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Pilot Implementation Report

Digital Pandemic Preparedness Assessment

Purpose

The Digital Pandemic Preparedness Assessment (DPPA) Toolkit was commissioned by GIZ and developed by GFA Consulting Group (GFA).

The purpose of this **Pilot Implementation Report** on the DPPA - that was carried out in five countries in West Africa in 2021-2022 - is to provide some background to the assignment and a description of the methodology used. The experiences of each country are briefly summarised and the report then addresses the implementation challenges faced. This report also shows how the challenges faced helped evolve the DPPA process and provides a look forward to the future (issues shared in more detail in report on the **Learnings from the DPPA**). Finally, an Annex provides an interpretation guide for the DPPA Toolkit and points to the Toolkit itself which provides guidance on how to conduct the assessments. Links to all these reports are on the www.digitalsquare.org/resourcesrepository/dppa-v2

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Acronyms

AI	:	Artificial Intelligence
API	:	Application Programming Interface
BMZ	:	Federal Ministry for Economic Cooperation and Development
CDC	:	Centre for Disease Control and Prevention
DICE	:	Digital Centre of Excellence
DP	:	Development Partners
DPP	:	Digital Pandemic Preparedness
DPPA	:	Digital Pandemic Preparedness Assessment
ECOWAS	:	Economic Community of West African States
EDIT	:	Early-Stage Digital Health Investment Tool
GAVI	:	Global Alliance for Vaccine and Immunisation
GFA	:	GFA Consulting Group
GIZ	:	German Agency for International Development Cooperation
ICT	:	Information Communication Technology
LMIC	:	Low and Middle Income Country
MOH	:	Ministry of Health
UNICEF	:	United Nations International Children's Emergency Fund
UN	:	United Nations
WBG	:	World Bank Group
WHO	:	World Health Organisation

1 Background

The COVID-19 pandemic exposed serious gaps in the ability of many public health systems to manage an effective response and was the spur to develop a DPPA tool. It was recognised from the outset that this pandemic was going to impact the whole health system and that many countries both lacked digital solutions and the capacity to integrate them. Also, it was evident that circumstances vary in each country and that it was challenging for each country to assess what solutions were needed and what was available. For Development Partners (DPs) too, knowing what solutions were available in any country and where there were gaps that they were able to fill given their priorities and expertise, was valuable information.

One of the most important lessons (from the Ebola 2014/2015 outbreak) was to start with the software and tools that are already known and used regularly. The Covid-19 pandemic prompted the US Agency for International Development (USAID) and PATH's Digital Square initiative to team up on a project known as Map and Match[1]. If many of the digital tools already used within a country's health system could be easily adapted the data gathered could answer important questions about how to mitigate the impact of COVID-19 using digital tools. The Map and Match (M&M) data collection was a significant achievement. Digital Square compiled the data through an extensive desk review of about 750 documents and websites to capture 2,910 tool deployments across 135 countries. But it did not in itself help countries to systematically assess what they needed to do.

The DPPA Toolkit was commissioned by GIZ and developed by GFA Consulting Group (GFA). The DPPA builds on the M&M data and had the objective "To provide a systematic assessment methodology for identifying the **need for digital tools** which fit into partner countries' **existing digital ecosystem** and that can **modernize overall pandemic preparedness"**. The initial intention was to use the DPPA toolkit to make **specific software** recommendations for each country.

An element of the original thinking in the DPPA (which grew in prominence during the project) was the need to understand the country's readiness (infrastructure, strategy) for digital health. To help in this process the DPPA incorporated use of the Early-Stage Digital Health Investment Tool (EDIT), a digital global asset developed by the Kati Collective[2]. The tool defines a set of 79 indicators that help describe the digital health landscape at the DPP national level and identify areas that require specific improvements or digital tools. The EDIT indicators are divided into six (6) key blocks. Each indicator is either informative, enabling, or critical.
The DPPA has been used in five Economic Commission of West African States (ECOWAS) countries, and this report is based on the experience of delivering this programme. However, it also draws on the insights given by other stakeholders, including the World Bank, and the UNICEF/WHO-led Digital Centre of Excellence (DICE).

2 Methodology

The approach taken to develop the DPPA tool was to

1. Define what **Digital Pandemic Preparedness** (DPP) meant in terms of practical software requirements (i.e. what tools are needed?).
2. Draw on epidemic response best practices and digital health standards to **define broad categories of functionality** for DPP-related software packages that constitute a **holistic DPP strategy.** This reduced the number of Map and Match Use Cases (17) to 14.

[1] COVID-19 Map & Match — Digital Square
[2] https://katicollective.com/what-were-thinking-1/edit-a-tool-for-the-greater-good

3. Identify **component functionalities** of software packages for each category (e.g. *Laboratory Systems > Link patient and healthcare workers to the patient sample sent to the laboratory for testing).*
4. Align with other, similar **international frameworks** (e.g. USAID Map & Match and WHO Digital Health Index).

A total of 14 DPP categories were identified, and the total of the functionalities within each of them was 64. The diagram below illustrates the breakdown for Laboratory Systems.

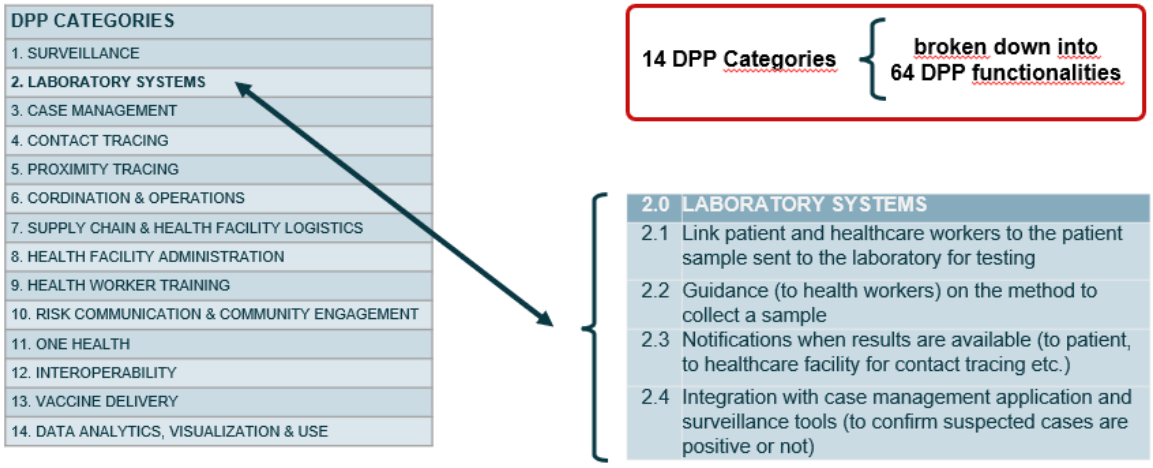

Figure 1: 14 DPP Categories and 64 functionalities

The DPPA tool takes the form of a **multi-sheet Excel workbook.** The **Analysis** sheets are for collection of:

1. **Metadata**: concerning stakeholder mapping and engagement of key informants
2. **EDIT tool (A0.1)**: Category; Indicator; Type; Score; Potential Actions.
3. **Additional and Optional background EDIT data (A0.2)**: internet accessibility and infrastructure; Digital skills; Legal/Regulatory; other comments.
4. **Articulation of existing DPP Software Packages – M&M Validation (A.1)**: Tool; Software name; Primary purpose of tool; DPP categories; Funder; Implementer; Government contributions; Proprietary/Open Source; Scale: National or sub-National; Scope/description; URL; Developer; Number of Regions using it; Number of Districts using it; Intended users of the tool; Estimated numbers of users; Estimated number of facilities using it; Hardware; Functionality; Data standards in use; USAID M&M use case; DPP Category; Organisation/ Government Entity Currently Maintaining Tool; Comments.
5. **DPP Overview (A.2)**: A table listing the identified tools against the 14 DPPA categories.
6. **Identification of Existing Software Functionalities (A.3)**: For each tool, the functionalities that it supports within each category.
7. **Qualitative Assessments (A4)**: For each tool a qualitative description of the functionalities that are supported.
8. **Gaps by DPP Category and Functionality (A.5)**: showing the software packages that are deployed and those that exist but are not deployed.

In addition, there were **Description** sheets provided which gave:

1. Definitions of the DPP Categories
2. Functionality descriptions for each DPP Category
3. A ranking of the modules
4. Overview of the procedural workflow
5. A decision tree for tool assessment
6. DPP Category Mapping against USAID M&M Use Cases

The overall process is shown in the flowchart below and explained in more detail in the Annex (section 8) which is an extract from the Toolkit interpretation guide which was produced. Also, an induction programme

and online training sessions were provided (both in English and French) focused on the data collection process and the use of the DPPA tool, and a video recording made for offline use. Included in the training was guidance on producing the final reports.

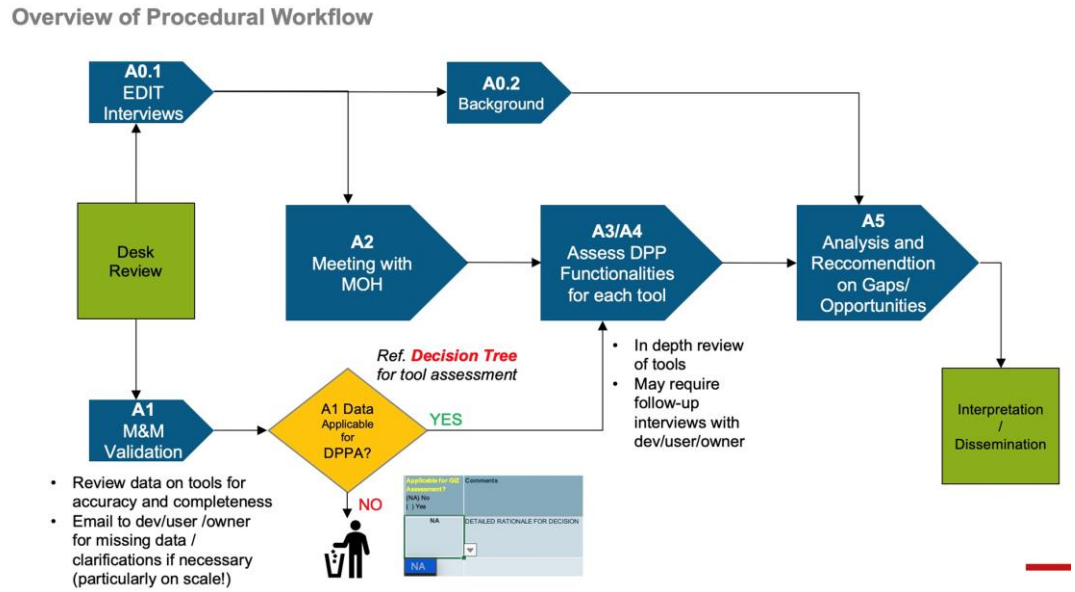

Figure 2: Assessment Workflow

Essentially there were to be three phases:

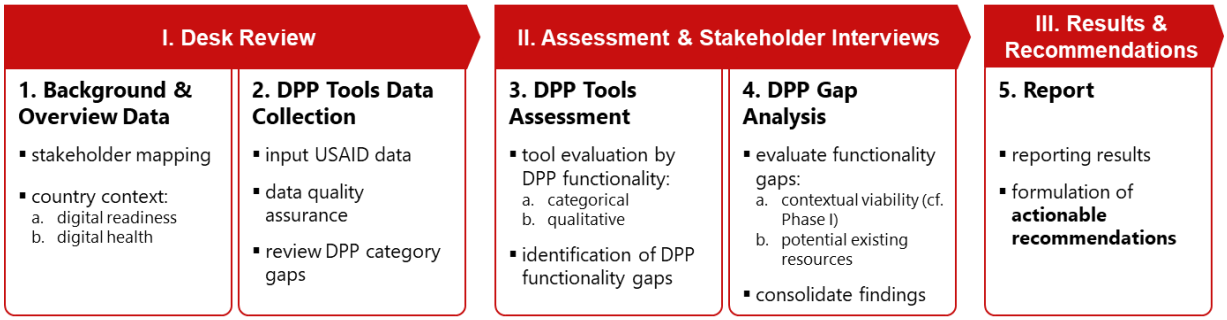

Figure 3: DPPA Work Packages

Work on the DPPA toolkit began in late 2020. The first version of the toolkit was published in March 2021. An early user of the toolkit told us that his experience (in mid-2021) of using it in Chad suggested that it was easy to get lost in the Toolkit and that it was important to take a more modular approach. He warned that the data collection and validation workload was high and that data collectors may need guidance on what the criteria should be used. As a result of this feedback a version of the toolkit was evolved in which guidance was given on the modules (categories) to which data collectors should give priority bearing in mind that these were different when the context was one of an outbreak or preparing for an outbreak. These are shown for the DPP categories in the table below.

	Outbreak	Preparedness
Module	**Outbreak Management (Ranking)** Health relevance (in the context of Outbreakmanagement / Pandemic response) - reemerging or newly emerging disease / health security issue (e.g. CBRN)	**Preparedness (pre- & post-outbreak / pandemic)** Health relevance (in the context of outbreak management / pandemic response)
Core Priority	CASE MANAGEMENT	SURVEILLANCE
	SURVEILLANCE	DATA ANALYTICS, VISUALIZATION & USE
	CONTACT TRACING	INTEROPERABILITY
	DATA ANALYTICS, VISUALIZATION & USE	ONE HEALTH
	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS	VACCINE DELIVERY
	VACCINE DELIVERY (if re-emerging disease)	LABORATORY SYSTEMS
Extended Secondary Priority	HEALTH WORKER TRAINING	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS
	ONE HEALTH	HEALTH WORKER TRAINING
	LABORATORY SYSTEMS	COORDINATION & OPERATIONS
	VACCINE DELIVERY (if emerging disease)	RISK COMMUNICATION & COMMUNITY ENGAGEMENT
	COORDINATION & OPERATIONS	CASE MANAGEMENT
	RISK COMMUNICATION & COMMUNITY ENGAGEMENT	CONTACT TRACING
General Tertiary Priority	HEALTH FACILITY ADMINISTRATION	HEALTH FACILITY ADMINISTRATION
	INTEROPERABILITY	PROXIMITY TRACING
	PROXIMITY TRACING	

Figure 4: Categories for the prioritization

The suggestion was to begin the digital assessment with the module of core categories, followed by the module of extended categories, and to complete the DPPA with the module of remaining categories. Countries could decide what approach to take depending on their own capabilities. From an epidemiological perspective the rationale was that:

- The **core categories** serve as baseline from the epidemiological perspective. These categories encompass what is anticipated to be already available, established and functioning in every country.
- Experience shows that the earlier **surveillance** highlights unusual clustering or reemergence of illness, the earlier **infection prevention control (containment)** measures start, and the better the overall impact.
- The holistic **One Health** approach (including humans & animals (zoonosis, environmental, …) along with reliable **data** and their accurate **analytics and use** in informed decision-making are critical (for any disease outbreak).

However, although this approach offered a way to manage the time spent on gathering key data, when it became evident that the number of systems being reviewed was becoming too small to provide a reasonable assessment, it was not used (though it still offers a viable way of prioritising work). The corollary of this was that the timetable that was initially programmed assuming 4 weeks to complete the assessment became defunct. That initial timetable, which shows the three basic stages involved is shown below.

		Resource Days		Week 1	Week 2	Week 3	Week 4
		NSTE	ISTE				
1	**Preliminary Analysis**						
1.1	Internal team preparations (consultations between ISTEs & NSTE, overview of mission, training on DPPA	0.5	0.5				
1.2	Online kickoff meeting with contractor, GIZ SP/Health, country GIZ health representatives and experts to discuss scope of work, country context and identify stakeholders for input relevant to the assessment	0.5	1				
1.3	Mapping of relevant stakeholders	0.5					
1.4	Desk review of existing country epidemic response readiness, COVID-19 response status, digital devel.	2.5	0.5				
1.5	Meeting with public health authority officials (Directors - Primary Health Care and Disease surveillance) to get buy-in for assessment, introductions, workshop scheduling etc.	0.5					
2	**Primary Data Collection**						
2.1	Implementation review meeting with GIZ health representatives and experts in partner country to discuss initial desk review findings, implementation plan, and identify additional stakeholders for input relevant to the	0.5					
2.2	Meeting with public health authority **technical team** for preliminary understanding of tools and functionalities	0.5					
2.3	Interviews with identified stakeholders (using DPPA toolkit). Select priority list of **maximum 8** interviews from all stakeholders (INCLUDING KC EDIT TOOL ANALYSIS: ISTE)	8	0.5				
2.4	Preparation and interpretation of preliminary findings	1.5					
2.5	Workshop with public health authority **technical team** to review preliminary findings including gaps and opportunities. Additionally assess which tools could add value (i.e. which tools and functionalities are already deployed as per assessment framework? Which functionalities/needs are not being met? Which solutions could apply given contextual viability? Analyse tools for contextual viability, i.e. in relation to epidemic progression, digital readiness and the health system capacities)	1	1				
3	**Assessment Report**						
3.1	Follow-up interviews and further desk review (as required)	1					
3.2	Development of draft report	2					
3.3	Finalisation of report (based on draft review by GIZ)	0.5	0.5				
3.4	Preparation for dissemination workshop	1					
3.5	Dissemination workshop	0.5	0.5				
	TOTAL:	21	4.5				

Figure 5: Original Timeline for the implementation of the DPPA

In practice the experience in all five countries, as shown below, was that the process took considerably longer than initially envisaged.

3 Country Experience

3.1.1 Togo

In Togo, the DPPA process began in September 2021. The final report was sent to the Ministry of Health in April 2022. The total number of systems from Map and Match was 17, and a total of 18 tools were assessed after validation of the M&M data. The report **recommendations** were to: extend the functionalities of the Health Management Information System (HMIS) in Togo to the online training of health professionals, scale the software already used by the Ministry for the management of human resources in health and acquire other software packages for the management of financial resources and the "One Health" approach.

3.1.2 Ghana

In Ghana, the DPPA process began in September 2021. The final report was sent to the MoH in May 2022. The total number of systems from Map and Match was 62. A total of 17 software packages were assessed for this exercise and another 21 were identified to be decommissioned or not in use. The assessment also revealed that 11 software were not relevant to pandemic preparedness and 12 were deemed to be useful for pandemic preparedness but relevant stakeholders for interviews could not be identified. The **recommendations** were: For future pandemic preparedness, the recommendation is for the Ministry of Health to update the current eHealth strategy in the light of pandemic preparedness and recent innovations in the digital health ecosystem. In addition, a new data warehouse is required to support collection, transformation, analysis of (pandemic-related) data and dissemination of evidence-based reports. Development partners should support MoH to develop a costed roadmap with key priorities for implementation in the short to medium term (1-5yrs). There is also an opportunity for MoH to partner GIZ to support identification of key areas for an accelerator program to develop an innovative application to enhance the country's preparedness for future

pandemic. Further recommendations are that the MoH needs to invest in the development of data science skills and cloud infrastructure, as well as developing a new business model and infrastructure for telemedicine and build a new gateway for managing social media platforms to support bidirectional communication. MoH should be encouraged to support the development of the Master Patient Index platform using the National ID number and integrate the national data warehouse with the lab information system.

3.1.3 Sierra Leone

In Sierra Leone, the DPPA process began in September 2021. The final report was sent to the Ministry of Health in April 2022. The total number of systems from Map and Match was 44 and 44 were reviewed. **Recommendations** concerning the major gaps include strengthening mobile phone communication for contact tracing and digital tracking, improved monitoring and management of animal, environment, and human disease outbreaks (One Health).

3.1.4 Nigeria

In Nigeria, the DPPA process began in August 2021. The final report was sent to the Ministry of Health in July 2022. The review of the Map and Match database showed that there were 159 software tools, but of these 28 (18%) were not relevant to pandemics, and 67 (42%) were defunct. 64 tools were applicable for the DPPA assessment representing 40% of the Map and Match dataset. Twelve **recommendations** were made to address the gaps and deficiencies identified at the ecosystem level, as well as towards improving digital pandemic preparedness. These included accelerating the release and implementation of the Nigeria Health ICT Framework (2022-2027), strengthening One Health initiatives, and developing a healthcare resource discovery tool. 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.

3.1.5 Ivory Coast

In Ivory Coast, the DPPA process began in November 2021. The final report was sent to the Ministry of Health in August 2022. The Map and Match database provided 29 tools to which 5 tools were derived from the Directorate of Informatics and Health Information database, and 2 from the literature review, making a total of 36 that were reviewed. **Recommendations** were that Ivory Coast will need to develop its **long-term plan for financing the digital health system** and **its strategic plan for digital health** (essential documents to mobilize resources from partners and the government). There will also be a need for a coordinating body and a framework document that clearly defines roles and responsibilities for digital health functions and activities, as well as the training of women's health personnel. In addition, attention should be paid to the advantages and disadvantages of open-source digital tools compared to proprietary digital tools.

4 Implementation challenges

Evidently the process of conducting the DPPA took much longer than was anticipated. The explanations for this vary between country, but there are some generic lessons to be learned.

4.1 Getting endorsement from the start

Both at the start and at the conclusion of the process there were challenges in most countries. Getting access to the MoH (and getting the right sequence of introductions to the relevant decision-makers) proved to be difficult, time consuming but was certainly necessary.

Setting up a kickoff workshop with stakeholders also took time to organise, particularly where in-country GIZ staff were not available (as in Ivory Coast). These startup workshops varied in the numbers of stakeholders

attending, and in one case had to be piggybacked onto another meeting. Nevertheless, the stakeholders who engaged were supportive and contributed their own perspectives on the process and outcome. However, as the process of data collection became extended, so it became increasingly difficult for stakeholders to maintain their engagement. As a once-off exercise, it is an understandable challenge for commitments to be made for regular meetings. At the conclusion of the DPPA process there were final workshops held to review the findings and receive final comments.

4.2 Finding and retaining consultants

Finding, training, retaining local consultants took time and effort. Since the process was being managed from outside each country, reliance was placed on the recommendations of GIZ staff in-country. The network of digital health experts in the pilot countries is limited and their expertise is highly requested. Even if several experts were interested in conducting the DPP assessment, their availability to work on such a short, intensive assignment was highly constrained. Private, unexpected circumstances also hindered our consultants' availability. To these challenges are added those of connectivity, power supply etc., which slowed down the project activities.

4.3 Coordination and engagement with development partners

The kickoff meetings provided a useful forum for involving Development Partners (DP). MoH contacts were very helpful in this process, though again it took time to organise as there was no existing forum. Some DPs, notably UNICEF and the World Bank played key roles in some countries. Evidently in every country there was no forum of DPs where programmes such as DPPA could be presented for review, and so it took time to set up arrangements in which all key stakeholders were identified and involved. The dangers of siloed assessments were noted. For example, in Sierra Leone, by the time the DPPA work began the World Bank Group (WBG) were already partway through a programme of work that was assessing digital preparedness for pandemics, albeit using a much more qualitative approach. There were several joint meetings to ensure overlap of effort was minimised; and in Ghana the WBG used the GIZ DPPA results and avoided replication before engaging directly with the MOH.

4.4 Selecting interviewees

Particularly regarding the EDIT process, it was a challenge to find appropriate people to interview. In some cases, the interviews were done 1 on 1, in other cases a group setting was used. In some cases, the EDIT template was emailed for respondents (once they had been identified) to complete and return. There were numerous issues for the local consultants to address to ensure they found the right person to contact to ensure data about a specific tool would be accurate.

4.5 Data collection, validation and data quality issues

Collecting data was helped by having the foundation of the Map and Match datasets to use. Without these, the process would have been prohibitively time-consuming. But, as was quantified in the case of Nigeria, 42% of these systems were now defunct. Validating data and cross-checking responses also took considerable time and judgements had to be made concerning the value of completing all data fields and the time this would take. In practice, for example, most countries did not collect data on the number of Districts the tool was being used in, or the types of users and their numbers, or the facilities using it. Whilst the Gaps in the categories and functionalities in use were identified, there was not time to conduct Stakeholder interviews on deployed software packages and associated challenges by each DPP functionality. Together with the other feedback, there was an increasing perception that recommendations should not be system specific. Initiatives to improve the quality of health data and its governance[3] in digital health systems would be a useful complement to the DPPA.

[3] opportunity Archive | Transform Health (transformhealthcoalition.org)

4.6 Managing operations in multiple, heterogenous settings

Countries differ considerably in their geographies, and this had an impact on how the process was managed. Also, leeway was given to pursue different approaches. For example, in Sierra Leone, there was seven districts were selected [out of a total of sixteen] to presumptively get a representative sample of epidemiological factors, terrain/access, stage of deployment of digital solutions and experience. This selection was made by the ICT Manager at the MoH, who oversees all digital health deployments in the country. The Monitoring and Evaluation Officers at the districts were designated as the participants to provide the necessary input into the study survey. These officers were each then sent an email explaining the purpose of the study with the DPPA Tool attached, together with clear instructions on how to complete the relevant sections i.e., tabs A3 and A4 of the tool. This approach showed that data collection for the DPPA tool can be undertaken in a decentralised way. But in larger countries, such as Nigeria, this approach is less feasible, and a centralised approach was taken. Without the restrictions of time, however, arranging data collection within each of the States would have been an option to consider.

4.7 Report formats

Though guidance was given on report formats in the training, they were revised. The initial feedback on Togo (the first country to start producing a report) indicated that more structure was needed. This was developed over several iterations, and then this common structure was used by the other countries in developing their reports.

5 Evolution of the DPPA process

Initially envisaged as a process that could be undertaken within a month, the reality was that it took each country on average about 6-7 months. The implementation challenges have been outlined above, but what did this mean from a programme perspective and how did the DPPA process evolve?

Firstly, as already discussed in Section 2, there was an evolution of the DPPA toolkit to prioritise the DPP Categories though this remains untested in practice because comprehensiveness of the assessment was preferred over fast delivery of prioritised results. However, were the DPPA process to be institutionalised in the operation of the digital health ecosystem of a country and a baseline established, it would offer a way of focusing the effort over, say, a three-year cycle on these different priorities.

As the DPPA process engaged with the MoH and stakeholders it became increasingly clear that the original intention of providing specific software recommendations was going to be problematic, and that more attention than originally intended needed to be paid to understanding what the state was of the **digital health ecosystem**. The lack of current digital health strategies in the five countries hampered overall assessments. But the initial publication of the Navigator tool[4] by Digital Square in November 2021 showed that EDIT was a tool well suited to assess a country's readiness to implement a digital solution(s) and reaffirmed the intent in the March 2021 version of the DPPA to use EDIT as part of the DPPA process. Different approaches were taken to using it. In some countries (e.g., Sierra Leone) data collection for EDIT was done remotely via email to health systems leaders. In others (e.g. Nigeria) the EDIT assessment was conducted in collaboration with identified assessors drawn from technical advisers at the MoH and representatives of regional, donors and civil society organisations. As a means of assessing digital health readiness scores the tool proved useful, and a great deal of qualitative information was also gained (e.g. by Ghana). But in all countries, progress was slow because this was a one-off exercise and not part of a regular process of monitoring and assessment.

Feedback from the EDIT interviews, from the stakeholder engagements and the implementation challenges all indicated that rather than provide specific actionable recommendations about systems to fill the gaps, the emphasis should be on recommendations concerning the digital health ecosystem, and about the steps to be taken to improve pandemic preparedness.

[4] A Navigator for Digital Health Capability Models_A Users Guide_1.0_Final_Feb2022.pdf (digitalsquare.io)

Unaddressed in the original DPPA was the desirability of **costing** the recommendations. As the recommendations began to be shared there was a request in some countries for recommendations to be costed and prioritised. In Ghana, for example, there was an attempt to engage with DPs to do just this. However, this process needs to be developed further in future versions of the DPPA, drawing on work about pricing digital health tools[5] and digital health investment[6].

Also initially unstated was the requirement that **ownership** of the process should remain in countries. The need for this was underlined in different ways during the DPPA and could have been stated more clearly at the outset and in the documentation shared.

A corollary of the time taken to manage the progress in the five countries was that other areas of work envisaged in the overall programme were not taken forward. There was **no engagement with ECOWAS** with a view to develop a regional framework.

Looking to the future, one of the (Core) functionalities that, apart from Ivory Coast, is featured as a "gap" is to do with One Health. Future development in digital tools to prepare for pandemics need to address the **cross-sectoral** issues with animal and environmental health, and indeed other sectors if a Whole-of-Government approach is adopted.

6 Looking to the future

Institutionalising digital health (and pandemic preparedness)

The DPPA process would have been even more time-consuming if the data from the Map and Match were not available. The risk is that the effort to collate this data (that was stimulated by the Covid-19 pandemic) will not be continued by USAID or anyone else, and the quality of the available data will deteriorate over time (already Nigeria reported 42% of systems were defunct). However, there are some key sources of available data and information concerning Digital Health Tools and Technologies. For example, UNICEF have been mapping digital tools and technologies in countries[7] and more detailed studies on IVR[8], and immunization data[9].

But, given that there continues to be little co-ordination of the aspects of digital health systems of interest to DPs themselves and making that easily available, the reality that digital health strategies are not kept up to date with knowledge from external or internal monitoring systems that report on the availability and functionality of the tools in use. Also, MoHs do not have information units established to address these issues, so assessing the digital aspects of pandemic preparedness will remain difficult to do.

Perhaps the major lesson to be learned is that **digital pandemic preparedness is just one aspect of a digital health system**. The Covid-19 crisis forced attention on what should be a matter of routine – keeping current the knowledge of what digital systems and functionalities are working to improve the health system. But to institutionalise a process to do this – to develop and improve a continuing cycle of digital health assessment requires resources that most LMICs do not have. Or at least the resources that are available are not co-ordinated in such a way that they enable LMICs to make best use of them.

What are the resources that are available? Firstly, every country has a **MoH** with the authority to make policies concerning health, and digital health. In many countries, such as Sierra Leone, there is increasing attention being given to improving "Whole of Government "- initiatives, and some have established governance arrangements that mean many digital issues to do with infrastructure and standards, for example, involve a

[5] FIND | RFP Pricing-access framework for digital tools and applications in low-and-middle-income countries (finddx.org)
[6] WHO_Digital_implementation_investment_guide_DIIG_R3.pdf (path.org)
[7] Mapping of Digital Health Tools and Technologies in Countries - Google Sheets
[8] IVR providers by country - Google Sheets
[9] DPGs Immunization Delivery Management Systems (no emails) - Google Sheets

Central Government Unit. Countries such as Nepal[10] and Egypt[11] have been supported by USAID to have a Digital Ecosystem Country Assessment. It is also likely that as more attention is paid to One Health issues that more cross-sector working is going to be required.

Secondly, every country is expected to have a current **Digital Health Strategy**. Guidance on this has been provided by the WHO since 2012, and by the African Union. These Strategies need to be kept up to date. At present, of the five countries studied, only Sierra Leone has a Strategy that is less than five years old.

In all countries, guidance on (best practice) **use cases and processes**, such as monitoring, that can help keep a strategy up to date are lacking. These can be in the form of the pandemic examples provided used by the DPPA. But there are other more formal frameworks available, notably the Classification of Digital Health Interventions[12].

There are of course a range of **capacity building networks** and resources that are available for digital health practitioners at national or local level. Some are available from the MoH of a country, some supported by DPs such as the WHO[13], and others supported by Regional and Continental networks, such as HELINA[14]. In many respects their task to help improve the use of data and learning.

How application systems that are in use generate the **data and information** that inform the whole health system remains largely unknown, and yet improving them from a technical and training point of view is vital. The ways in which "accelerating country-led digital health transformation for data use to improve health outcomes" is the subject of a research project led by PATH and Cooper/Smith[15] and is reinforcing the need to understand data use as part of a digital health ecosystem in which the key elements for implementation are shown below:

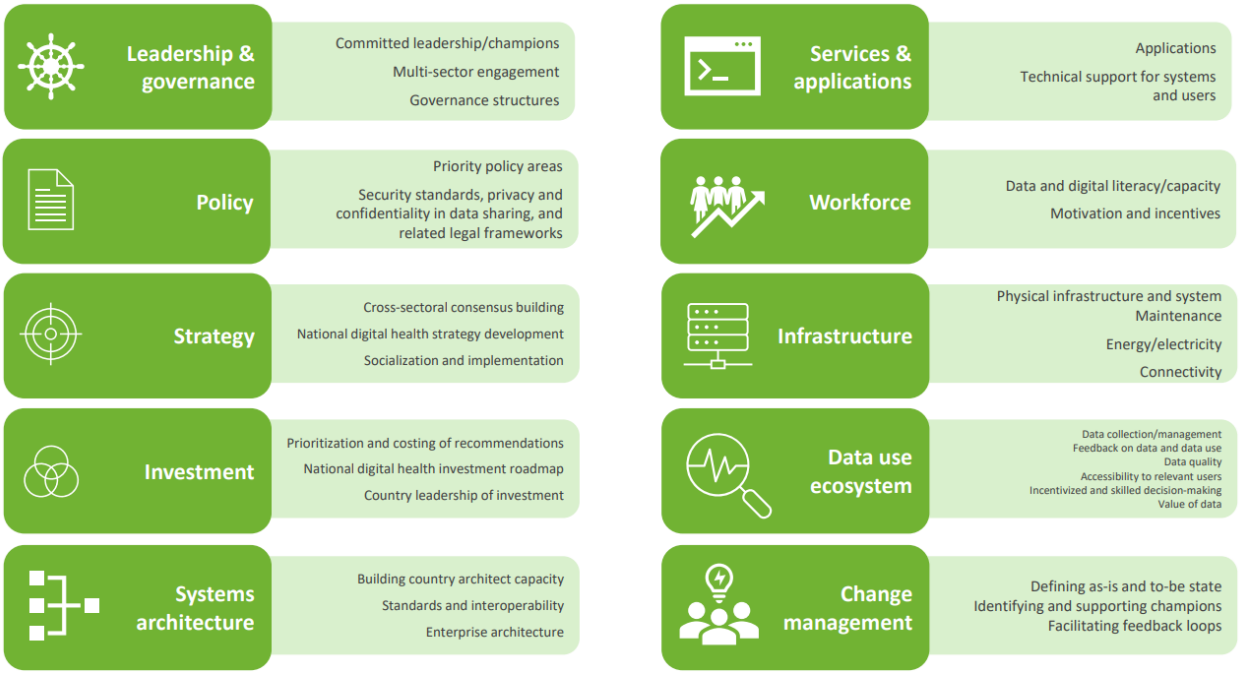

Figure 6: Data Use Acceleration and Learning (DUAL) - key elements for implementation[16]

[10] Nepal Digital Ecosystem Country Assessment | U.S. Agency for International Development (usaid.gov)
[11] Digital Ecosystem Country Assessments | Digital Strategy | Technology | U.S. Agency for International Development (usaid.gov)
[1212] WHO-RHR-18.06-eng.pdf
[13] WHO-ITU Digital Health Leadership training | ITU Academy
[14] HELINA – Health Informatics in Africa – The Pan African Health Informatics Association and the African regional body of the International Medical Informatics Association (IMIA).
[15] PowerPoint Presentation (globaldigitalhealthnetwork.org)
[16] https://www.acceleratedatause.org/

With a strong data use ecosystem in place, and interoperability between systems when crises such as Covid-19 hit, countries can pivot quickly to respond to them (as Malawi and Vietnam, for example did in the COVID-19 crisis).

Learning from others is not just about individual capacity building. It is also about **knowledge management** and sharing so that others can learn from it. There are resources available to help countries, and DPs, learn from each other and try to converge on some digital health solutions[17]. National assessments of digital health issues that are compiled from knowledge (data and information) generated at a District/Regional level enables performance to be assessed and perhaps best practices identified. At a Regional the same applies. ECOWAS, for example, has taken a proactive role regarding ICT with a Regional Strategy[18] and Human Capital Development[19]. At a Global level, the WHO provide a global technology registry platform containing knowledge about the existence of digital health solutions[20]. UNICEF too have mapped digital health tools and technologies in 159 countries[21]. Though useful, neither source is comprehensive – in part because its use (by collecting data and uploading digital health solutions) is not yet institutionalised in the work of MoHs. Perhaps if global resources have country pages that can also be used at a National level institutionalised sharing would become more prevalent.

Whilst countries need to invest more in (digital) health, a key task for MoHs is to invest in the structures (people and processes) needed to coordinate and manage the process of development and implementation of digital health policy and strategy across the relevant sectors. Such a unit is would then be in a position to facilitate the development of improved coordination between DPs, researchers and others, and gather the evidence that substantiates the benefits of pooling resources (including secondments of people) in a managed way. With **converged donor support** much more can be done. There would also be the scope for more active participation in the high-level working groups that develop global information policy, e.g. the Health Data Collaborative.

A summary of this Digital Health Assessment Cycle is shown below.

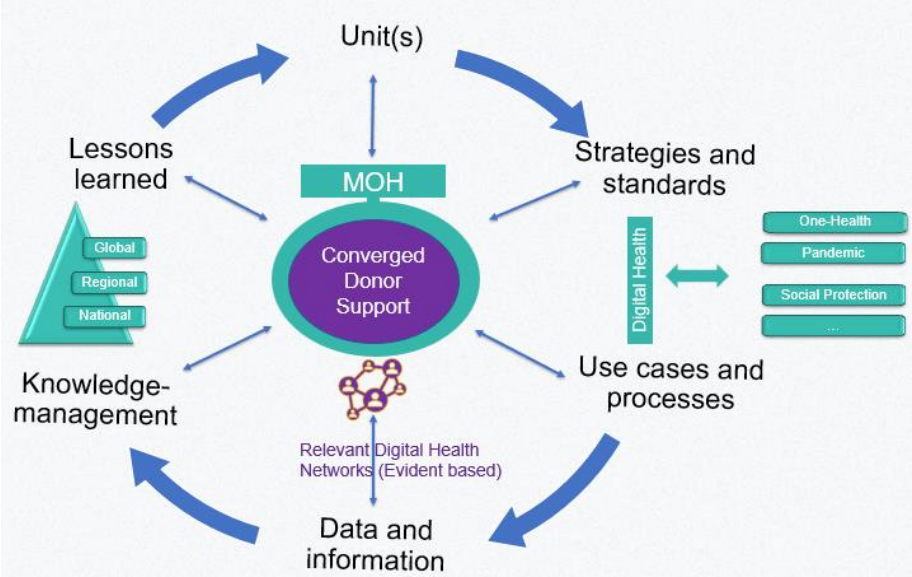

Figure 7: Digital Health System Cycle - First Draft

In institutionalising digital health (and pandemic preparedness) a summary of the lessons learned is:

- Ownership must be with the countries within a cross-sectoral coordination unit;
- Use available standards, use cases and categories;

[17] Digital Health Convergence Meeting Tool Kit (adb.org)
[18] ICT | Economic Community of West African States(ECOWAS)
[19] ECOWAS Human Capital Development 2030 | Economic Community of West African States(ECOWAS)
[20] DHA (digitalhealthatlas.org)
[21] Mapping of Digital Health Tools and Technologies in Countries - Google Sheets

- Active involvement of the donor community and DH Networks; usage of centralized repositories (National, Regional and Global), but informed by a “bottom-up” approach;
- Foster learning communities and keep recommendations and interventions updated.

Annex 1: TOOLKIT interpretation guide

Introduction

The DPPA Toolkit provides a methodology for collecting data and making recommendations to assist partner countries in **identifying the need for digital tools** which fit into their existing digital ecosystems, and which can modernize overall pandemic preparedness. The toolkit is a multi-sheet Excel workbook which provides the structure for the assessment. The following pages provide a **basis for actionable recommendations** which can be distributed to relevant stakeholders. The document may also serve as an executive summary of findings.

Context

The DPPA results and recommendations are set within an assessment of the digital health context of the country. To do this, the results from a desk review of relevant material should be assembled (e.g., documentation relevant to state of health system digitalisation), and in addition, considering the output of the EDIT[22] tool which is used in Sheet A0.1. This requires a scoring of 22 questions which, at a high level, give an overview of the state of digital health readiness within the country. These critical indicators, with their scores (from 1-5) are supplemented by qualitative assessments captured in Sheet A0.2.

Interpretation methodology

The data collected during the assessment is used to draft a concluding set of results in sheet A5 of the workbook. This follows a two-step process comprising tables 1-3 (sheet A5):

1. Identify gaps and opportunities by DPP functionality;
    - **Gap:** no existing software available for an identified need within the partner country DPP context;
    - **Opportunity:** existing software available for an identified need within the partner country DPP context.
2. Provide analysis-based action recommendation for each gap/opportunity.
    - **New Software Recommendation:** no existing software available for an identified gap within the partner country DPP context. Based on the contextual viability analysis (A0.1, A0.2) we recommend exploring options for new software meeting this functionality requirement.
    - **Leverage Existing Software:** existing software available as an identified opportunity within the partner country DPP context, based on survey of existing software (A1,A3,A4) and the contextual viability analysis (A0.1, A0.2) we recommend exploring the use of [SOFTWARE] currently operated by [OWNER] in order to meet this functionality requirement.

As the result of step 2 is a list of recommendations per identified DPP functionality gap/opportunity, a further step is necessary to provide **concrete recommendations for actual software procurement**. The 3rd step is as follows:

3. Provide minimum set of **software recommendations** matching identified DPP with rationale based on contextual viability.
4. Provide **descriptive information** on the recommended software including links, deployment and operational costs, and other considerations.

[22] https://katicollective.com/tools

The output of step 3 is a list of the recommended software packages, with a mapping to each identified gap/opportunity, including a detailed rationale (ref. Table 4). This step takes into account the broader picture, in an attempt to both **minimise the quantity of software packages recommended** (i.e. by seeking to recommend software that aligns with the highest number of identified gaps) and **provide the best match to the context** of the partner country.

Procedure

1. From DPPA Sheets A0.1 and A0.2, together with Desk Review develop Table 0.1 and 0.2;
2. From the DPPA Toolkit Sheet A5, **insert** Tables 1, 2 and 3 below for *reference purposes* (it is suggested to copy and paste as pictures);
1. **Complete** Table 4: Recommended Software by Identified Gap/Opportunity;
2. **Complete** Software Descriptions.

EDIT Assessment of the Critical Indicators for Digital Health

DPPA Toolkit – Excel sheet - Table 0.1

Category	Indicator	Score
Human Capacity	Mechanisms for capacity development and information sharing	4
	Specialized knowledge to support and maintain system	4
	Regular supportive staff supervision	5
Standards and Interoperability	Master facility list	5
	Ability to unambiguously identify an individual	5
Governance and Policy	Leadership and political will	5
	Existence of institutionalized digital health governance structures	5
	Existence of a digital health strategy	1
Data Capture and Use	Geographic data for the country	4
	Standardized Logistics Management Information System (LMIS)	5
	Community Health Worker Registry	3
	Standardized Immunization Registers	5
	Demographic Data Availability	5
	Data entry workload	2
	Data improvement plan	4
Investments and Funding	Costed, long-term plan to operate, maintain and support digital health systems	4
	Political interest and support in investing in ICT for service improvement	4
	Existence of sufficient funding to support infrastructure strengthening	4
Infrastructure	Proportion of facilities with functionable and accessible computers	5
	Proportion of facilities with functionable and accessible mobile devices	5
	National level capacity of maintaining hardware in the data storage centers	5
	Ability to maintain and troubleshoot both hardware and software at district level	3
TOTAL		92

Figure 8: Example EDIT Assessment; Overall Average Score: 92/22 = 4.18

Summary: The Country is updating its Digital Health Strategy, and in doing so can build on an encouraging state of digital health readiness. Though attention needs to be paid to the important issue of data entry workload, and to improving community health worker registries and the ability to troubleshoot IT problems at District level, fundamentally the foundations are all in place and now need to be built on. Though the Government wants to incorporate an Open-Source approach, the Private Sector is playing an increasingly important role, and may have different perceptions of the benefits and risks involved.

Additional Qualitative Assessments of Digital Readiness

DPPA Toolkit – Excelsheet - Table 0.2

EXAMPLES OF KEY ISSUES	ASSESSMENTS (AND SOURCES)
Strategy	Have an (old) Strategy that is being built on. From 2017 began process to re-draft. Hiatus last year because of Covid and aligning it with the National Health Policy for 2020-2025. Some initial costing for a 5-year Action Plan done. Will have a new Digital Health Strategy early 2022. It will align with the WHO framework. (Source: EDIT Interviews)
Internet usage	Individuals using the Internet (% of population) in 2019 = 53% (Source https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=)
Infrastructure	Cloud hosting well established, and mostly hosted in country. The National Data Centre (under the main government National IT Agency) hosts a lot. The LMIS does not do in-country hosting (but looking to do this), but all the personally identifiable data is hosted on systems in-country (Source: EDIT interviews)
Digital Skills	Almost all facilities, from regional level and Teaching Hospitals to District Hospitals have IT managers trained in technical areas. There is an adequate service level. But still struggling for IT managers at local level. (Source: EDIT-Interviews)
Licensing	The available digital health tools rely on different software licensing types for sustainability with open source and proprietary being the most common. A limitation of the Map and Match analysis was the inability to find complete information about licensing type and scale of some of these tools. (Source: Map and Match Profile).
Etc…	

Figure 9: Example of qualitative results

Table 1

S/N	DPP Categories	Matching Software Packages Deployed
1	SURVEILLANCE	18
2	LABORATORY SYSTEMS	4
3	CASE MANAGEMENT	16
4	CONTACT TRACING	7
5	**PROXIMITY TRACING**	
6	COORDINATION & OPERATIONS	7
7	SUPPLY CHAIN & HEALTH FACILITY LOGISTICS	19
8	HEALTH FACILITY ADMINISTRATION	9
9	HEALTH WORKER TRAINING	12
10	RISK COMMUNICATION & COMMUNITY ENGAGEMENT	19
11	ONE HEALTH	2
12	**INTEROPERABILITY**	
13	VACCINE DELIVERY	5
14	**DATA ANALYTICS, VISUALIZATION & USE**	

Figure 10: Gaps by DPP Category (A2 aggregated)

Table 2

S/N	DPP Functionalities	Software Packages: DEPLOYED	Software Packages: Existing but NOT DEPLOYED
1.1	Real-time reporting of aggregate data on individuals with symptoms, laboratory confirmation, etc. (ref. Coordination & Operatio	2	4
1.2	Specification of a subset of minimum critical data points for reporting to facilitate rapid analysis and planning	5	1
1.3	**Early Warning Surveillance based on data from web searches for common symptoms or social media sentiment analys**		2
2.1	Link client and healthcare workers to the client sample sent to the laboratory for testing	2	2
2.2	Guidance (to health workers) on the method to collect a sample	2	
2.3	Notifications when results are available (to client, to healthcare facility for contact tracing etc)	2	
2.4	Integration with case management application and surveillance tools (to confirm suspected cases are positive or not)	9	
3.1	Registration of clients in the system with a unique ID	2	2
3.2	client's past health records available from the system	2	
3.3	Input of client contact information	2	
3.4	Input of client demographics, vital signs, risk factors, and symptoms	2	
3.5	Creation of lab requests	2	
3.6	Communication with client via phone call (through app)	3	
3.7	Unidirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp)	2	1
3.8	Bidirectional communication with client via messaging (e.g. SMS, social media, in-app, WhatsApp, email)	2	
3.9	Monitoring and updating of further client interactions and outcomes	2	
3.10	View a summary record and services provided for a client per encounter	2	
3.11	Editing of record in case of errors	2	
3.12	Enrolment of travellers who have visited high-risk locations at ports of entry for monitoring and follow-up (Port of Entry Screenin	2	
4.1	Documentation of detailed contact history about the time, place, and person for each high-risk encounter	2	
4.2	Creation of a listing of high-risk contacts linked to suspected and existing cases	2	
4.3	Creation of record to input demographics and risk factors of high-risk contact	2	
4.4	Communication with contact via phone call (through app)	2	
4.5	Unidirectional communication with contact via messaging (e.g. SMS, social media, in-app, WhatsApp)	2	
4.6	Bidirectional communication with contact via messaging (e.g. SMS, social media, in-app, WhatsApp)	2	
4.7	Update contact records with new changes/ symptoms	2	
4.8	Editing of contact record in case of errors	2	
4.9	Functionality adapted to generalised epidemic response (not strictly COVID-19)	2	
4.10	Allows simultaneous management of multiple epidemic types	2	
4.11	Compatibility with country public health management information system (HMIS)	2	
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 strictly COVID-19)**		
6.1	Easy access to real time aggregated data to inform response	4	1
6.2	Clear visualisations of key indicators	3	
6.3	Efficient and effective communications with health facilities and field staff	5	
6.4	Modelling of epidemic impact scenarios to prepare response (simulations)	3	1
6.5	Clear visualisation of risk factors (risk index) at subnational level	1	
6.6	Monitoring of response capacities (relevant health personnel, hospital beds, equipment, national or internal Emergency Medica	2	
6.7	**Big Data analysis (e.g., mobility monitoring based on mobile phone data, rumour monitoring based on social media ana**		
7.1	Registration of healthcare facilities	2	
7.2	Collection and reporting of data on epidemic-specific consumables (vaccines, PPE etc.), e.g. stocking and stock forecasting, c	2	
7.3	Collection and reporting of data on epidemic-specific equipment (x-ray machines, critical care beds, ventilators etc)	2	
7.4	Collection and reporting of data on epidemic-specific operational metrics (e.g. available ICU capacity, current staffing levels etc	1	1
8.1	Fiscal management	2	
8.2	Donor compliance reporting (Fraud prevention, transparent monitoring etc)	2	
8.3	Human resource management	2	
9.1	Epidemic-specific symptoms monitoring	2	
9.2	Use of personal protective equipment (PPE), delivering vaccination, etc.	2	
9.3	Safety protocols for facilities	2	
10.1	**Point of care communications tools (videos through app etc)**		1
10.2	Integrated mass communications tools (web, social media, SMS, robocalls etc)	1	
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)	2	
12.2	Support for Healthcare Coding Standards (e.g. ICD-9, ICD-10, LOINC, SNOMED)	2	
13.1	Integration with immunization registry	1	
13.2	Immunization scheduling	4	2
13.3	Vaccination/immunization delivery monitoring, tracking and follow-up at client-level	1	
13.4	Reporting on adverse effects	1	
13.6	Microplanning	1	
14.1	Inbuilt data visualisation features	4	3
14.2	Multi-level data aggregation and user acess to inform decision-making	2	

Figure 11: Gaps by DPP Functionality (A3 aggregated)

Table 3

S/N	Functionality Gap Identified	Functionality Viability Analysis	Potential Use of Existing Software Packages	RECOMMENDATIONS
1.3	Early Warning Surveillance based on data from web searches for common symptoms or social media sentiment analysis (or keywords)	Review of preconditions shows poor suitability for this functionality. - This type of technology requires a high prevalence of social media engagement amongst the populace. - Internet use is very limited in the country, outside of the major urban areas (ref. xyz). Price is the key factor, with the cost per MB equivalent to USD $2.4 - below the affordability threshold defined by the UN (ref. abcd). - Additionally, import tariffs restrict the supply of low-end smartphones. - As a result, digital literacy is very low; subsequently social media uptake is very low (despite heavy promotional campaigns from carriers and zero-rating for Facebook) - To further compound this, the country has approximately 60 widely dialects with 4 lingua franca (incl. the colonial language) which are not well spoken. There is currently an attempt to build NLP models for processing local languages, but the effort is still nascent. - Therefore any attempt deploy a software package to meet functionality of this type would rely on minimal data from a respondent base biased towards urban elites	Software package #5 WEB4DEV is currently deployed nationally by the Data4EV NGO in cooperation with the government health programme and funded by JICO. As detailed in Sheet A4, this package does have the capacity to meet functionality 1.3 with the addition of an NLP module. However, this would incur additional license costs of approximately USD $800 yearly per user (with likely 12 users required). Moreover, Data4EV's operating directive is very independent, and could be problematic in terms of collaboration with GIZ Additionally software package #62 MediSee (currently deployed in Ube city only) has this functionality under an existing license (not deployed) but is not interoperable with the national HMIS (DHIS2), so would not be viable.	We recommend not to proceed with procurement of services for functionality 1.3 This decision is predicated on the following rationale: - Insufficient contextual viability to ensure any measure of efficacy - No opportunities currently exist in terms of deployed software packages that can be leveraged for a quick win.
11.1	Tracking of infectious disease outbreaks in domesticated animals (livestock etc...)	Yes, it's viable to deploy a digital tool that would meet the needs of this identified DPP functionality gap in-country BECAUSE	None identified	We recommend to proceed with procurement of services for functionality 11.1. This decision is predicated on the following rationale: - The count
11.2	Tracking of infectious disease outbreaks in wildlife	As per 11.1	None identified	As per 11.1
11.3	Ecological surveillance of environment for changes that could increase risk of zoonotic infection	As per 11.1	None identified	As per 11.1

Figure 12: Overview of Key findings

Table 4

Recommend Software Packages	Contextual Rationale • Why is this software recommended? • Is it interoperable with other DPP software? • Is it recommended to merge this software with other existing software? • How will data be shared?	DPP Functionality Alignment
Afyadata	Given the existing capacities of NCDC in surveillance and IT systems management, Afyadata is a natural addition to the existing framework. Afyadata uses a REST API which makes it compatible with the national HMIS (DHIS2). Furthermore, the software uses healthcare coding standard ICD-10 which ensures classification alignment with the rest of the public health system. The software can be integrated seamlessly with DHIS2 and therefore will require minimal additional capacity building for operators and operational overhead. Data sharing is integrated with DHIS2 directly in this case. The software uses a SQL database (we recommend to host this on a separate AWS virtual server for operational resilience) which the DHIS2 API queries every 2 hours.	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.

Figure 13: Recommended Software by identified Gap/Opportunity

Annex 2: Link to DPPA Toolkit and Documentation

The landing page www.digitalsquare.org/resourcesrepository/dppa-v2 provides links to the:

DPPA Toolkit and Templates (English, French, and Map and Match data)

- 0. Read me
- 1. Introduction for Stakeholders (Slide Deck)
- 2. Instructions (Slide Deck)
- 3. Completion of Missing Map & Match Data
- 4. DPPA Toolkit Interpretation
- 5. DPPA Report Template
- 6. DPPA Data Entry Template (excel)
- 7. DPPA Data-Entry_SELF-REPORT_SINGLE (excel)
- 8. DPPA Data-Entry_SELF-REPORT_MULTI (excel)
- 9. DPPA_Data-Entry_EXAMPLE

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