi	Public Sector	national	technical advisor - Public Health
WORLD HEALTH ORGANIZATION	Geoffrey Namara	International Organisation	international	strategic/decision-making
WORLD BANK	Micheal Olugbile	Donor	international	strategic/decision-making
African Alliance Of Digital Health Networks	Olasupo Oyedepo	Technical assistance to the Nigerian Federal Ministry of Health	national	Project director
AFENET AFRICAN FIELD EPIDEMIOLOGY NETWORK	Wilson Idongesit	Non-profit networking and service alliance	International (31 countries in Sub-Saharan Africa)	Epidemiologist, Field Coordinator
AFENET AFRICAN FIELD EPIDEMIOLOGY NETWORK	Adamu Sule	Non-profit networking and service alliance	International (31 countries in Sub-Saharan Africa)	Senior Field Coordinator

ANNEX 2: Qualitative EDIT interviews

This Annex is derived from conversations held with six key informants and designed to reflect on the quantitative findings of the EDIT assessments shown in the main body of this report. It fleshes out some of the data points and includes subjective assessments of some key actions that can be take.

Key issues	Evaluations (Sources)
Human Capabilities	The mechanisms for capacity development and information sharing among the healthcare workforce for digital health implementation currently exist in a manner that doesn't rely exclusively on cascade training (e.g. peer-to-peer, notice board, mentoring, etc.). Specialized knowledge to support and maintain system is provided via technicians who are available on an ad hoc basis. Supportive staff supervision is established but implemented on an ad hoc basis. Human capabilities definitely exist across the country, the challenge seems to be deploying the resources in a systematic manner across various locations and level and well-coordinated scheduled manner.
Standards and Interoperability	There exists a Master facility list that includes all currently active public, NGO and private health facilities[6].The list however seems to be limited to medical facilities with an exclusion of the diagnostic and pharmaceutical facilities. The list is not actively maintained. The ability to unambiguously identify an individual is limited due to the inability to de-duplicate or cross check client data to unambiguously identify a person/ child. There is a current push to implement a national identification number (NIN) which has the possibility of helping uniquely identify and providing the basis to uniquely identify individuals. The enrolment currently stands at about 38% of the population, 83 million out of total pollution of about 220 million Nigerians[7].
Governance and Policy	Considerable work has been done to address some of the legislative and guidance issues that are relevant to digital health, but implementation remains uncoordinated. Leadership and political will is largely contained within the DPRS and the Department of ICT within the Federal Ministry of Health. There is a need to create an environment where leadership and political will for digital health extends beyond and across the FMOH as well as other relevant government agencies and resources are allocated to indicate broad support and prioritization of digital health. A strong collaborating partner at the federal level will be the Federal

[6]https://hfr.health.gov.ng
[7]https://nimc.gov.ng/enrolment-dashboard-may-2022/

	Ministry of Digital Economy (FMODE) in pushing the digital health agenda in the country. Without doubt the various donor agencies have a role to play in this as well; they will however follow the leadership and direction set by the primary ministry concern with digital health. The impact of this on the efficient utilization of funds and various other resources cannot be understated. The existence of institutionalized digital health governance structures is critical. A digital health governance committee/leadership is available on paper but is not operationalized. The National Health ICT Strategic Framework 2015-2020[8] recommended a National Health ICT Steering Committee and supporting structure. Such a Steering Committee should be responsible for overseeing Health ICT planning, implementation, coordination, governance and evaluation to the achievement of the Health ICT Vision. A Steering committee reporting to the National Council on Health (and with two sub committees - the Technical Working Group (TWG) and the Health ICT Project Management team) was inaugurated in 2016 but seems to have gone defunct currently. There will be need to resuscitate the Steering committee and deepen its relationship with the DPRS, for effective coordination and governance of digital health projects and programmes that have digital component especially when led by development partners. The National Health ICT Strategic Framework 2015-2020[9] was approved in March 2016, but was not costed, and was fraught with varying challenges with its implementation. The learning from that framework was used as an input for the current draft National ICT Strategic Framework 2022-2027. This framework is it in final approval phase and it will be costed as a potential input to budgetary allocation in the next fiscal year.
Data Capture and Use	Geographic data exists for the country, but it is not up to date and is used inconsistently. There exist GIS markers for almost fifty thousand health facilities across the country. Detailed mapping has also being done for pharmacies and even patent medicine vendors accruing from various programmes. EHA helped the efforts in digitizing maps that were used for immunization for the polio campaign across the country. Logistics Management Information Systems (LMIS) exist in the country but they are not standardized. Various implementing partners have their own LMIS for their vertical programmes. There is also the Nigerian Health LMIS (NHLMIS) that is used to capture, store, and track and assess logistics data across the nation's pharmaceutical supply chain for key public health programmes. [10] A Community Health Worker Registry exists, but is not standardized across the

[8]https://www.health.gov.ng/doc/HealthICTStrategicFramework.pdf
[9]https://www.health.gov.ng/doc/HealthICTStrategicFramework.pdf
[10]Nigeria Health Logistics Management Information System (NHLMIS)

	country. Employment of community health workers is at the state level. Registries for other professional workers, such as doctors and nurses, exist at the various professional regulatory councils Medical and Dental Council, Nursing and Midwifery Council respectively. Again, Immunization Registers exist but not in standardized format for routine immunizations. However, the recent nationwide COVID immunization utilized a central standardized digital immunization registry based on the DHIS2. Demographic data exists up to the first administrative level (State level). The last Census was in 2006. Another is planned for the later part of 2022. Other public datasets exist for demographic data such as the Facebook Dataset for Good. With respect to data entry workload there are insufficient staff to enter data at the point of delivery in real time. There has been mass exodus of healthcare professionals across all cadres and disciplines and this has put pressure on the existing staff to meet the current demands of the patients visiting the facilities. This in turn leads to long wait times and shorter interaction periods with the healthcare professionals and impacts the ability of the professional to document in real time the health encounters. However there is a role for user centred design system in deploying technology that is able to turn this seeming disadvantage into an advantage. Data improvement plans have been developed but are not being implemented. These plans exist in silos around specific programmatic data. This is also reflective of the maturity level of data governance infrastructure currently in place.
Investments and Financing	The level of Political interest and support in investing in ICT for service improvement in Nigeria, is assessed as being minimal. This is evidenced by early national level dialogue around the issue of funding for ICT. However, development partners have made significant investments. Conversations, led by the relevant FMOH entity, are needed to ensure the funding sought is targeted towards the deployment of ICT for service improvement. A unit is needed to take the lead to galvanize and coordinate the effort of the international, national and subnational partners in this direction, in the realization that government alone cannot fund the required investment for this transformation to happen. A costed long-term plan to operate, maintain and support digital health systems in the country does not currently exist. This is difficult to achieve when there are almost independent arms of government responsible for healthcare delivery. To have a single document that covers the spectrum of ICT-enabled healthcare delivery for a country like Nigeria can be a tall order. While it might be slightly easy for disease verticals such as HIV/AIDS, COVID etc., it can be challenging for horizontal platforms. Despite these challenges, the current draft of the health ICT strategy framework (2022-2027) seeks to solve this problem by providing a cost analysis that can act as a guide.

	Sufficient funding to support infrastructure strengthening seems not to exist. While there is no single central pool of funds to support this activity, there exist pockets of funding from a disease vertical point of view to support infrastructure strengthening. This current scenario is fraught with its deficiencies or disadvantages which include duplication of efforts (different funds doing the same thing), lack of continuity of utility of deployed infrastructure, and a lack of accountability. These factors present a dismal outcome where the output is disproportionately poor compared to the global sum of inputs. The solution might lie not in more funds but better centralized coordination and monitoring of the digital health infrastructure across the country at both national and subnational level, so that wastages and duplication is controlled, and the services which can be shared (e.g. across vertical programmes) is optimised. The country is then able to do more with less and not less with more.
Infrastructure	The proportion of facilities with functionable and accessible computers is unknown and the proportion of facilities with functionable and accessible mobile devices is also unknown. This dearth of data on the state of infrastructure across facilities in the country implies that the baseline required for planning is missing. It thus underpins the necessity to undertake a landscape analysis of the digital health infrastructure. The right foundations need to be laid. The ability to maintain and troubleshoot both hardware and software at district level district-level capacity is inadequate. The capacity tends to be skewed toward the facilities in urban population. There is need to incentivize the availability of this capacity at district level and the creation of technical career path with the FMOH or State ministry of health employee structure. The national level capacity of maintaining hardware in the data storage centres is inadequate. Several options to address this were raised. They included having both national or sub national centres; buying services at outsourced data centres, or the use of cloud-based services. Whatever path the Ministries of Health decide, they will need to remain in line with the National Data Privacy Act, and also consider how young Nigerians with devOps skill set are attracted and retained within health organizations.

ANNEX 3: Detailed view of digital tool opportunities

S/NO	TOOL	Description in the context of Nigeria	Use case
1	**Ada Health App**	The app was initially created as a service for doctors, and it was then adapted in 2016 to provide a more comprehensive view of patients' symptoms. It takes into account the various factors that affect a person's health, and it matches the symptoms of patients with similar ages and genders.	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
2	**AVADAR: Auto-Visual AFP Detection and Reporting**	Auto-Visual AFP Detection and Reporting (AVADAR) is a mobile sms-based software application designed to improve the quality and sensitivity of Acute Flaccid Paralysis (AFP) surveillance by health workers and key informants within hospital facilities and local communities.	SURVEILLANCE
3	**CHAIN**	CHAIN is enterprise software that learns, building the Predictive Supply Chain for Health from the ground up. CHAIN makes it possible for existing resources to serve more people in need, unlocking capacity and increasing access to care.	COORDINATION & OPERATIONS
4	**Chekkit**	Chekkit is a DAG blockchain powered anti-counterfeiting solution for food and drug supply chain tracking and customer insights platform. It is also a consumer intelligence tool using USSD code to provide health information	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
5	**ColdTrace**	ColdTrace monitors temperature in vaccine storage equipment in health facilities with low connectivity or during transportation. Track temperature and GPS coordinates to protect the vaccine supply chain in remote areas, provide visibility into carrier performance by model, and inform best practice for packing and route planning.	VACCINE DELIVERY
6	**CommCare**	A smarter software that is used to collect and track data over time with case management feature. It works offline, allowing field team to collect data wherever, without interruption.	SURVEILLANCE, CASE MANAGEMENT, RISK COMMUNICATION & COMMUNITY ENGAGEMENT

7	**Community Health Insurance Enrolment and Authentication System (CHIEASY)**	Community Health Insurance Enrollment and Authentication System (CHIEASY) is a software that helps health care leaders to offer spontaneous resolutions to key policy challenges affecting health care service delivery especially between the provider and the Health Management Organization (HMO). The software is a state-of-the-art, fully integrated health information system. It provides healthcare organizations with a full suite of tools for improved health facility management, clinical tasks and patient administration.	COORDINATION & OPERATIONS
8	**COVIDConnect / Luscii**	CovidConnect is a new virtual monitoring app with a back-end care coordination center that gives subscribers access to needed clinical support from a team of medical experts, and provides users access to credible sources of information on Covid-19.	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
9	**Distributed Electronic Clinical System**	DECS synchronizes the health data collection across all sites (27 health facilities), providing near real-time access to on-demand data analysis, Decision Support, and detailed analytic capabilities for IHVN, State, and Federal Health Agencies. The "system" allows for direct synchronization with District Health Information System, Version 2 (DHIS2), through the World Health Organization's SDMX-HD (data exchange format).	DATA ANALYTICS, VISUALIZATION & USE
10	**Doctoora**	Doctoora provides easy and affordable online and offline access to verified, quality healthcare services by Doctors, other experts and hospitals in Nigeria.	COORDINATION & OPERATIONS
11	**DrugStoc**	DrugStoc is a hassle-free procurement platform to source all the medications, consumables, and small medical devices needed for your practice.	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
12	**Elasticsearch/Kibana**	Kibana is a free and open user interface visualizes elasticsearch data and navigate the Elastic Stack. It can do anything from tracking query load to understanding the way requests flow through the apps.	DATA ANALYTICS, VISUALIZATION & USE
13	**Emergency Operations Center (EOC) Web portal**	A public health emergency operations centre (EOC) refers to a physical location or virtual space in which designated public health emergency management personnel assemble to coordinate operational information and resources for strategic management of public health events and emergencies.	COORDINATION & OPERATIONS

14	**End-Use Verification Activity surveys**	It captures information about the malaria supply chain and malaria diagnosis and treatment at public health facilities in focus countries in sub-Saharan Africa. Results from these quarterly End- Use Verification Activity surveys provide rapid, actionable findings for decision makers	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
15	**eTB Manager**	e-TB Manager is a web or desktop-based tool for managing all the information needed by national TB control programs. It integrates data across all aspects of TB control, including information on suspected cases, patients, medicines, laboratory testing, diagnosis, treatment, and outcome.	CASE MANAGEMENT,
16	**Field Supply**	Field Supply is a fully-featured, enterprise-grade LMIS; designed with an intimate understanding of the unique challenges faced by people working in frontier health systems. Field Supply represents a new kind of enterprise software: one which is designed from the ground up to support the women and men that public health systems depend on for health outcomes, critical data, and ultimate success.	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
17	**GloEpid**	Gloepid is a two-pronged tracking and surveillance technology solution focused on contact tracing, self assessment, and reporting to identify quickly track travel, and contact information, to be able to contain the spread of COVID-19.	CONTACT TRACING, PROXIMITY TRACING, SUPPLY CHAIN & HEALTH FACILITY LOGISTICS, RISK COMMUNICATION & COMMUNITY ENGAGEMENT
18	**gricd**	Gricd provides IoT solutions to enable last mile delivery of temperature-controlled products such as vaccines, insulin and food.	
19	**GxAlert**	GxAlert is a software tool specifically for TB. Aspect is a multi-disease platform. Abbott HIV-VL and TB. Roche VL and TB. PIMA CD4	DATA ANALYTICS, VISUALIZATION & USE

20	**Health Network Quality Improvement System (HNQIS)**	The Health Network Quality Improvement System (HNQIS) is an electronic tablet-based application created by Population Services International (PSI) and used to improve quality of health services in health care networks and effectively manage and reach health impact at scale.	HEALTH FACILITY ADMINISTRATION It helps to establish an accurate health care location data and the tools necessary to upload, manage and make the data easily accessible.
21	**healthsites.io**	It helps to establish an accurate health care location data and the tools necessary to upload, manage and make the data easily accessible.	DATA ANALYTICS, VISUALIZATION & USE
22	**iHRIS**	A free, Open-Source HRIS solutions, distributed under the General Public License (GPL), to supply health sector leaders and managers with the information they need to assess HR problems, plan effective interventions and evaluate those interventions.	HEALTH FACILITY ADMINISTRATION
23	**iHRIS Qualify**	iHRIS Qualify enables a licensing or certification authority, such as a nursing council, to track complete data on a health worker cadre from pre-service training through attrition. It captures information about health professionals in that cadre from the time they enter pre-service training through registration, certification, and/or licensure.	HEALTH FACILITY ADMINISTRATION
24	**iHRIS Train**	iHRIS Train sheds light on a critical area of the health workforce picture. This tool collects and reports data on the number of health professionals being trained in necessary skills and important cadres.	HEALTH WORKER TRAINING
25	**IHVN and CDC EMR**	Health facility records management	CASE MANAGEMENT
26	**ISS: Integrated Supportive Supervision**	ISS was conducted by the Federal Government and organizations to ensure management of resources and best delivery of healthcare services in health facilities.	HEALTH FACILITY ADMINISTRATION
27	**KompleteCare**	A telemedicine platform for online doctor consultation and booking hospital appointments and home-based care.	DATA ANALYTICS, VISUALIZATION & USE
28	**Lafiya Management Information System (LAMIS®)**	It is used for the management and monitoring of PLHIV using electronic systems in Nigeria	CASE MANAGEMENT,

29	**LAMIS Plus**	Hospital Management Information System	DATA ANALYTICS, VISUALIZATION & USE
30	**Life Bank**	On-demand delivery of blood and blood products to healthcare facilities using WHO-recommended cold chain infrastructure.	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
31	**LoMIS**	Logistic Management Information Systems (LoMIS) is a suite of offline-capable mobile and web applications “LoMIS Stock” and “LoMIS Deliver” which address challenges with supply/distribution of health commodities to last-mile health facilities. The LoMIS Suite applications provide critical solutions to ensure availability of health commodity, effective vaccine management, and enable broader health system policy decisions through the use of real data for insight and execution at the community, state and national level.	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
32	**Mango**	Mango Health offers an attractive and easy to use med management app that is helpful in giving information and instructions for each medication being tracked	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
33	**Mobenzi**	It is a survey tool that presents data in a simple, intuitive way to fieldworkers and respondents on any device	SURVEILLANCE, LABORATORY SYSTEMS, CASE MANAGEMENT, COORDINATION & OPERATIONS, SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
34	**MobiDoc**	Mobidoc is a mobile wellness platform that aids doctors/patients consultations	CASE MANAGEMENT
35	**mSupply**	The database is used to store information on items received, issued, and stock balances at the warehouse as well as on the management of medicine and consumables supply for easy access and affordability.	LABORATORY SYSTEMS, COORDINATION & OPERATIONS
36	**mVaccination**	It is a digital, cloud-based solution that connects all stakeholders engaged in the provision, management and monitoring of vaccines	VACCINE DELIVERY

37	**MyService-Agent**	MyServiceAgent is an artificial intelligence (AI) powered intelligent IVR system that can communicate with hundreds to thousands of callers simultaneously and intelligently and disseminate correct information from the Nigeria Centre for Disease Control as well as pass on the data to the NCDC to act on swiftly.	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
38	**National HMIS**	It is the Nigeria electronic system that provides effective and efficient planning, monitoring & evaluation of health services depends on reliable data.	DATA ANALYTICS, VISUALIZATION & USE
39	**ODK**	ODK is an open-source mobile data collection platform. It enables users to fill out forms offline and send form data to a server when a connection is found. Once on the server, the data can be viewed, downloaded, and acted upon. ODK is primarily used by organizations working in humanitarian aid and global development	SURVEILLANCE, DATA ANALYTICS, VISUALIZATION & USE
40	**ODK (Kobo and OnaData)**	Free open-source suite of tools that allows data collection using Android mobile devices and data submission to an online server, without an internet connection or mobile carrier service at the time of data collection.	SURVEILLANCE
41	**OpenMRS**	The OpenMRS custom design mirror the Federal Ministry of Health tools for HIV/AIDS and MDR-TB programs as well as certified data collection tools (DCTs). OpenMRS is currently deployed to over 119 health care facilities by phase implementation, with more than 475 users trained across supported states in Nigeria.	CASE MANAGEMENT, COORDINATION & OPERATIONS
42	**Otrac**	OTRAC is a healthcare Learning Management System (H-LMS) that provides cloud based medical contents to vary array of medical practitioners.	HEALTH WORKER TRAINING
43	**OVC data reporting system**	It is used to collect data to guide program implementers and policy makers in making evidence-based program decisions	DATA ANALYTICS, VISUALIZATION & USE
44	**QGIS**	GIS functions as geographic information system (GIS) software	DATA ANALYTICS, VISUALIZATION & USE
45	**RapidPro**	The open-source tool is being scaled to monitor and evaluate the prevention and treatment of malnutrition	DATA ANALYTICS, VISUALIZATION & USE

46	**RapidSMS Bednets Distribution**	It is a platform for data gathering and group communication using the short messaging system (SMS) on mobile phones, their aim was simply to tackle the problem of slow data transmission within the food security surveillance system	DATA ANALYTICS, VISUALIZATION & USE
47	**Safe Delivery App**	The Safe Delivery App is a smartphone application that provides skilled birth attendants with direct and instant access to evidence-based and up-to-date clinical guidelines, supporting their everyday work.	HEALTH WORKER TRAINING
48	**SENAITE**	SENAITE provides a powerful dashboard to visualize the performance of the lab on a daily, weekly, monthly, quarterly, biannually and yearly basis	LABORATORY SYSTEMS,
49	**SORMAS**	SORMAS) is an open-source mobile and web application software that we developed to enable health workers to notify health departments about new cases of epidemic-prone diseases, detect outbreaks, and simultaneously manage outbreak response.	SURVEILLANCE, LABORATORY SYSTEMS, CASE MANAGEMENT, CONTACT TRACING, SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
50	**Odoo**	Odoo is a suite of business management software tools including, for example, CRM, e-commerce, billing, accounting, manufacturing, warehouse, project management, and inventory management.	HEALTH FACILITY ADMINISTRATION
51	**Tableau**	A tool for data visualization and management	DATA ANALYTICS, VISUALIZATION & USE

ANNEX 4: Overview of gaps and opportunities of existing digital tools

S/N	DPP CATEGORY and FUNCTIONALITY	Software packages: DEPLOYED	Software packages: Existing but NOT DEPLOYED
1.0	**SURVEILLANCE**		
1.1	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc, (ref, Coordination & Operations)	AVADAR, eTB Manager, SORMAS	
1.2	Specification of a subset of minimun critical data points for reporting to facilitate rapid analysis and planning	AVADAR, eTB Manager, eSURV (Electronic Surveillance), SORMAS	
1.3	Early warning surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)	SORMAS/TATAFOO	
2.0	**LABORATORY SYSTEMS**		
2.1	Link client and healthcare workers to the client sample sent to the laboratory for testing	Xpert, Aspect, SENAITE	
2.2	Guidance (to health workers) on the method to collect a sample	Xpert, Aspect	
2.3	Notifications when results are available (to client, to healthcare facility for contact tracing, etc)	Xpert, Aspect, SENAITE	
2.4	Integration with case management application and surveillance tools (to confirm suspected cases are positive or not)	Xpert, Aspect, SENAITE	
3.0	**CASE MANAGEMENT**		
3.1	Registration of clients in the systems with a unique ID	Ada Health App, CommCare, Community Health Insurance Enrollment, OpenMRS;DHIS2, Doctoora, KompleteCare, Lafiya Management Information System, MobiDoc,	

3.2	Client's past health records available from the system	Ada Health App, CommCare, Community Health Insurance Enrollment, OpenMRS;DHIS2, Doctoora, KompleteCare, Lafiya Management Information System, MobiDoc,	
3.3	Input of client contract information	Ada Health App, CommCare, Community Health Insurance Enrollment, OpenMRS;DHIS2, Doctoora, KompleteCare, Lafiya Management Information System, MobiDoc	
3.4	Input of client demographics, vital signs, risk factors, and symptoms	Ada Health App, CommCare, Community Health Insurance Enroll, OpenMRS;DHIS2, ment, Doctoora, OpenMRS, KompleteCare, Lafiya Management Information System, MobiDoc,	
3.5	Creation of lab requests	OpenMRS;DHIS2, Doctoora, OpenMRS, KompleteCare, Lafiya Management Information System,	CommCare
3.6	Communication with client via phone call (through app)	KompleteCare, Lafiya Management Information System, MobiDoc	
3.7	Undirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp)	CommCare, Doctoora, OpenMRS	
3.8	Bidirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp, email)		
3.9	Monitoring and updating of further client interactions and outcomes	CommCare, OpenMRS;DHIS2, Doctoora, OpenMRS, KompleteCare, Lafiya Management Information System, MobiDoc,	

3.10	View a summary record and services provided for a client per encounter	CommCare, Community Health Insurance Enrollment, OpenMRS, KompleteCare, Lafiya Management Information System,DHIS2, Doctoora, MobiDoc,	
3.11	Editing of record in case of errors	CommCare, OpenMRS;DHIS2, KompleteCare, Lafiya Management Information System, , MobiDoc,	
3.12	Enrolment of travellers who have visited high-risk locations at ports of entry for monitoring and follow-up (Port of Entry Screening and Follow-Up)		
4.0	**CONTACT TRACING**		
4.1	Documentation of detailed contact history about the time, place, and person for each high-risk encounter	2 Covid 19 Tracker, SORMAS	1 SORMAS
4.2	Creation of a listing of high-risk contacts linked to suspected and existing cases	1 Covid 19 Tracker, SORMAS	1 SORMAS
4.3	Creation of record to input demographics and risk factors og high-risk contact	2 Covid 19 Tracker, SORMAS	1 SORMAS
4.4	Communication with contact via phone call (through app)		2 DHIS2, SORMAS
4.5	Undirectional communication with contact via messaging (e.g. SMS, social media, in-app. WhatsApp)		2 DHIS2, SORMAS
4.6	Undirectional communication with contact via messaging (e.g. SMS, social media, in-app. WhatsApp)		2 DHIS2, SORMAS
4.7	Update contact records with new changes / symptoms	6 HAMS, DHIS2, Light Wave, SORMAS, OpenMRS	
4.8	Editing of contact record in case of errors	5 HAMS, DHIS2, Light Wave, SORMAS	
4.9	Functionality adapted to generalised epidemic response (not strictly COVID-19(	6 DHIS2, OpenMRS, Light Wave, Port Health, Gx-Alert, SOMAS	
4.10	Allows simultaneous management of multiple epidemic types	6 DHIS2, OpenMRS, Light Wave, HAMS, SORMAS	

4.11	Compatibility with country public health management information system (HMIS)		
5.0	**PROXIMITY TRACING**		
5.1	Automated mass contact tracing of anonymous contacts via smartphone (or bracelet) Bluetooth signals		
5.2	Optional notification of positive infection diagnosis with high-risk contacts via user's smartphone app		
5.3	Functionality adapted to generalised epidemic response (not stricktly COVID-19)		
6.0	**CORDINATION & OPERATIONS**		
6.1	Easy access to real time aggregated to inform response	Emergency Operations Center (EOC), RapidPro, RapidSMS	
6.2	Clear visualisations of key indicators	Emergency Operations Center (EOC), RapidPro, RapidSMS	
6.3	Efficient and effective communications with health facilities and field staff	Emergency Operations Center (EOC), RapidPro, RapidSMS	
6.4	Modelling of epidemic impact scenarios to prepare response (simulations)		
6.5	Clear visualisation of risk factors (risk index) at subnational level		
6.6	Monitoring of response capacities (relevant health personnel, hospital beds, equipment, national or internal Emergency Medical Teams)		
6.7	Big Data analysis (e.g. mobility monitoring based on mobile phone data, rumour monitoring based on social media analysis)		
7.0	**SUPPLY CHAIN & HEALTH FACILITY LOGISTICS**		
7.1	Registration of healthcare facilities	Ishango, ColdTrace, DrugStoc, Field Supply, gricd, Life Bank, LoMIS, mSupply	

7.2	Collection and reporting of data on epidemic-specific consumables (vacciones, PPE etc.), e.g. stocking and stock forecasting, cold chain monitoring (for vaccines)	Ishango, ColdTrace, DrugStoc, Field Supply, gricd, Life Bank, LoMIS, mSupply	
7.3	Collection and reporting of data on epidemic-specific equipment(x-ray machines, critical care beds, ventilators, etc)	Ishango, ColdTrace, DrugStoc, Field Supply, gricd, LoMIS, mSupply	Life Bank
7.4	Collection and reporting of data on epidemic-specific operational metrics (e.g. available ICU capacity, current staffing levels etc)		
8.0	**HEALTH FACILITY ADMINISTRATION**		
8.1	Fiscal managment		
8.2	Donor compliance reporting (Fraud prevention, transparent monitoring, etc)		
8.3	Human resource management	iHRIS, iHRIS Qualify,	
9.0	**HEALTHCARE WORKER TRAINING**		
9.1	Epidemic-specific symptoms monitoring	Otrac	iHRIS Train, Safe Delivery App
9.2	Use of personal protective equipment (PPE), delivering vaccination, etc.	Otrac	iHRIS Train, Safe Delivery App
9.3	Safety protocols for facilities	Otrac	iHRIS Train, Safe Delivery App
10.0	**RISK COMMUNICATION & COMMUNITY ENGAGEMENT**		
10.1	Point of care communications tools (videos through app, atc)		
10.2	Integrated mass communications tools (web, social media, SMS, robocalls, etc)		
11.0	**ONE HEALTH**		
11.1	Tracking of infectious disease outbreaks in domesticated animals (livestock etc)		

11.2	Tracking of infectious disease outbreaks in wildlife		
11.3	Ecological surveillance of environment for changes that could increase risk of zoonotic infection		
12.0	**INTEROPERABILITY**		
12.1	Standardised interface (IHE, OpenHIE, REST, API, HL7, HL7-FHIR, supporting the OpenHIE architecture and workflows)		
12.2	Support for healthcare Coding Standars (e.g. ICD-9, ICD-10, LOINC, SNOMED)		
13.0	**VACCINE DELIVERY**		
13.1	Integration with immunization registry	myVaccination	
13.2	Vaccination/Immunization delivery monitoring, tracking and follow-up at client	myVaccination	
13.3	Vaccination/immunization delivery monitoring, tracking and follow-up at client-level	myVaccination	
13.4	Reporting on adverse effects	myVaccination	
13.5	Digital vaccine certificicate support	myVaccination	
13.6	Microplanning	myVaccination	
14.0	**DATA ANALYTICS, VISUALIZATION & USE**		
14.1	Inbuilt data visualisation features	Elasticseacrh/Kibana, MagPi (formally EpiSurveyor), healthsites.io, eSURV (Electronic Surveillance), Mobenzi, ODK, CommCare, QGIS, RapidPro, RapidSMS, Tableau	
14.2	Multi-level data aggregation and user acess to inform decision-making	Elasticseacrh/Kibana, MagPi (formally EpiSurveyor), Mobenzi, ODK, CommCare, RapidPro, RapidSMS, Tableau	

ANNEX 5: Digital tools supporting each of the DPP functionalities

MODULE Country in outbreak management or preparedness mode? **Ranking selector:**	**DPP CATEGORIES**	Ada Health App	AVADAR: ODK, SMS	Ishango	Chekkit	ColdTrace	CommCarev	Community Health Insurance Enrolment and Authentication System	COVIDConnect / Luscii	OpenMRS: DHIS2	Doctoora	DrugStoc	Elasticsearch / Kibana	Emergency Operations Center (EOC) Web portal	MagPi (formally EpiSurveyor)	eTB Manager	Field Supply	GloEpid	gricd	Xpert, Aspect	Helath Network Quality Improvement System (HNQIS)	healthsites.io	iHRIS	iHRIS Quality	iHRIS Train	OpenMRS	eSURV (Electronic Surveillance)	KompleteCare	Lafiya Management Information System (LAMIS)	OpenMRS	Lite Bank	LoMIS	Mango	Mobenzi	MobiDoc	mSupply	mVaccination	MyServiceAgent	DHIS2	ODK	ODK	OpenMRS	Otrac	Commcare	QGIS	RapidPro	RapidSMS	Safe Delivery App	SENAITE	SORMAS	Tableau
Core	1. SURVEILLANCE		1				1																			1						1	1					1	1	1					1				1	
Extended	2. LABORATORY SYSTEMS																			1												1		1												1	1	
Core	3. CASE MANAGEMENT	1					1	1		1						1									1		1	1	1				1	1				1			1		1					1	
Core	4. CONTACT TRACING																	1																														1	
General	5. PROXIMITY TRACING																	1																															
Extended	6. CORDINATION & OPERATIONS									1	1			1	1														1				1		1													
Core	7. SUPPLY CHAIN & HEATH FACILITY LOGISTICS			1								1					1		1											1	1	1	1												1			1	
General	8. HEALTH FACILITY ADMINISTRATION																				1		1	1																										
Extended	9. HEALTH WORKER TRAINING																								1																				1					
Extended	10. RISK COMMUNICATION & COMMUNITY ENGAGEMENT				1		1		1									1																			1								1				
Extended	11. ONE HEALTH																																																
General	12. INTEROPERABILITY																																																
Core/Extended*	13. VACCINE DELIVERY			1		1																															1												
Core	14. DATA ANALYTICS, VISUALIZATION & USE												1								1																	1	1	1				1		1				1

ANNEX 6: Findings from the online survey

This annex summarises the findings from a short online survey the team developed to collect information on the range of systems used in Nigeria in the context of pandemics. The questionnaire was developed using Google Forms, a free web-based survey tool offered by the Google Docs Editors suite. The questionnaire included three questions collecting information on the name of the software deployed by DPP category and related functionalities. The questionnaire is available for adaptation and re-use as a contribution to keeping knowledge current about the digital health landscape in Nigeria[11].

The questionnaire was sent as a link to the Nigerian digital health community, as well as to the 37 Directors of Planning Research and Statistics, State Ministry of Health.

We received a total of 26 responses. The vast majority presented overlaps with tools already in the Map and Match dataset. The table below lists the additional software packages captured by the survey, not included in the Map and Match dataset.

These additional tools are primarily deployed for surveillance purposes, case management, health worker training, coordination & operations activities, laboratory systems and risk communication and community engagement. All tools are deployed at subnational level.

These software packages could represent additional opportunities that can be leveraged for strengthening digital pandemic preparedness. A more in depth review would be needed to assess functionalities and viability.

Table 8 *List of additional digital tools identified by the online survey*

S/NO	TOOL	IMPLEMENTER	DESCRIPTION	DPP CATEGORY
1	Well covid19 Tool	Wellvis	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc. (ref. Coordination & Operations), Specification of a subset of minimum critical data points for reporting to facilitate rapid analysis and planning	SURVEILLANCE
2	Wcea	World Continuing Education Alliance	Use of personal protective equipment (PPE), delivering vaccination, etc.	HEALTH WORKER TRAINING

[11]Link to the questionnaire: bit.ly/dppa-nigeria

3	SafeCare-4COVID	SafeCare	Donor compliance reporting (Fraud prevention, transparent monitoring etc), Human resource management	HEALTH FACILITY ADMINISTRATION
4	SafeCare-4COVID	SafeCare	Epidemic-specific symptoms monitoring, Use of personal protective equipment (PPE), delivering vaccination, etc., Safety protocols for facilities	HEALTH WORKER TRAINING
5	Mobile Application for Tuberculosis Screening	PharmAccess Foundation	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc. (ref. Coordination & Operations), Specification of a subset of minimum critical data points for reporting to facilitate rapid analysis and planning, Early Warning Surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)	SURVEILLANCE
6	Kulawa.ng	PharmAccess Foundation	Integrated mass communications tools (web, social media, SMS, robocalls etc)	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
7	Mobile Application for Tuberculosis Screening (MATS)	PharmAccess Faoundation	Documentation of detailed contact history about the time, place, and person for each high-risk encounter, Creation of a listing of high-risk contacts linked to suspected and existing cases, Creation of record to input demographics and risk factors of high-risk contact, Communication with contact via phone call (through app), Bidirectional communication with contact via messaging (e.g. SMS, social media, in-app, WhatsApp), Update contact records with new changes/ symptoms, Editing of contact record in case of errors, Functionality adapted to generalised epidemic response (not strictly COVID-19)	CONTACT TRACING
8	Laboratory Assessment Tool	PharmAccess Foundation	Guidance (to health workers) on the method to collect a sample	LABORATORY SYSTEMS

9	Nigeria Medical Information System		Registration of clients in the system with a unique ID, client's past health records available from the system, Input of client contact information, Input of client demographics, vital signs, risk factors, and symptoms, Creation of lab requests, Monitoring and updating of further client interactions and outcomes, View a summary record and services provided for a client per encounter, Editing of record in case of errors	CASE MANAGEMENT
10	Early warning outbreak recognition system	InStrat Global Health Solutions	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc. (ref. Coordination & Operations), Specification of a subset of minimum critical data points for reporting to facilitate rapid analysis and planning, Early Warning Surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)	SURVEILLANCE
11	COVID-19 Call Centre Data Management Information System Platform	FCT Health and Human Services Secretariat	Easy access to real time aggregated data to inform response, Clear visualisations of key indicators, Modelling of epidemic impact scenarios to prepare response (simulations), Clear visualisation of risk factors (risk index) at subnational level, Big Data analysis (e.g., mobility monitoring based on mobile phone data, rumour monitoring based on social media analysis)	COORDINATION & OPERATIONS
12	Caselink	Wella Health Technologies	Point of care communications tools (videos through app etc), Integrated mass communications tools (web, social media, SMS, robocalls etc)	RISK COMMUNICATION & COMMUNITY ENGAGEMENT

13	Healthstack	Healthstack Solution Limited	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc. (ref. Coordination & Operations), Early Warning Surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)	SURVEILLANCE
14	Healthstack	Healthstack Solution Limited	Registration of healthcare facilities, Collection and reporting of data on epidemic-specific consumables (vaccines, PPE etc.), e.g. stocking and stock forecasting, cold chain monitoring (for vaccines);	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
15	Healthstack	Healthstack Solution Limited	Easy access to real time aggregated data to inform response, Clear visualisations of key indicators, Efficient and effective communications with health facilities and field staff, Clear visualisation of risk factors (risk index) at subnational level, Monitoring of response capacities (relevant health personnel, hospital beds, equipment, national or internal Emergency Medical Teams)	COORDINATION & OPERATIONS
16	Healthstack	Healthstack Solution Limited	Registration of clients in the system with a unique ID, client's past health records available from the system, Input of client contact information, Input of client demographics, vital signs, risk factors, and symptoms, Creation of lab requests, Communication with client via phone call (through app), Unidirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp), Monitoring and updating of further client interactions and outcomes, View a summary record and services provided for a client per encounter, Editing of record in case of errors	CASE MANAGEMENT

17	Healthstack	Healthstack Solution Limited	Link client and healthcare workers to the client sample sent to the laboratory for testing, Guidance (to health workers) on the method to collect a sample, Notifications when results are available (to client, to healthcare facility for contact tracing etc), Integration with case management application and surveillance tools (to confirm suspected cases are positive or not)	LABORATORY SYSTEMS


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