Health Data Ecosystem Mapping
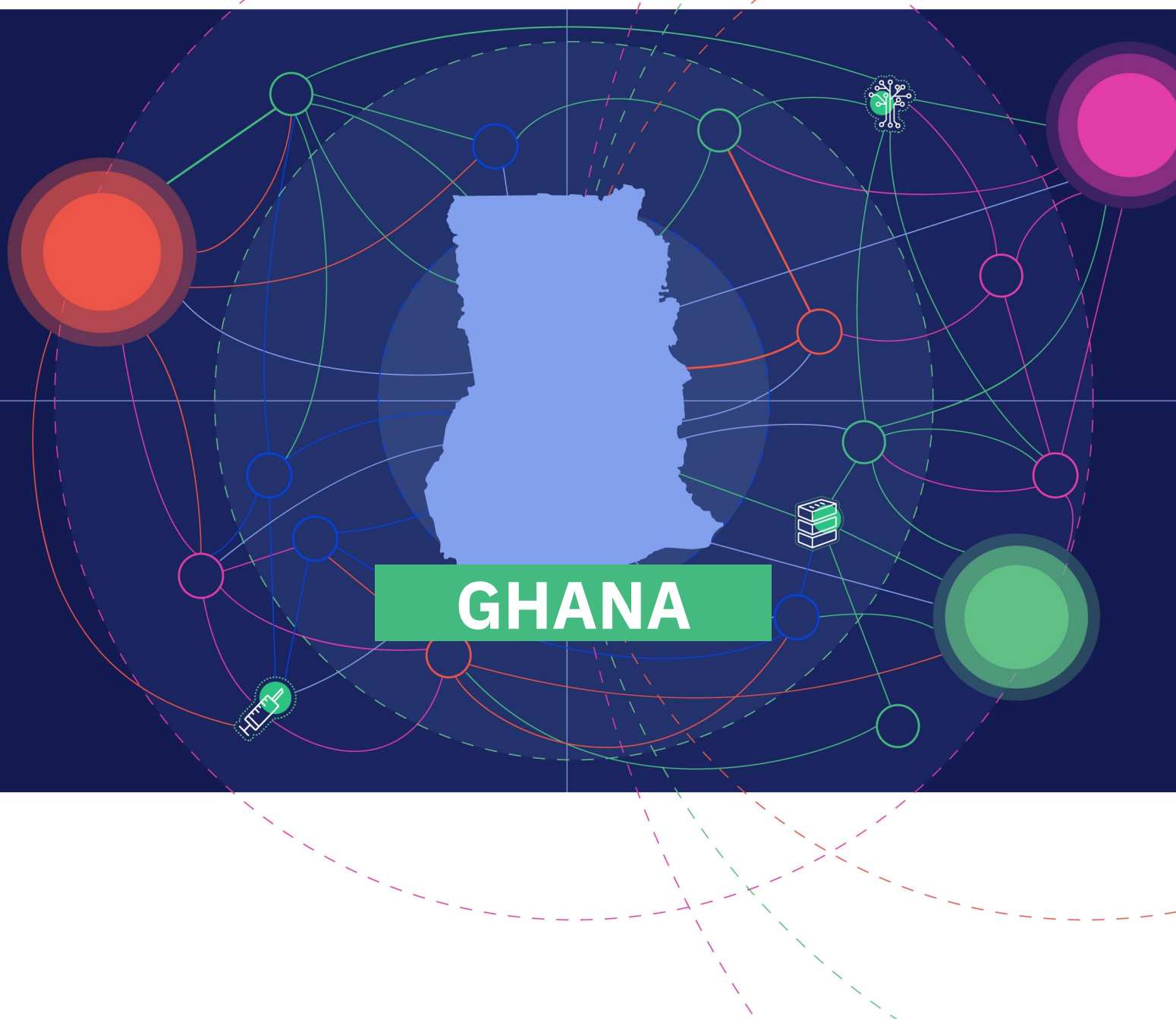
Scaling the Use of Digital tools for Vaccination Planning, Deployment and Monitoring

GHANA

GHANA HEALTH SERVICE
GHS
Your Health · Our Concern

digital square

PATH

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by
giz
Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

CONTENTS

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ACRONYMS

CDC	Centers for Disease Control and Prevention
CHPS	Community-based Health Planning and Services
CHISU	Country Health Information Systems and Data Use
DAK	Digital Adaptation Kit
DHTWG	Digital Health Technical Working Group
DICE	Digital Health Centre of Excellence
DIPC	Digital Innovation in Pandemic Control
DHIMS2	District Health Information Management System II
DHIS2	District Health Information System II
EPI	Expanded Programme on Immunization
FHIR	Fast Healthcare Interoperability Resources
GCNet	Ghana Community Network
GhiLMIS	Ghana Integrated Logistics Management Information System
GHS	Ghana Health Service

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICT	Information Communication Technology
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
LHIMS	Lightwave Health Information Management System
MOH	Ministry of Health
OpenHIE	Open Health Information Exchange
PPMED	Planning, Policy, Monitoring, and Evaluation Department
RDHTC	Regional Digital Health Technical Committees
SORMAS	Surveillance Outbreak Response Management System
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

02
EXECUTIVE SUMMARY

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) launched the **Digital Innovation in Pandemic Control (DIPC) project**[1] in 2021 to bring digital health technical expertise to countries to create more pandemic-prepared health systems. The DIPC project provided an award to Digital Square to partner with ministries of health and other key stakeholders from November 2022 to 2024 to scale the use of digital tools for COVID-19 and routine vaccination planning, deployment, and monitoring. **The DIPC project is creating models for improved and more sustainable pandemic-prepared health systems with a focus on immunization workflows using three exemplar countries: Ghana, Malawi, and Tanzania.**

Digital Square partnered with Ghana Health Service (GHS) to review existing assessments and workflows to better understand the landscape of tools currently used in Ghana's immunization health domain. GHS and Digital Square used various methodologies to produce this countryprofile, which included a desk review, consultative sessions with ministry officials, and an online survey that included representation from all 16 regions in the country. **This country profile provides an overview of current digital immunization systems used in Ghana and outlines priorities so that Ghana—led by the direction of GHS and its existing governance mechanisms and supported by other key stakeholders—can use the findings to inform its journey to develop and operationalize interoperable digital systems that support immunization from end to end.**

Key findings from ecosystem mapping reveal that GHS has strong existing digital health governance mechanisms in place, such as a Digital Health Technical Working Group and Regional Digital Health Technical Committees. **Five digital systems for immunization are described in this report, each one including an overview of the solution, its major functional features, existing challenges, and recommended interventions to strengthen the systems.** The five digital systems described in detail include District Health Information Management System II (DHIMS2), e-Tracker, Surveillance Outbreak Response Management and Analysis

System (SORMAS), Ghana Integrated Logistics Management Information System (GhiLMIS), and Lightwave Health Information Management System (LHIMS). GHS is experiencing rapid growth in the development and adoption of these mobile and web-based digital health systems; however, a number of the existing systems are not integrated and/or interoperable. Although there is a strong technical capacity in Ghana to work with digital systems, there is a need for more training—particularly at the community and facility levels (e.g., Community-based Health Planning and Services [CHPS]). There is also an urgent need to address the lack of stable internet connectivity and the availability of data plans to ensure users can use the systems. Interoperability challenges and gaps in the digital systems supporting the functional components of immunization also exist (e.g., digital immunization certificates, microplanning, product catalog).

As part of the ecosystem mapping exercise, end users (e.g., regional health managers) of the digital systems provided specific recommendations on features and interventions they would like to see added, with data exchange across systems surfacing as the most requested intervention during this mapping. GHS has a clear vision for its national digital health strategy and how existing tools can be adapted and scaled up to support the functional components of immunization. As part of this ecosystem mapping process, Digital Square partnered with GHS to determine that DIPC project implementation in Ghana from 2023 to 2024 will be aimed at strengthening existing in-country digital immunization systems by working to:

1. Enhance DHIS2 e-Tracker so it can serve as Ghana's immunization information system for COVID-19 and routine immunization, according to a defined and validated set of requirements prioritized by the GHS, and within the time and budget available.

2. Strengthen the capacity of health workers by updating content for the GHS eLearning platform so they can effectively use identified digital immunization systems. This will include an assessment of training needs according to GHS priorities.

3. Support interoperability of current digital immunization tools by defining and validating the data exchange requirements between two or three prioritized systems and supporting the development and testing of an interoperability solution that utilizes the HL7 FHIR standard so that data can be exchanged securely across digital platforms (e.g., SORMAS, GhiLMIS).

03
BACKGROUND

DIPC PROJECT OVERVIEW

Since the beginning of the COVID-19 pandemic, **Digital Square** has leveraged its unique role and strengths to support countries , donors, and partners to use existing digital tools in response efforts. Harnessing our technical expertise and established relationships across the global digital health ecosystem, including our engagement with and support of digital public goods for health, Digital Square is supporting countries to innovatively select and adapt digital tools to navigate the complexities of the pandemic and strengthen routine immunization systems.

WORKSTREAM 1	Accelerate implementation of digital tools to support immunization	Mapping and analysis — Requirements, challenges, needs	Country consultation on what is the need and priority for each country	Implement specific components of the product suite	
WORKSTREAM 2	Develop immunization product suites aligned with WHO's Digital Adaptation Kit (DAK) for immunization	Initiate request for application and select vendors	Develop product suites (with builtin in tests)		Improved and sustainable immunization systems
WORKSTREAM 3	Strengthen capacity of countries to support immunization digitally	Understand country capacity and needs	Design trainings per country needs	Conduct country-level training	

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), together with GIZ actors from the field of digitalization and health, including the **Digital Health Centre of Excellence (DICE) initiative²** co-led by United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), launched the **Digital Pandemic Control (DIPC)** project in 2021 to bring digital health technical expertise to countries to create more pandemicprepared health systems. The DIPC project provided an award to Digital Square to partner with ministries of health and other key stakeholders from November 2022 to 2024 to scale the use of digital tools for COVID-19 vaccination planning, deployment, and monitoring. The DIPC project is aligning its project activities with countries' national digital health strategies to strengthen health systems to better equip them to respond to COVID-19 and future pandemics.

The DIPC project is creating models for improved and more sustainable pandemic-prepared health systems with a focus on immunization workflows using three exemplar countries: **Ghana, Malawi, and Tanzania.** The project is carrying out the work by focusing on three primary workstreams, visualized in Figure 1.

ECOSYSTEM MAPPING SCOPE AND METHODOLOGY

Digital Square completed mapping the digital immunization ecosystem in Ghana as an initial activity under Workstream 1, aimed at accelerating the implementation of digital systems to support COVID-19 and routine immunization. Digital Square and the Ghana Health Service (GHS) partnered to review existing assessments and workflows to better understand the landscape of systems currently used in the country's immunization health domain. GHS and Digital Square used the ecosystem mapping to produce this **country profile,** which will be shared with all project stakeholders (e.g., government stakeholders, funders, and implementing partners) so that the information is widely available. This country profile helps define the priority needs so that Ghana—led by the direction of GHS and the existing governance mechanisms—can use it as a resource in its journey to develop and operationalize an interoperable digital solution that supports the full end-toend immunization use case.

Digital Square employed the following methods to collect the data included in this report:

- Conducting a **desk review** of Ghana's health and digital governance documents (e.g., Ghana Health Service Policy and Strategy on Digital Health: 2023–2027[3]) and previous landscaping reports (e.g., Digital Pandemic Preparedness Assessment[4] and the Map & Match project[5]).

- Holding **consultative sessions** with country leaders to validate the current state assessment of the immunization ecosystem and propose to strengthen relevant components of the digital health immunization ecosystem as needed.

- Sending out an **online survey** to all sixteen (16) regional IT managers to identify digital tools used for immunization in their regions by interviewing regional Expanded Programme on Immunization (EPI) managers and Disease Control Officers.

Ghana's ecosystem mapping findings

Enabling environment for leadership, governance, and coordination of stakeholders
Ghana's digital health landscape

Increasing demands on health care systems call for a change in the organization and management of health services, including the information systems that support timely and accurate decisions. GHS implements several digital platforms that support data management, service delivery, and quality assurance initiatives as well as social and behavior change communication initiated by its different divisions. The GHS is experiencing rapid growth in the development and adoption of mobile and web-based digital health systems that address challenges related to access to health services and information along with its administration and management. A number of the existing applications in GHS are not integrated and/or interoperable.

A list of the governance mechanisms and many key stakeholders involved in the digital health immunization space in Ghana are listed in Table 1 below. The DIPC project is committed to supporting the GHS and working with the governance mechanisms (e.g., Digital Health Technical Working Group, Regional Digital Health Technical Committees) to strengthen the immunization system in a well-coordinated way by sharing information with the relevant stakeholders listed below.

Figure 2. *Ghana Health Service digital health strategy's strategic objective six.*
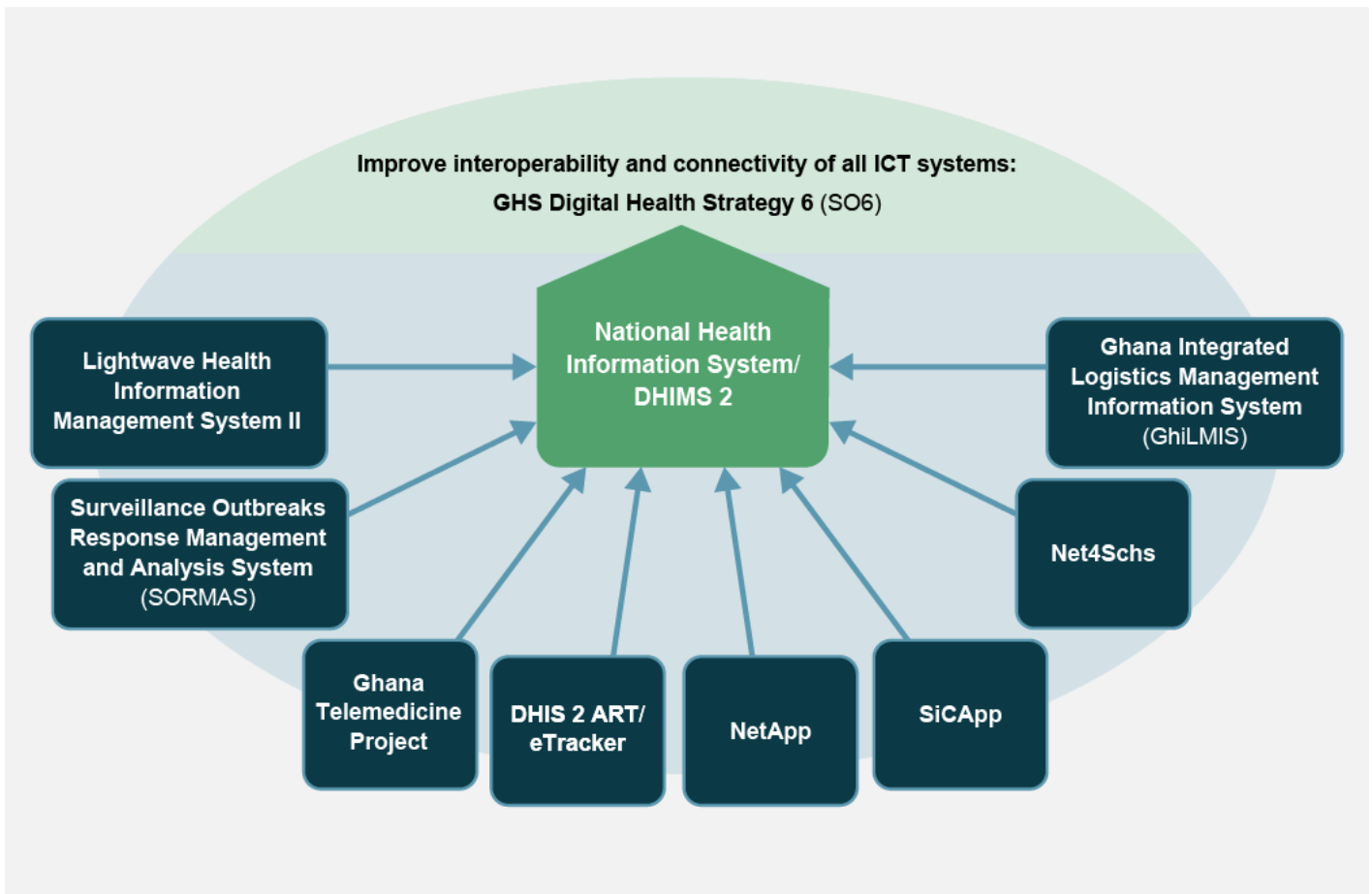
Table 1. *Key stakeholders and governance mechanisms pertinent to the digital health immunization space.*

MOH departments	Governance mechanisms
• Finance Division (FD) • Health Administration and Support Services Division (HASS) • Human Resources and Development Division (HRDD) • Information Technology Division (IT) • Internal Audit Division (IAD) • Office of Director General (ODG) • Policy, Planning, Monitoring, and Evaluation Division (PPMED): PPMED leads the implementation of the National Digital Health Strategy. • Public Health Division (PHD) • Supplies, Stores and Drugs Management Division (SSDM)	• Digital Health Technical Working Group (DHT-WG): This working group meets once every quarter with the objectives of providing monitoring, evaluation, and learning (MEL) for digital health initiatives and overseeing the implementation of the national digital health strategy. • Regional Digital Health Technical Committees (RDHTC): These committees oversee the implementation of digital health strategies on a regional level. • National Digital Health Steering Committee: This committee reviews and approves digital health initiatives for GHS.

Funders	Implementing partners	Multilateral organizations
• Danish International Development Agency • GIZ • United States Agency for International Development (USAID)	• Chemonics • John Snow, Inc. • Ghana Community Network (GCNet) • PATH/Digital Square	• World Health Organization (WHO) • United Nations Children's Fund (UNICEF) • Local developers • GHS PPMED

Note: this list is not comprehensive but is intended to provide a robust picture of the stakeholder landscape.

Strategy

Digital Square analyzed the Ghana Health Service Policy and Strategy on Digital Health: 2023–2027 to determine where there is alignment across the DIPC project workstreams to prioritize how the project can support GHS to deliver on the activities named in its national digital health strategy (Table 2). Digital Square plans to partner with GHS to develop the interoperability lay er and strengthen digital immunization systems while also providing technical documentation, training (e.g., on the expanded functionality of digital immunization systems), and mentoring to health workers to develop, implement, and maintain the digital immunization systems.

Table 2. A snapshot of the analysis showing alignment opportunities between the national strategy activities and DIPC project workstreams.

Ghana Health Service Digital Health Strategy: 2023–2027 activity	DIPC project workstream
2.1: Improve the policy and regulatory framework to ensure client safety, data security, confidentiality, and privacy. **4.1:** Strengthen ICT infrastructure and solutions for disease surveillance and response systems at all levels, most especially in rural and remote areas. **6.1:** Establish an integrated information architecture of interoperability for the effective sharing of health information across health systems and services.	**1:** Accelerate implementation of digital tools to support immunization systems. **2:** Develop immunization product suites.
2.2: Ensure deployment of qualified human resources competent in developing, implementing, and maintaining digital health platforms. **7.2:** Mainstream eLearning in capacity building for service providers. **7.3:** Strengthen ICT infrastructure and resources to support the institutionalization of eLearning. **8.1:** Institute peer learning communities among ICT staff for continuous capacity building and education.	**3:** Implement innovative and sustainable capacity-strengthening approaches.

Technical capacity

The GHS has trained ICT staff with a high capacity to develop and manage ICT systems. The staff capacity comprises software, hardware, and network engineers that serve as the backbone and sustenance of the current technologies available. The GHS has a local area network (LAN) at the national level, which helps provide connectivity for routine work. The ICT unit oversees and supports seamless broadband internet service from a provider for all divisions at the national level. At the regional level, various network infrastructures and topologies are used to support the multiple directorates and health facilities. Some equipment used includes network servers, switches, routers, computers, mobile handheld devices, and printers.

Previously, the technical capacity of the health officers based at the facility level was low, as they ran a paperbased system by tallying immunization registers to provide monthly data reports. With the introduction of the e-Tracker in 2018, which came with training in computer use, tablets, and interaction with online data, the technical capacity of health officers has generally improved. However, the issues around internet connectivity, especially in hard-to-reach communities, and funds to buy internet data remain the same.

Overview of Ghana's digital systems to support immunization

Figure 3 defines components, features, and requirements. The figure illustrates how requirements make up a software system feature and how those features roll into a functional component. Figure 4 illustrates how a Health Information Exchange composed of various digital health systems may be implemented together to fulfill the five core immunization workflows, shown at the bottom of the diagram. It also shows how the software components supporting immunization and vaccine supply chain management are aligned with the OpenHIE Architecture[6] domains. The point of service applications (e.g., immunization information system, notification service, microplanning tool) should be designed to exchange data with the OpenHIE registry

service applications, and each other, via an interoperability layer. The interoperability layer is a middleware software that enables secure, standards-based communication between software applications. The five additional digital systems shown on the right may interact with the immunization system in the future, although they are out of scope for this DIPC project phase because they are not directly involved in the core immunization workflows. This also emphasizes the importance of why system architecture that is interoperable is a critical part of any immunization solution.

Figure 3. Diagram defining how a functional component, features, and requirements of a digital system fit together.

REQUIREMENTS

Describe what the software system must do.

Example: **Immunization information system (IIS) requirements**
- Allow the user to search for the patient given some demographic information.
- Enforce a minimal data set to allow for a new patient registration.

SOFTWARE SYSTEM FEATURES

A functional software product characteristic, which consists of a cohesive set of requirements.

Example: An example of an **IIS** feature is the system can collect and store patient-level data for an immunization event.

FUNCTIONAL COMPONENT

A software product that is a building block that performs a specific function and fits together with other software products to form an interoperable solution.

Example: An **IIS** is a confidential, population-based, computerized database that records all immunization doses administered by participating providers to persons residing within a given geopolitical area. (Ref. CDC).
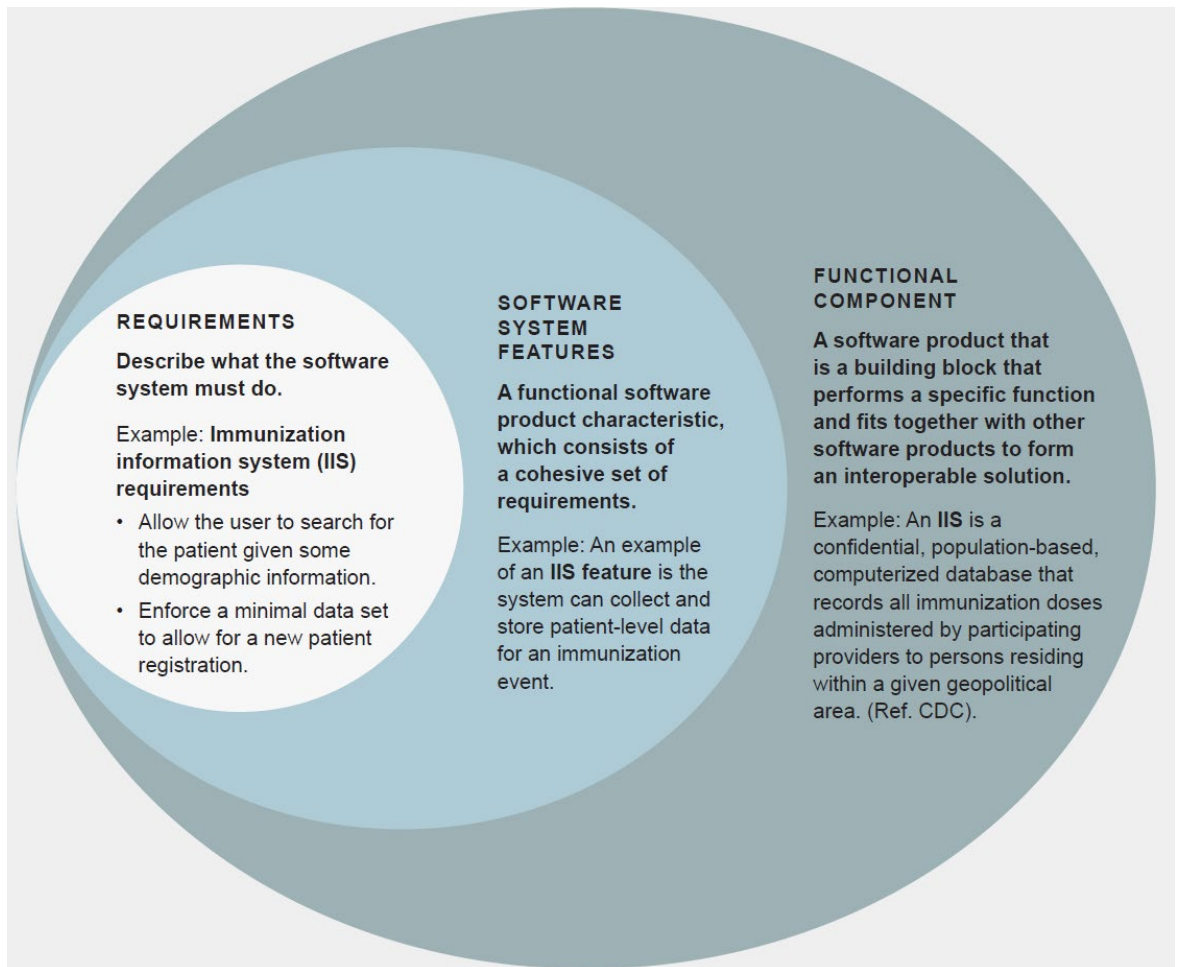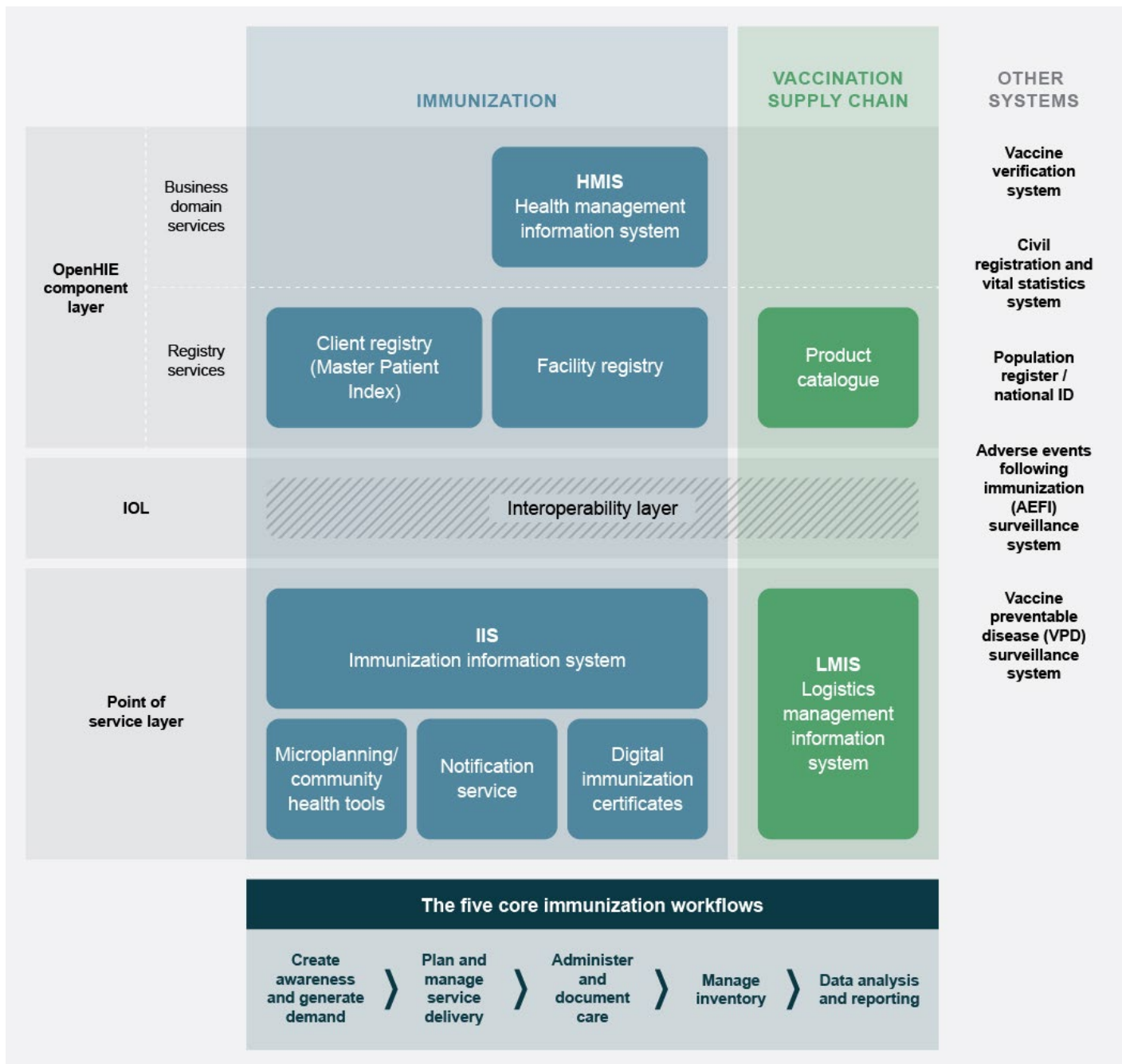
Figure 4. *Functional immunization components.*
Abbreviation: OpenHIE, Open Health Information Exchange.

A landscape analysis revealed several tools currently in use or planned for use in Ghana based on the ser-
vices they provide in the context of immunization. Table 3 below summarizes the tools mapped, the different
functional components, and their current deployment status.

Table 3. *Overview of the current landscape of Tanzania's digital systems to support functional components
of immunization.*

Functional components	Deployed on national scale	Deployed on sub-national scale	Not yet deployed or current gap
Client registry		LHIMS	
Community health		E-Tracker	
Create awareness & demand generation		E-Tracker	
Digital immunization certificates			Gap
Facility registry			Planned*
Health management information system	DHIMS2	E-Tracker, Penless	
Immunization information system		LHIMS	
Inter-operability layer			
Learning and training	GHS eLearning platform		
Logistic management information system	GhiLMIS		
Micro-planning			Planned: QGIS
Product catalog			Planned: DHIMS2
Surveillance	SORMAS	LHIMS	

Light blue
System is deployed, but
not prioritized in DIPC
project phase 2 scope

Green
System is prioritized for
support as part of DIPC
project phase 2 scope

Grey
Gap or system is not yet
deployed; out of scope
for DIPC project phase 2

*Abbreviations: DHIMS2: District Health Information Management System II; GhiLMIS: Ghana Integrated Logistics Management Infor-
mation System; LHIMS:*

*Lightwave Health Information Management System; SORMAS: Surveillance Outbreak Response Management and Analysis System.
There is a project currently underway to identify a suitable digital solution for the National Facility Register for Ghana, as a founda-
tional component of a national Health Information Exchange (HIE).*

04

RESULTS OF GHANA'S KEY DIGITAL SYSTEMS SUPPORTING THE IMMUNIZATION HEALTH DOMAIN

Descriptions and parameters overview

The section below describes five digital systems (i.e., DHIMS2, e-Tracker, SORMAS, GhiLMIS, and LHIMS) that Ghana uses to support the immunization health domain. For each digital tool, the results provide an overview and details about its **major features[1], users, challenges, and recommendations.** The DIPC team applied classifications from WHO's <u>Classification of Digital Health Interventions v1.0</u>[2,7] to frame the analysis, looking at the users, challenges, and recommendations to describe how the digital systems are currently supporting the immunization health domain and where there are gaps and opportunities to improve these digital systems.

The **major features of digital systems** include **functional features** that describe the functional requirements the digital system must have to meet the users' needs and achieve tasks within a business process. An example of a functional feature is the ability to register a new client in the immunization registry. This also includes nonfunctional requirements that provide the general attributes and features of the digital system to ensure usability and overcome technical and physical constraints. In addition to security and privacy features that have their own section attributed to them in the analysis due to their importance, other examples of non-functional requirements include the ability to work offline or having multiple language settings.

Security and privacy features (e.g., password protection) describe the non-functional requirements of each system that relate to keeping information secure and private. An example of a security feature is the requirement for system users to log in using a customized username and password to prevent unauthorized viewers from accessing protected health information.

Users describe the targeted primary user of each intervention. WHO's Classification of Digital Health Interventions breaks users into the following four overarching groupings. For the analysis included in this report, the section below will only focus on the first three user groupings.

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[1] Many systems have a separate call-out box for security and privacy features to emphasize the importance of these non-functional requirements.

[2] WHO's Classification of Digital Health Interventions is a resource document that provides a shared language to describe the uses of digital technology.

01 **Interventions for clients:**
Clients are members of the public who are potential or current users of health services, including health promotion activities. Caregivers of clients receiving health services are also included in this group.

02 **Interventions for health care providers:**
Health care providers are members of the health workforce who deliver health services.

Examples of job roles in Ghana pertaining to this user grouping include community health workers, nurses, doctors, facility-level immunization providers, and pharmacists/pharmacist technicians.

03 **Interventions for health system or resource managers:**
Health system and resource managers are involved in the administration and oversight of public health systems. Interventions within this category reflect managerial functions related to supply chain management, health financing, and human resource management.

Examples of job titles in Ghana pertaining to this user grouping include supply chain managers, human resource managers, and finance officers.

04 **Interventions for data services:**
This consists of crosscutting functionality to support a wide range of activities related to data collection, management, use, and exchange.[3]

Health system challenges describe issues that each system faces, categorized according to WHO's eight groupings in its Classification of Digital Health Interventions:

1. Information **2.** Availability **3.** Quality **4.** Acceptability

5. Utilization **6.** Efficiency **7.** Cost **8.** Accountability

Recommendations are organized using tables and use the same four categories from the users tables to specify which user grouping the recommendation is intended to target (i.e., clients, health care providers, health system or resource managers, and/or data services).

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[3] This WHO classification user group is omitted from the analysis below because many of the health care providers or health system or resource managers are responsible for data services.

Digital systems in Ghana

PRIORITY DIGITAL SYSTEM 1
DHIMS2

DHIMS2 is based on the global good District Health Information Software 2 (DHIS2). DHIMS2 is an open source, web-based health management information system (HMIS) platform. DHIMS2 can assist with the appropriate management of data in the health system through the integration and aggregation of information, as well as facilitate data entry at the operational level of services provision. The DHIMS2 system can be adapted for different health programs and use cases to support service delivery within GHS from primary to tertiary levels.

DHIS2 supports the collection, analysis, visualization, and sharing of aggregate data, including mobile and offline data collection using the DHIS2 Android app. DHIS2 offers a number of mobile solutions, including SMS, plain HTML, and Java options for feature phones as well as a web-based solution with offline support for smartphones. Clients can use their mobile phones for registering cases and events and for collecting aggregate data. To learn more about Ghana's DHIMS2 implementation, read:

- [Utilization of the national cluster of district health information system for health service decision-making at the district, sub-district and community levels in selected districts of the Brong Ahafo region in Ghana (2020)[8].](#)

SYSTEM OVERVIEW

Global Goods Guidebook v.4 (pages)	Scale	WHO classification	System owners	Software maturity	Offline capability	Partners	Licensing	Implementers
DHIS2 (41–42); established application	National	N: Health Management Information System	GHSP-PMED	GHS-PPMED Health standards: ICD-9, ICD-10, ICD-11; LOINC; GS1; SNOMED Interoperability standards: HL7 FHIR; ADX; mCSD; SVCM	Yes	USAID, Global Fund, World Bank, JICA, KOICA	Free and open source; BSD-3-clause	GHS

MAJOR FEATURES OF THE DIGITAL SYSTEM

- Serves as a data warehouse that provides aggregated data visualizations, including maps, charts, and dashboards.
- Collects, manages, and analyzes transactional, case-based data records.
- Currently serves as the Master Facility List for GHS.
- Provides the aggregate levels for vaccine stock management.

SECURITY AND PRIVACY

Basic requirements	Description
Password requirements	Minimum of 8 characters with a mixture of special characters and numbers.
Data encryptions (data-inmotion and at rest)	DHIMS2 allows for the encryption of data. Web-proxy server configured with TLS/SSL. Database data are in a separate location, which allows for encryption at rest.
Access level/user permissions	DHIMS2 allows for role-based access control, which means that permissions are assigned to users based on their role within an organization. DHIMS2 can also set expiration dates for user accounts and automatically disable inactive users to help prevent unauthorized system access.

USERS

Users can run this digital solution on tablets, laptops, and desktop computers.

Grouping	Users	Description
1 Clients	No	
2 Health care providers	Yes	DHIMS2 is used by health care providers at facility and community levels (community health workers, community health nurses, etc.). The health care workers tally the immunization data from the paper-based registers and input the aggregated data into DHMIS2 at those facilities where the system is operational.

USERS		
3 Health system or resource managers	Yes	DHIMS2 is used by supervisors, program managers, and regional and district health officers. Job titles of end users in Ghana include IT Officers, Regional IT Managers, Health Information Officers, District Health Information Officers, and Regional Health Information Officers. Health Information Officers are the primary users who input data into the DHIMS2 and who use the dashboards/reports to inform decision-making. DHIMS2 is also used by national-level stakeholders and administrators. MOH/GHS uses DHIMS2, specifically, the ICT Unit and the Policy, Planning, Monitoring & Evaluation Unit.

HEALTH SYSTEM CHALLENGES

End users shared the challenges they encountered using the system, which are categorized according to WHO's Classifications of Digital Health Interventions in the table below.

1	Information	
1.2	Delayed reporting of events	Delays in assigning tools to facilities for reporting, delays in password allocation.
1.5	Lack of access to information or data	• Difficult to retrieve data and cannot conduct data analysis. • Insufficient resources to pay for internet data plans. • Frequent server connection errors. • System is not able to interoperate with other systems used for immunization.
5	Utilization	
5.2	Geographic inaccessibility	Several regions reported internet instability and connectivity challenges. Intermittent breaks of service. Network connectivity challenges sometimes lead to loss of data.
7	Cost	
7.2	Lack of effective resource allocation	Users would like funds to support the purchase of internet data.

RECOMMENDATIONS

Users made several recommendations to strengthen this digital system (categorized according to the digital health interventions v1.0).

2	Health care providers	
2.3.1	Provide prompts and alerts based according to protocol	Users would like DHIMS2 to prompt feedback for actions and to provide real-time results.
2.7.2	Schedule health care provider's activities	Users would like to see decentralized responsibilities assigning tasks to reduce delays.

RECOMMENDATIONS		
2.8.1	Provide training content to health care provider(s)	Make the system more user-friendly. Users described challenges with the system not providing real-time records and frequent clearing of user dashboards being deemed unfriendly.
3	**Health system managers**	
3.5.6	Manage budget and expenditures	Users would like funds to support the purchase of data.
4.	**Data services**	
4.1.3	Data synthesis and visualization	A user recommends restoring the original pivot table interface. Users should more frequently be able to review and access data.
4.1.4	Automated analysis of data to generate new information or predictions of future events	The system should provide a basic descriptive analysis of the data.
4.1.2	Data storage and aggregation.	Users recommend setting a designated period within each month for data rectification and assigning to the regional/district level. Data validation rule to be set for all dataset reports.
4.3.3	Map location of clients and households	A user recommends tracking the geo-positions of immunization campaigns or services.
4.4.1	Data exchange across systems	Should be linked to other software in use by Ghana Health Service such as SORMAS, LHIMS, and others so that reports from those programs will auto-populate in DHIMS2.

PRIORITY DIGITAL SYSTEM 2
E-Tracker

E-Tracker is a built-in application within DHIS2 that expands the DHIS2 data model from aggregate to individuallevel data. This turns DHIS2 into a powerful tool for not only collecting and analyzing case-based data (which can be automatically aggregated to meet reporting requirements), but also for managing patient care workflows on a facility and/or community level. E-Tracker provides a customizable platform for entering, tracking, analyzing, and reporting individual-level data within the DHIS2 software platform.

Ghana has been deploying E-Tracker for COVID-19 and routine immunization data progressively as resources become available. The initial version of E-Tracker was used to capture data on COVID immunization but has since been expanded and upgraded to capture other immunization service data including modules on antenatal care, HIV, and tuberculosis. GHS has collaborated with partners (e.g., JSI's Country Health Information Systems and Data Use [CHISU] project) in their regions of interest to deploy E-Tracker. The E-Tracker deployment plan is currently under review with assistance from CHISU. E-Tracker has already been deployed in the following regions: Bono East, Upper East, Volta, Oti, and Eastern. The E-Tracker deployment in Savanna is currently in progress.

For more information on the E-Tracker implementation, read:

- [An mHealth-Based Health Management Information System Among Health Workers in Volta and Eastern Regions of Ghana: Pre-Post Comparison Analysis (2022)[9].](#)

SYSTEM OVERVIEW

Global Goods Guidebook v.4 (pages)	Scale	WHO classification	System owners	Software maturity	Offline capability	Partners	Licensing	Implementers
DHIS2 41-42 (established application)	Sub-national	N: HMIS	GHSPPME	Health standards: ICD-9, ICD-10, ICD-11; LOINC; GS1; SNOMED Interoperability standards: HL7 FHIR; ADX; mCSD; SVCM	Yes	USAID, Global Fund, World Bank, JICA, KOICA	Free and open source; BSD-3-clause	Center for Health Information Management (CHIM)

MAJOR FEATURES OF THE DIGITAL SYSTEM

- Conducts registration of clients.
- Is used to collect, track, and analyze immunization data at the individual level.
- Is a GHS-approved immunization solution.
- Has GPS capabilities.
- Has notification capabilities.
- Has offline capabilities.

SECURITY AND PRIVACY

Basic requirements	Description
Password requirements	Minimum of 8 characters with a mixture of special characters and numbers.
Data encryptions (data-inmotion and at rest)	E-Tracker allows for the encryption of data. Web-proxy server configured with TLS/SSL. Database data are in a separate location, which allows for encryption at rest.
Access level/user permissions	E-Tracker allows for role-based access control, which means that permissions are assigned to users based on their role within an organization. E-Tracker can also set expiration dates for user accounts and automatically disable inactive users to help prevent unauthorized system access.

USERS

Users can run this digital solution on tablets, laptops, and desktop computers.

Grouping	Users	Description
1 Clients	No	
2 Health care providers	Yes	Community Health Officers (CHOs)

USERS		
3 Health system or resource managers	Yes	IT Officers, Regional IT Managers, ICT Unit (GHS Policy, Planning, Monitoring & Evaluation Unit)

HEALTH SYSTEM CHALLENGES		

End users shared the challenges they encountered using the system, which are categorized according to WHO's Classifications of Digital Health Interventions in the table below.

1	Information	
1.5	Lack of access to information or data	• Internet connectivity challenges. • Lack of financial support to provide stable internet connectivity for system use. • The system is not interoperable with DHIMS2, which creates double the work. • The notifications feature is not currently used due to financial constraints.

RECOMMENDATIONS		

Users made several recommendations to strengthen this digital system (categorized according to the digital health interventions presented in WHO's Classification of Digital Health Interventions v1.0).

4	Data services	
4.4.1	Data exchange across systems	Users suggest connecting the E-Tracker to DHIMS2 so users do not have to input data into both systems.

PRIORITY DIGITAL SYSTEM 3

SORMAS

The Surveillance Outbreak Response Management and Analysis System (SORMAS) is an open source mobile eHealth software that is designed to organize and facilitate disease control and outbreak management procedures in addition to disease surveillance and epidemiological analysis for all administrative levels of the public health system. Its mission is to improve the prevention and control of communicable diseases. SORMAS is available under an open source license and adheres to the highest data protection standards, good scientific practice, and open access policy. SORMAS is characterized by the following features: digitized notification at the health facility level, multi-directional information flow, offline functionality, contact follow-up management, event management, laboratory functionality, analytics, and user-centered design.

SYSTEM OVERVIEW								
Global Goods Guidebook v.4 (pages)	**Scale**	**WHO classification**	**System owners**	**Licensing**	**Software maturity**	**Offline capability**	**Funders**	**Implementers**
56 (emergent application)	National	V: Public health and disease surveillance system*	GHS-Disease Surveillance Department (DSD)	Free and open source	Organization for Standardization (e.g., ISO/TC 215); OpenHIE standards (HL7 FHIR)	For Android versions only	EU, Ghana Community Network Services Limited (GCNet), GHS, GIZ	Digital Square, GHS, SORMAS

MAJOR FEATURES OF THE DIGITAL SYSTEM

- Is a case-based surveillance system.
- Conducts contact tracing.
- Includes a basic immunization module to collect individual-level immunization data.
- Includes a laboratory module.

USERS

Users can run SORMAS on a variety of devices, including mobile phones, tablets, laptops, and desktop computers.

Grouping	Users	Description
1 Clients	No	
2 Health care providers	Yes	SORMAS is used by CHWs and at the health facility level. Job titles of users in this category include Hospital Informant, Community Informant, Surveillance Supervisor, and Laboratory Officer.
3 Health system or resource managers	Yes	SORMAS is used by Disease Control Officers and Laboratory Technicians. Regional officers reported that SORMAS helps users understand the disease burden by tracking positive and negative cases. SORMAS also helps capture the geographical locations of cases so that health managers can plan interventions.

HEALTH SYSTEM CHALLENGES

End users shared the challenges they encountered using the system, which are categorized according to WHO's Classifications of Digital Health Interventions in the table below.

1	Information	
1.5	Lack of access to information or data	• When the upgrade is done, synchronization of data becomes a challenge, particularly the Android version. • Sometimes the system generates duplicate records during a system upgrade. • After the system updates, users are not able to log in and must wait for headquarters to find a solution. • The system is unstable and runs slowly. • The system has frequent downtimes.

RECOMMENDATIONS		
Users made several recommendations to strengthen this digital system (categorized according to the digital health interventions presented in WHO's Classification of Digital Health Interventions v1.0).		
4	**Data services**	
4.4.1	Data exchange across systems	SORMAS should interoperate with DHIMS2 to avoid entries of similar data into the two systems. There is not currently a plan to integrate the two systems.

PRIORITY DIGITAL SYSTEM 4

Ghana Integrated Logistics Management Information System (GhiLMIS)

GhiLMIS leverages One Network NEO platform and is Ghana's electronic logistics management information system that connects more than 1,500 medical facilities across the country on the One Network Digital Supply Chain Network™. GhiLMIS is used to capture data on vaccines for enhanced logistics management and uses consumption patterns to project and forecast vaccine use. GhiLMIS captures and processes COVID-19-related transactions through the entire value chain. The system also tracks and traces COVID-19 items throughout the supply chain. Ghana uses the data derived from the GhiLMIS to inform its decisions related to demand and supply planning and scenario modeling, distribution segmentation, and demand prioritization. The implementation has been based on a patient-centric approach with a focus on data quality assurance leveraged to improve and optimize operational performance and reduce supply chain costs.

For more information on GhiLMIS, read:

- Ghana Public Health Sector Enables Efficient COVID-19 Response Readiness with GhiLMIS (2021)[10].
- Ministry of Health launches GhiLMIS to improve supply chain in the health sector[11].

SYSTEM OVERVIEW							
Scale	WHO classification	System owners	Licensing	Software maturity	Offline capability	Funders	Implementers
National	T: Logistic Management Information System	MOH-Supplies, Stores and Drugs Management Division (SSDM)	Proprietary	n/a	n/a	Global Fund	GHS-SSDM Systems for Development (S4D)

MAJOR FEATURES OF THE DIGITAL SYSTEM

- Performs vaccine supply chain management including receipts, issues, transfers, consumption, replenishment planning, inventory management, and forecasting.
- Serves as the National Product Catalog for vaccination commodities.
- Is the MOH-approved LMIS.

USERS

Users can run GhiLMIS on a variety of devices, including tablets, laptops, and desktop computers.

Grouping	Users	Description
1 Clients	No	
2 Health care providers	Yes	Pharmacists whose duties include supply chain management use GhiLMIS. The GhiLMIS rollout at the Community-based Health Planning and Services (CHPS) is ongoing on a phased basis. The rollout started from the national level down and is now being rolled out at the community level, which is the lowest level of care. The facilities at the community level are called CHPS. Health care providers who use GhiLMIS include community health nurses (CHN), community health nurse midwives, midwives, and enrolled nurses.
3 Health system or resource managers	Yes	Supply chain managers at the national, regional, and district levels use GhiLMIS.

HEALTH SYSTEM CHALLENGES

End users shared the challenges they encountered using the system, which are categorized according to WHO's Classifications of Digital Health Interventions in the table below.

1	Information	
1.2	Delayed reporting of events	Requests made on the GhiLMIS system from lower-level facilities experience delays before they are received at the regional level.
1.5	Lack of access to information or data	• Frequent system downtimes discourage staff from using the system. • Inadequate tools for running the system (computers and internet connectivity). • Lack of financial support for internet connectivity, which affects the user'sability to input data into the system.

1.7	Lack of unique identifier	The system does not allow for vaccine batch numbers to match with accompanying items.

RECOMMENDATIONS		
Users made several recommendations to strengthen this digital system (categorized according to the digital health interventions presented in WHO's Classification of Digital Health Interventions v1.0).		
4	**Data services**	
4.2.3	Classify disease codes or cause of mortality	The system should be able to catch all antigens, which is not currently the case.
4.4.1	Data exchange across systems	Interoperability with other systems used for immunization.

PRIORITY DIGITAL SYSTEM 5
Lightwave Health Information Management System (LHIMS)

The LHIMS application provides accurate and timely data for hospital administrators, management, providers, and clinicians for vital decision-making needs that lead to positive outcomes for patients. It serves as a health information management system that addresses key challenges hospitals face to support health care delivery. LHIMS is designed to securely and confidentially deliver the following functionalities: to provide easy and timely access to the patient's health record, to have patient records follow the patient from service point to service point seamlessly, to provide the ability to track and process revenue, to build and file claims data, and to meet reporting needs in a secure and confidential environment. LHIMS's flexibility allows it to manage electronic medical records and provide lab management and patient engagement for hospitals, labs, and clinics.

For more information on LHIMS, read:

• [National E-Health Project with Bio-surveillance (Early Warning) System](#)[12].

SYSTEM OVERVIEW						
Scale	WHO classification	System owners	Licensing	Offline capability	Funders	Implementers
Sub-national	H: Electronic Medical Record System	MOH	Proprietary	Yes	MOH	GHS, CHISU

MAJOR FEATURES OF THE DIGITAL SYSTEM

- Conducts registration of clients.
- Manages longitudinal electronic medical record for individual clients.
- Manages laboratory information.
- Collects national health insurance scheme (NHIS) claims.
- Provides early detection of disease outbreaks by using bio-surveillance feature.
- Is an MOH-approved EMR solution.

USERS

Users can operate LHIMS on tablets and computers.

Grouping	Users	Description
1 Clients	No	
2 Health care providers	Yes	Doctors, nurses, pharmacists, laboratory technicians
3 Health system or resource managers	Yes	Health Information Officers, Regional and Facility IT Managers

HEALTH SYSTEM CHALLENGES

End users shared the challenges they encountered using the system, which are categorized according to WHO's Classifications of Digital Health Interventions in the table below.

1	Information	
1.5	Lack of access to information or data	Lack of access to data from other relevant systems

RECOMMENDATIONS

Users made several recommendations to strengthen this digital system (categorized according to the digital health interventions presented in WHO's Classification of Digital Health Interventions v1.0).

4	Data services	
4.4.1	Data exchange across systems	GHS would like to make LHIMS FHIR-compliant so that it can interoperate with other systems like DHIMS2 and E-Tracker.

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CONCLUSION AND NEXT STEPS

Digital Square partnered with GHS to identify opportunities where the DIPC project can support strengthening the digital health immunization systems. The primary challenges identified during this ecosystem mapping phase are:

01   **Challenges with infrastructure,** especially unreliable and intermittent internet connectivity, as well as lack of funding to purchase data for internet connectivity.

02   **Gaps in the functional components required to support the end-to-end immunization workflow,** namely:

- **Production of digital immunization certificates.**
- **Microplanning for delivery of immunization services.** However, to address this gap, a national guidelines document for microplanning is currently under development by the EPI unit and should be completed by the end of September 2023.
- **National product catalog for immunization commodities.**
- **Master Facility Registry.** DHIMS2 acts as the de facto Master Facility List currently. There is a WHO initiative to introduce a full master facility registry, but this is still at the landscaping phase and no solution has been selected yet.

03   **Lack of interoperability of existing systems.** End users (e.g., regional health managers) of the existing digital systems provided many specific recommendations on features they would like to see added, with data exchange across systems surfacing as the most requested intervention during this mapping. The lack of interoperability leads to siloed information that cannot be shared across systems and inefficiencies due to duplicate data entry across systems.

04   **Lack of funding to sustain the GHS DHIMS2 servers.** The servers that host the existing DHIMS2 and E-Tracker systems have been supported financially by donor-funded projects that have now ended. As a result, there is a gap for the annual server costs.

GHS has a clear vision for its national digital health strategy, and there are many existing tools that support the functional components of immunization that need to be adapted or scaled up. As part of this ecosystem mapping process, Digital Square partnered with GHS to determine that the focus of DIPC project implementation in Ghana will be strengthening existing in-country digital immunization tools by working together until 2024 to:

01

Enhance DHIS2 E-Tracker so it can serve as Ghana's immunization information system, according to a defined and validated set of requirements prioritized by the GHS, and within the time and budget available.

02

Strengthen the capacity of health workers updating content for the GHS eLearning platform so they can effectively use identified digital immunization systems. This will include an assessment of training needs according to GHS priorities.

03

Support interoperability of current digital immunization tools by defining and validating the data exchange requirements between two or three prioritized systems and supporting the development and testing of an interoperability solution that utilizes the HL7 FHIR standard so that data can be exchanged securely across digital platforms (e.g., SORMAS, GhiLM-IS).

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