



Factors Affecting Cloud Adoption in Low-Resource Settings

Data gathered in July 2020 unless otherwise indicated

Objectives

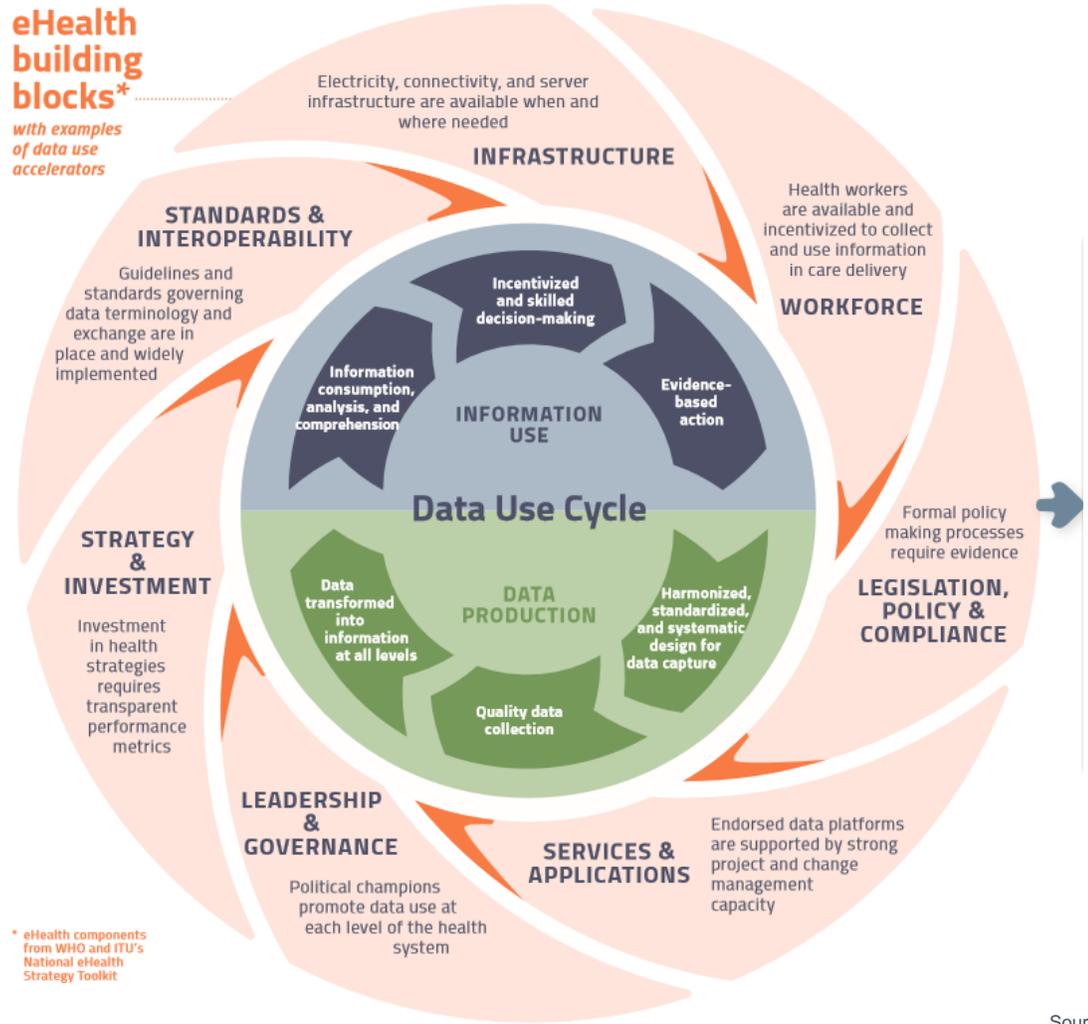
- Understand drivers and barriers for cloud adoption in low-resource settings
- Identify areas of saturation and gaps within digital health markets

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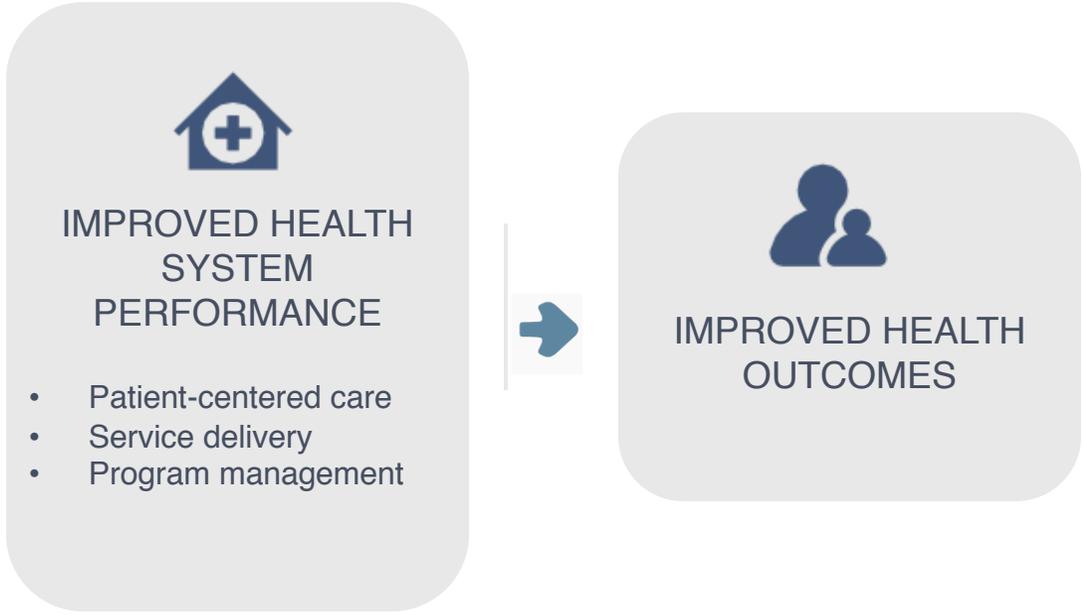
- **Landscape of current digital health and health data sector**
 - Drivers and barriers for adoption
 - Overview of digital health architectures and high-priority features for success, by segment
 - Overview of key digital and data standards and high-priority features for success, by segment
 - Exemplar product case studies
 - Digital health case studies: Mozambique, Kenya, and Uttar Pradesh
- **Opportunities for impact**
 - Saturation and gap analysis intervention category
 - Saturation and gap analysis architecture domains
 - Key gaps by market maturity level

Drivers and Barriers to Adoption

Seven eHealth building blocks underlie the theory of change and serve as drivers of digital health adoption and scalability



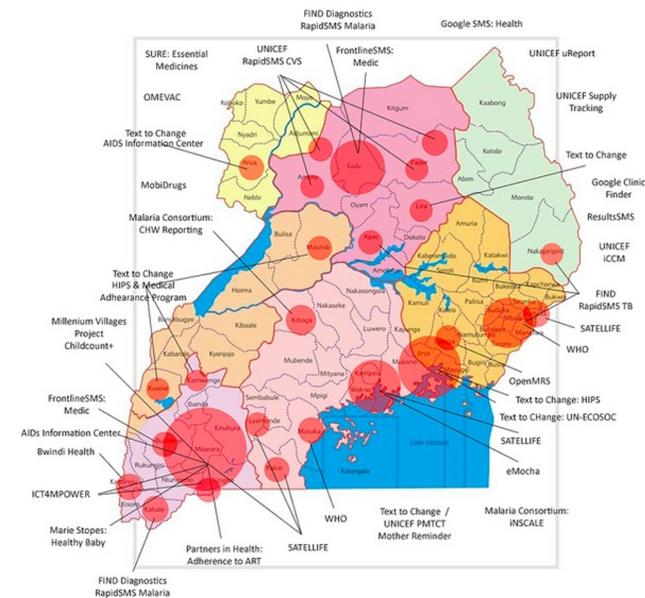
Theory of Change: Factors that accelerate the use of data for improved health system performance.



Source: Theory of Change for the Data Use Partnership: <https://www.path.org/resources/data-use-partnership-theory-of-change/>

Uganda's health information landscape exemplifies the challenges LMICs face when scaling digital health solutions

Uganda digital health projects



● Pilot project and relative size

- Often focused on disease-specific program (“health verticals”).
- Heterogeneous implementing organizations and funders.
- Arose due to lack of national coordination/eHealth policy.
- Limited data exchange and sharing policies.
- Data protectionism (vendors & MOH units).
- Often driven by public health and tech innovators.
- Prioritized functional requirements not limited to EMRs.

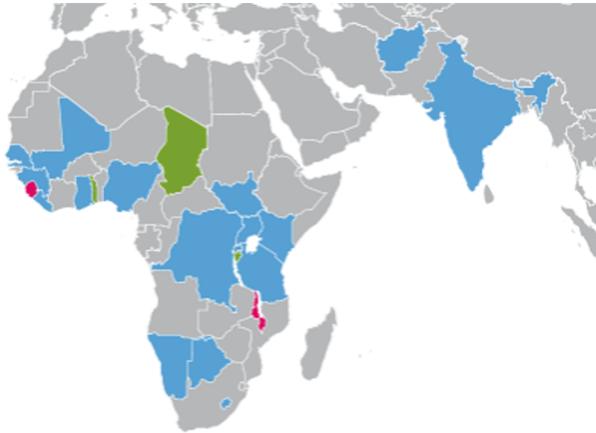


Image: Courtesy of Blaschke @ UNICEF

The current HIS landscape leverages open source software solutions with strong communities of practice

iHRIS

(health workforce)



- Implementation supported by IntraHealth (current & past implementations)
- Independently implementing or supported by other donors
- Supported by IntraHealth and independently/through other donors

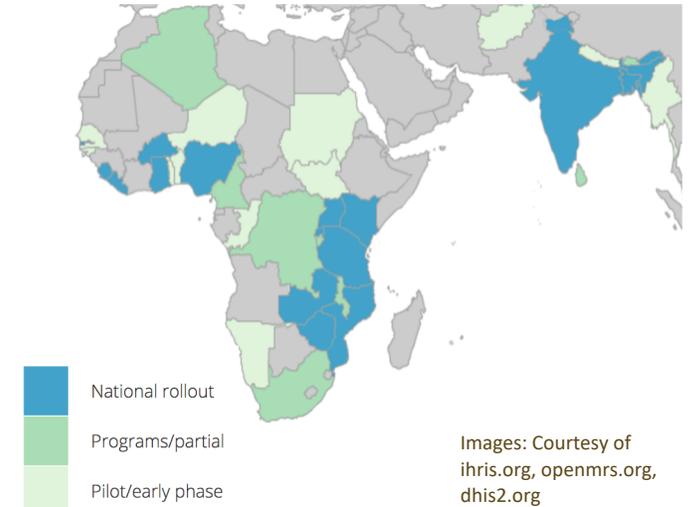
OpenMRS

(electronic medical records)



DHIS2

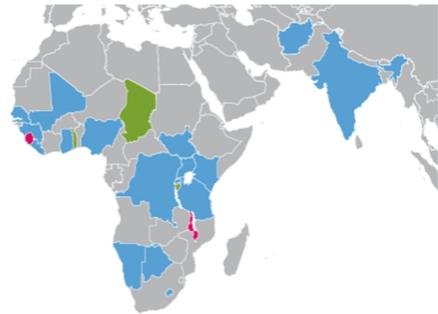
(public health & service delivery)



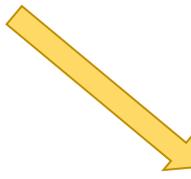
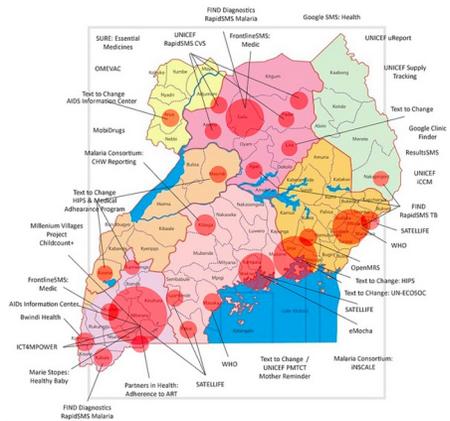
Images: Courtesy of
ihris.org, openmrs.org,
dhis2.org

- Potential to achieve interoperability at scale.
- De facto authorities for health system metadata.
- Existing networks of local and regional informaticians, developers, implementers.
- Part of MOH HIS strategic plans and donor funding requests.

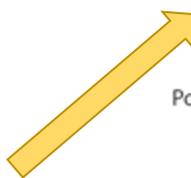
Digital health partners strive to improve interoperability and advance information exchange. How do we get there?



- Implementation supported by IntraHealth (current & past implementations)
- Independently implementing or supported by other donors
- Supported by IntraHealth and independently/through other donors



OpenHIE
Component Layer

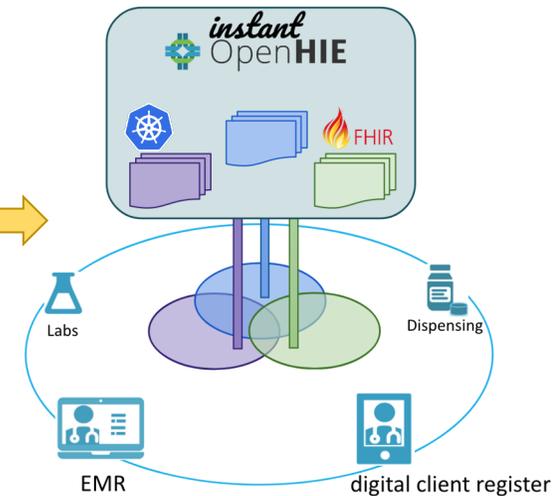


Point of Service

OpenHIE architecture



Reference implementation



HL7® FHIR® and standards GS1®

Images: Courtesy of ihirs.org, Blaschke @ UNICEF, ohio.org

Overview of Digital Health Architectures and High-Priority Features

Digital architectures patterns

Software Architectural Patterns (WHO/Digital Square)	Example Software
<p>Siloed: A digital health enterprise architecture comprising standalone application(s). A digital health <i>project</i> is a time-bound implementation of a siloed digital health enterprise, usually to demonstrate proof of concept.</p>	<p>CHW training apps</p>
<p>Big Ball of MUD (<i>monolithic, un-architected software distributions</i>): A haphazardly structured, sprawling, sloppy, duct-tape-and-baling-wire, spaghetti-code jungle. These systems show unmistakable signs of unregulated growth and repeated, expedient repair. Information is shared promiscuously among distant elements of the system, often to the point where nearly all the important information becomes global or duplicated.</p>	<p>DHIS2 (large market share)</p>
<p>Integrated: A digital health enterprise architecture in which 2 or more digital applications are directly connected to each other (i.e., without an intermediary data exchange) intended to address 1 or more health system challenges and fulfill health program goals.</p>	<p>Bahmni™, various DHIS2 integrations</p>
<p>Exchanged: A digital health enterprise architecture consisting of multiple applications using standards to connect through a health information exchange to address collective needs across the health system, operating in a coordinated manner within a digital health architecture.</p>	<p>MomConnect, mHero, DATIM4U, patient-level monitoring (PEFPAR)</p>

More-mature architecture patterns offer a more sophisticated set of features

	HIS Interoperability		HIS Stages of Continuous Improvement							
	National HIS Enterprise Architecture	HIS Subsystems	ICT Business Infrastructure Support	Networks and Internet Connectivity	Enterprise Architecture	Patient Data Exchange	Terminology Management	Unique Person Identity Management	Indicator Registry	Master Facility List
Siloed	1	1	1	1	1	1	1	1	1	1
Integrated	3	3	2	2	2	2	2	2	2	2
Exchanged	4	4	4	4	4	4	3	3	3	4

Maturity scenarios are intended to be progressive, key milestones, or stages for countries as they mature their HIS.

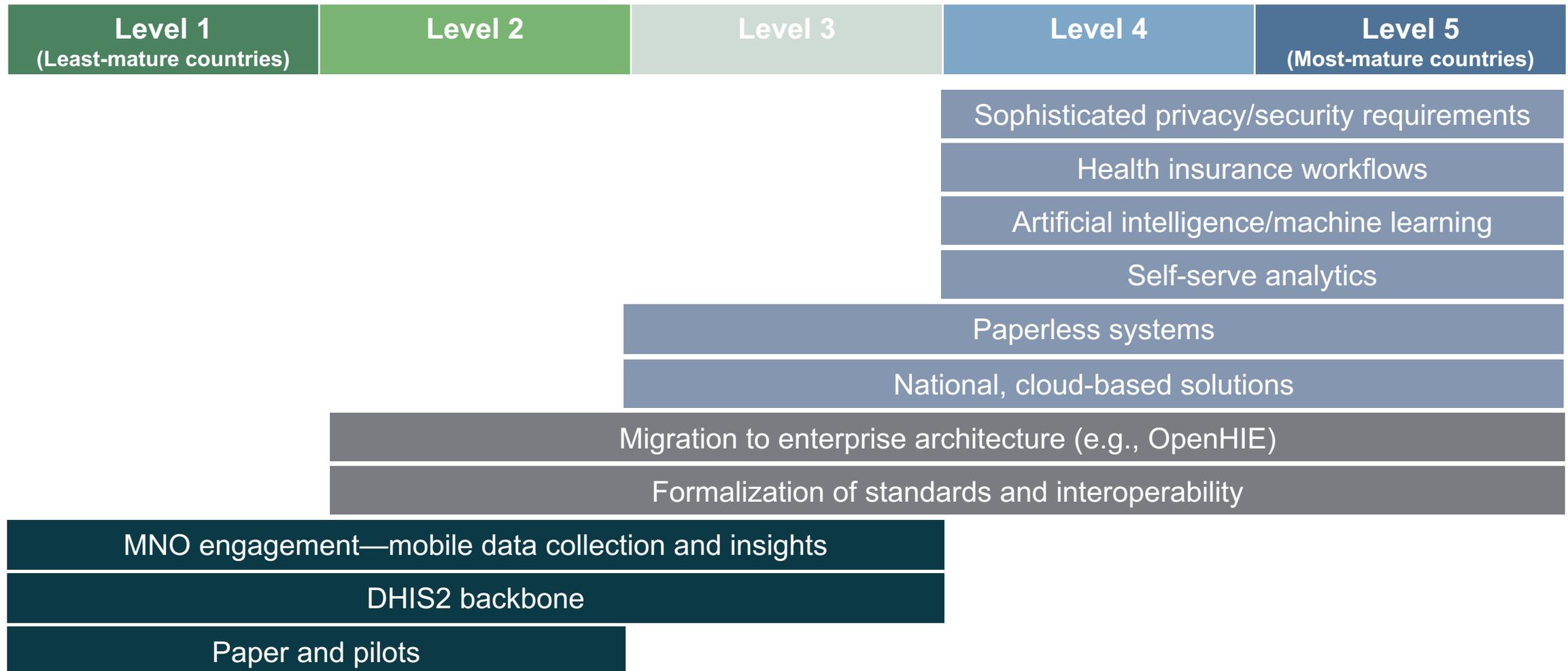
Each row representing a country's required score to be classified as siloed, integrated or exchanged HIS. This classification is intended to support feasibility considerations when designing a digital health intervention.

Sources:

[HIS Interoperability Maturity Model](#) Evaluation Domain: Leadership and governance; Human resources; Technology
Scale: 1 = Nascent; 2 = Emerging; 3 = Established; 4 = Institutionalized; 5 = Optimized

[HIS Stages of Continuous Improvement](#) HIS Core Domains: Leadership and governance; Management and workforce; ICT infrastructure; Standards and interoperability; Data quality and use
Scale: 1 = Emerging/Ad Hoc; 2 = Repeatable; 3 = Defined; 4 = Managed; 5 = Optimized

Certain features become more or less critical at different levels of digital health market maturity



Architectures and Communities of Practice—examples

Scope	Examples
National	<ul style="list-style-type: none"> • South Africa: <i>National Health Normative Standards Framework for Interoperability in eHealth</i> (being updated to be FHIR-centric). • Liberia: eIDSR over SMS. • Tanzania: BID (Immunization Registry) based on OpenHIE; adapted OpenHIE under Data Use Partnership. • Ethiopia: Adapted OpenHIE under Data Use Partnership. Establishing regional center of expertise in OpenHIE. • Kenya: Government enterprise architecture and clinical care management systems document defines commitment to open standards and adoption of HL7 FHIR. Architecture is derivative of OpenHIE. • Mozambique: Adopting open source tools and reference applications from OpenHIE. MOASIS supports national digital health architecture initiatives.
Regional	<ul style="list-style-type: none"> • Digital REACH (East African Community): Cross-border care management. • Africa CDC: Public health disease surveillance. • West African Health Organization: Federated aggregate data/indicator reporting. • AeHIN: South and Southeast Asia COP. Advocates for FHIR and OpenHIE.
Global	<ul style="list-style-type: none"> • PEFPAR: DATIM reporting stack is based on OpenHIE and will lean on FHIR and CQL for aggregate reporting. WHO HIV and Global Fund aligned with approach. • WHO: Digital accelerator kits and computable guidelines, based on FHIR, for various health program areas designed to transition to exchanged architectures. Funding from major donors (e.g., UNFPA for family planning, Gavi for vaccines). • OpenHIE: COP and maintainers of adaptable architectural patterns.

Overview of Digital Health Standards and High-priority Features

Focus on clinical care management and semantic digital health standards

Business Domains

- Clinical information systems
- Medical imaging
- Labs and connected diagnostics
- Supply chain
- Health financing
- Health workforce
- Public health
- Home-based records



Digital Health Semantic Standards

Name	Pros	Cons	Country Interest/Adoption
Systematized Nomenclature of Medicine – Clinical Terms 	<ul style="list-style-type: none"> Waver for countries in WB LIC bands. SNOMED GPS freely available but not complete for needs. 	<ul style="list-style-type: none"> Tiered license fee following graduation from band D/E. 	<ul style="list-style-type: none"> Uttar Pradesh, South Africa, Tanzania (recommended).
International Classification of Diseases 11th Revision (ICD-11)	<ul style="list-style-type: none"> Currently open access for noncommercial use. Will soon be licensed under Creative Commons. ICD standards relatively nascent in LICs; thus, few with upgrade costs. WHO accelerator kits will map to ICD-11. WHO will support FHIR API endpoints for ICD. 	<ul style="list-style-type: none"> Commercial use requires licensing fee. Upgrading to new version requires recoding links to existing software, training. Currently lacking granularity needed for classifying specific services within health areas (e.g., HIV). 	<ul style="list-style-type: none"> Uttar Pradesh, South Africa (ICD-10), Tanzania (recommended). Several countries (e.g., Namibia) are using ICD-11 for reporting death stats; majority of rest use ICD-10. WHO will officially require ICD-11 by 2022.
Logical Observation Identifiers Names and Codes 	<ul style="list-style-type: none"> Open access for noncommercial and commercial use. To be subsumed/cross-mapped with ICD-11. 	<ul style="list-style-type: none"> LOINC to CPT mapping from 2005. 	<ul style="list-style-type: none"> Uttar Pradesh, South Africa, Tanzania (recommended), DRC. Included in several open source lab information systems used in LMICs.
Columbia International eHealth Laboratory (CIEL)	<ul style="list-style-type: none"> Concept dictionary mapped to reference terminologies, including SNOMED CT, to support the OpenMRS EHR. 	<ul style="list-style-type: none"> Potential licensing issues with IMO, particularly for commercial use. 	<ul style="list-style-type: none"> Used as part of OpenMRS default terminology.
International Organization for Standardization 	<ul style="list-style-type: none"> Assurance that product meets quality standards. 	<ul style="list-style-type: none"> 3rd party certification costs. 	<ul style="list-style-type: none"> Uttar Pradesh.
Current Procedural Terminology 	<ul style="list-style-type: none"> Needed for classifying insurance claims. 	<ul style="list-style-type: none"> US centric. License fee. No equivalence in LICs. 	<ul style="list-style-type: none"> Countries are looking for an appropriate code system. Currently, local code systems are usually used.

Digital Health Syntactic Standards

Name	Pros	Cons	Country Interest/Adoption
Digital Imaging and Communications in Medicine 	<ul style="list-style-type: none"> Enables the integration of hardware from multiple manufacturers into a picture archiving and communication system (PACS). 	<ul style="list-style-type: none"> Lacks reference information model of imaging domain. 	<ul style="list-style-type: none"> Uttar Pradesh, Tanzania (recommended), DRC.
Integrating the Healthcare Enterprise 	<ul style="list-style-type: none"> Users with clinical and operational experience identify integration and information-sharing priorities and vendors to develop standards. 	<ul style="list-style-type: none"> Limited bandwidth in committees for the development of new profiles. 	<ul style="list-style-type: none"> South Africa (PAM, XDS-MS, XD-LAB), DRC.
HL7 Version 2/Version 3 	<ul style="list-style-type: none"> High penetration in high-income markets. Proven interoperability and security. 	<ul style="list-style-type: none"> Limited adoption in LMICs. High barrier to entry with Version 3. 	<ul style="list-style-type: none"> Uttar Pradesh, South Africa, DRC.
Fast Healthcare Interoperability Resources 	<ul style="list-style-type: none"> Known for efficient and safe interface. Strong momentum in LMICs. Being adopted by WHO and PEPFAR as major drivers for future uptake. 		<ul style="list-style-type: none"> Uttar Pradesh, Haiti (EMR exchange), Nigeria (workforce). Interest: Ghana, Kenya, Tanzania (hack-a-thon).
HL7/ASTM <i>Continuity of Care Document</i>	<ul style="list-style-type: none"> Provides a framework for referring to concepts from coding systems, such as SNOMED or LOINC. 	<ul style="list-style-type: none"> Limited/no uptake of CCD and CDAs in LICs. 	<ul style="list-style-type: none"> Uttar Pradesh, South Africa.

HL7 FHIR Adoption in Global Goods (1 of 2)

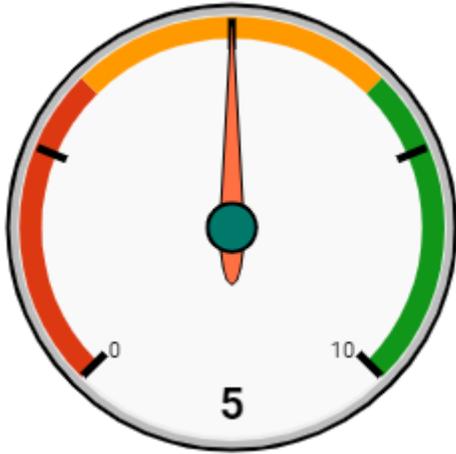
Product	Product Type	Standards Adoption	Future Developments/Unmet Needs
DHIS2 Tracker	Case management	Planned to support FHIR, but unclear roadmap as data model is too unwieldy (uses EAV, no semantic model)	Potentially, focus will be on SDC and FHIR Questionnaire. Plans to provide capabilities to mapping to relevant terminologies (ICD, SNOMED).
DHIS2 Aggregate	Indicator reporting	Support for ADX (based on SDMX, not FHIR)	Planning to support IHE's mADX (FHIR Measure), IHE's SVCM (ValueSet, ConceptMaps), and IHE's mCSD (FHIR Location) for indicator exchange and reporting.
OpenELIS, BLIS	Laboratory	Initial support for diagnostic reporting with HL7 FHIR using draft OpenHIE specification	
OpenMRS	Medical records	Sync 2.0 module enables 2-way synchronization between OpenMRS and FHIR Server for the key FHIR resources (e.g., Observation, Practitioner, Patient, Observation). Base terminology is CIEL	Transitioning to tight integration with FHIR server (HAPI). Seeking funding from Digital Square to sync with a shared health record.
Instant OpenHIE	Health information exchange	Packaging and preconfiguration of (Docker + Kubernetes) of reference OpenHIE components with FHIR profiles	Uses HAPI FHIR as metadata store and for shared health record (requirements still being refined). Targeting development and testing, with eventual plans for production deployment as MOH infrastructure.

HL7 FHIR Adoption in Global Goods (2 of 2)

Product	Product Type	Standards Adoption	Future Developments/Unmet Needs
mHero / emNutt	Health worker communication	Supports IHE's mACM (FHIR Communication) profile for 1-way alerts and reporting; FHIR Questionnaire for SMS and IVR 2-way communication; IHE's mCSD (FHIR Location and Practitioner). Uses HAPI FHIR as back-end data store.	
iHRIS	Health workforce	Supports IHE's mCSD (FHIR Location and Practitioner).	Moving to HAPI FHIR as back-end data store.
OpenIMIS	Health insurance management	Transitioning to FHIR (HAPI) as primary data store to support health insurance claims, coverage, and beneficiary enrollment workflows.	Looking at AI/ML-based algorithms for claims adjudication. Challenge in identifying global equivalent to CPT codes.
OCL	Terminologies		Adding support for IHE's SVCM (FHIR ValueSet and ConceptMap).
GOFR	Metadata	Tool to duplicate multiple health facility lists, which uses HAPI FHIR as a back-end data store and is compliant with IHE's mCSD (FHIR Location).	
OpenLMIS	Supply chain/logistics	Support synchronization of facility lists with IHE's mCSD (FHIR Location) and stock related indicators using IHE's mADX (FHIR Measure). Also supports GS1 supply chain standards.	Early candidate for FHIR R5 supply chain updates and associated IHE profile.

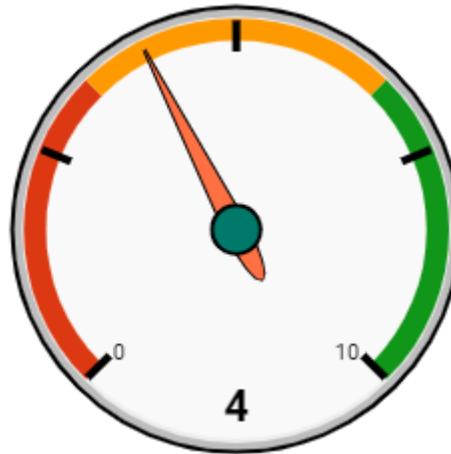
Exemplar Products and Key Gaps

Digital health product exemplars based on the Global Good Maturity Model



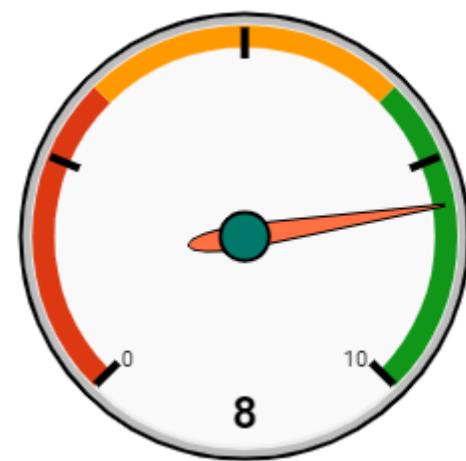
Software Maturity

- Security
- Scalability
- Software productization
- Technical documentation
- Interoperability and data accessibility



Global Utility

- Country utilization
- Country strategy
- Digital health interventions
- Source code accessibility
- Funding and revenue



Community Support

- Community engagement
- Community governance
- Software roadmap
- User documentation
- Multilingual support

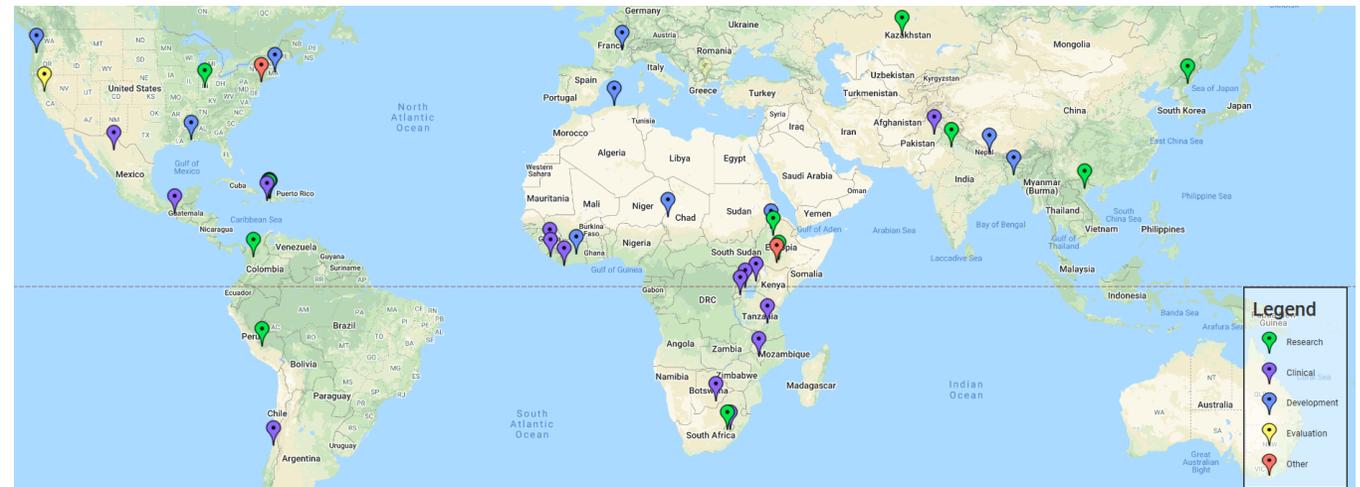
Open Medical Record System (OpenMRS)

- An open source, integrated electronic medical records platform aimed at resource-constrained settings.
- FHIR support: Sync 2.0 module supports basic FHIR resources, moving to more substantive support through FHIR Squad.
- Used in over 5,500 health facilities globally. Many deployments focused on data collection for PEPFAR indicator reporting.

Global Good Maturity



Global Distribution of OpenMRS



Sources: [OMRS evaluation for Digital Health Software: Global Good Maturity Model - v2.0](#); [OpenMRS Atlas](#)

District Health Information Software 2 (DHIS2)

- Applied as national WASH, logistics, agriculture, land tenure, community health, and education information system.
- Serves as centralized IS for multinational donor databases and NGO projects.
- Two products, “Aggregate” and “Tracker,” for indicator and case management.
- National HMIS in 55 countries, scaling up in an additional 33 countries.
- Currently has limited support for standards, though developing FHIR roadmap.

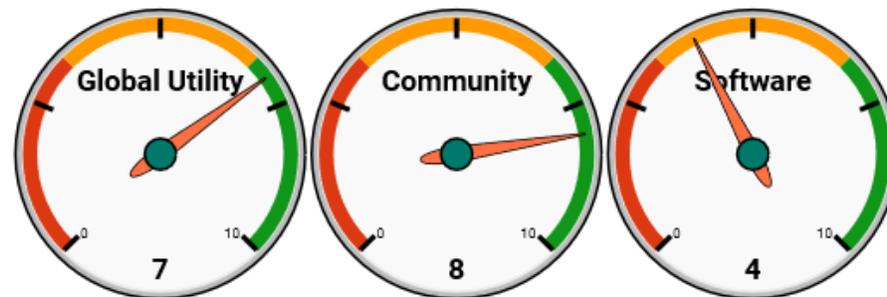


Source: [Digital Square Investments in Global Goods](#)

Open Smart Register Platform (OpenSRP)

- An open source mobile health platform that allows health workers to electronically register and track the health of their entire client population. Particularly focused on last mile/community health workers.
- Modular design allows users to adapt content and functionality to health workers' needs.
- Interoperable with OpenHIE, DHIS2, OpenMRS, and RapidPro.
- Developers aspire to identify and implement FHIR interfaces to improve the ability of OpenSRP to integrate with third-party systems like OpenHIE, shared health records, etc.
- Early adopters of Android FHIR SDK (in development) and CQL.

Global Good Maturity



Source: [Global Goods Self Assessment](#)

Key challenges with Exemplar Digital Health Tools

OpenMRS	DHIS2	OpenSRP
<ul style="list-style-type: none"> Limited long-term resources available to sustain future growth and maintenance; heavy reliance on implementation projects to support core software. Reliant on unstable donor funding. Community has loose affiliation with several vendors, so more diversified funding streams but lack of core resources makes it difficult to bring country customizations back into core. No long-term roadmap, as not resourced. Government dependency on a product that is not under their control. Primarily funded by PEFPAR, resulting in a historic focus as a data entry tool for aggregate reporting rather than clinical care management; PEFPAR is starting to shift focus to clinical care but needs more support outside of HIV care. Limited synchronization with lab systems. Enthusiastic about FHIR though not fully resourced. 	<ul style="list-style-type: none"> Reliant on unstable donor funding. Community is dominated by UiO, which maintains tight management control over implementor network (HISP); leadership is insular; strengths of HISP nodes vary widely. Government dependency on a product that is not under their control; limited alternatives for support when not a priority for UiO. Case centric, not patient centric, but trying to be an EMR. Countries are adopting Tracker as an EMR due to DHIS2 market dominance rather than suitability. No internal data models for non-aggregate data, so challenging to maintain standards compliance. Each deployment of Tracker uses bespoke data model. Slow to adopt standards and, as dominant market player, contributes to lack of uptake of FHIR. No long-term roadmap. 	<ul style="list-style-type: none"> Reliant on unstable donor funding. Limited long-term resources available to sustain future growth and maintenance with heavily reliance on implementation projects to support core software. No long-term roadmap, as not resourced. Community revolves around a single vendor, Ona, which supports tool development as well as deployment. Government dependency on a product that is not under their control. Moving from OpenMRS as back-end data store to FHIR, but not fully resourced. Support for only a limited number of health program areas.

Digital Health Case Studies for 3 Geographies with Different Digital Health Maturity

Kenya Case Study

Market Maturity Level 3



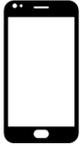
Kenya overview



51.5 million population



73% living in rural areas



82% of women, **86%** men own mobile phones



26% of women, **43%** of men using mobile Internet
Best connection speed in Africa (~**12 mbps**)



High **cross-border migration** with Tanzania, Uganda, Rwanda



5.4% HIV prevalence in adults

Health and HIS ecosystem

- **Decentralized health system**—strategy, management, and finance decision at county (n = 47) level.
- Kenya recently published a **Primary Healthcare Strategic Framework** (2019-2024) to advance UHC
- Health facilities are a **mix of public** (49%, 1/3 HCWs) and **private** (51%, 2/3 HCWs).
- Kenya HMIS is at **national scale**; EMR, lab management IS, master facility list **HIS subsystems are at national or near-national scale**.
- A **digital health infrastructure** provision and maintenance plan partially and inconsistently implemented; **< 25%** in place.
- National Integrated Identity Management System, *Huduma Namba*, launched in 2018 to create and manage a **single, central source of individual data, to eventually link to a unique ID**. Recently halted by the High Court due to privacy and security concerns.

HIS Governance and Management Enabling Environment

Indicator	Status (Available/Links)	Notes
National policies for eHealth and DH outline the vision, goals, and activities to support the health system	Kenya National eHealth Policy 2016–2030 Kenya National e-Health Strategy 2011–2017	A 2019 DH&I assessment identified a need to update guidance documents more regularly and to establish management and budget to do so
Data exchange standards include organizational policies, procedures, and best practices related to HIS	Kenya Standards and Guidelines for mHealth Systems (2017) Standards and Guidelines for Electronic Medical Record Systems in Kenya (2010)	National-level standards are outlined but not consistently used
Architecture guides the synergistic links of all DH initiatives	Kenya Government Enterprise Architecture (2016)	Operable health enterprise architecture exists, but policies are not applied consistently throughout the country. HIS activities occur in siloed efforts that often fail to integrate with established policies and standards.
Leadership and coordination structure oversees implementation of policies and HIS/DH activities	eHealth Unit/Ministry of Health	Established but not fully functional or meeting regularly.
National HMIS	DHIS2, integrated disease surveillance and response system	All districts and selected health facilities are connected to DHIS2 national server using mobile Internet on computers.

HIS Subsystems

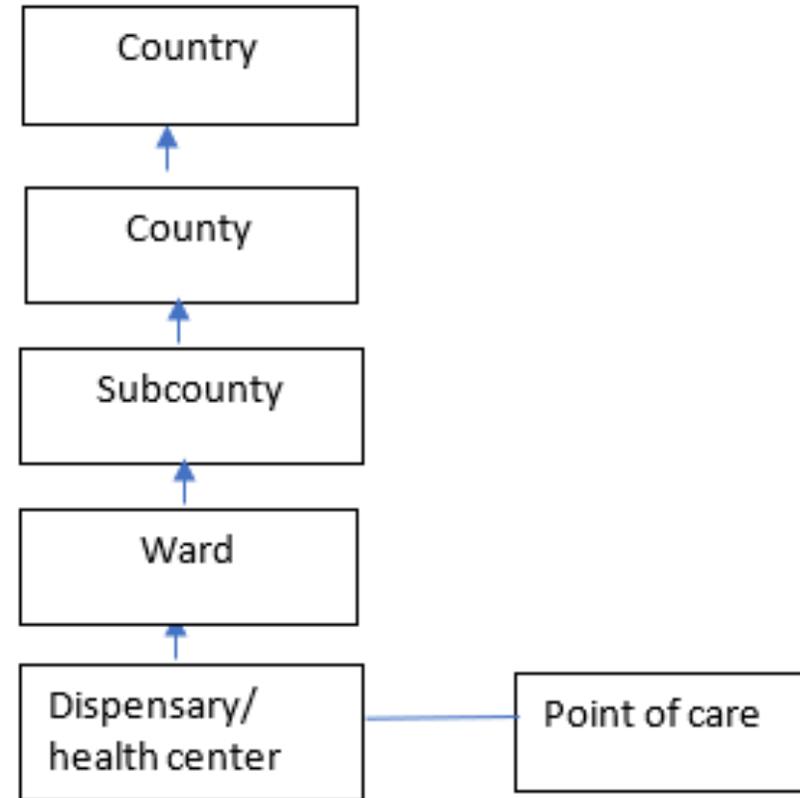
Category	Software Platform(s)	Notes
Laboratory information systems	OpenELIS	Laboratory information system.
Health workforce information system	iHRIS software	Integrated system for tracking, managing, and planning health workforce.
Clinical information system	Two HIV EMR systems: IQCare KenyaEMR	IQCare at clinics and hospitals to create multiple departments and forms. KenyaEMR is a tailored distribution of OpenMRS .
	Bahmni	Customization of OpenMRS .
	OpenSRP	Electronic medical records.
Home-based records	Maternal and child health booklet	Paper booklet retained by families.
	Medic Mobile/Community Health Toolkit	Mobile application combines SMS messaging, data collection, and analytics for health workers and health systems in hard-to-reach areas.
	CommCare	Community-based information system.
Other HIS implementations	TIBU	Integrates with DHIS2 with data on patients, treatment and outcome, drug availability, lab inventory, and payments through M-PESA.
	Kenya Master Health Facility List	Identifies facility and community units with unique code, geolocation, administrative location, ownership, services offered.
	National Health Insurance Fund	Provides a package of basic health services for pregnant women and infants based on need to meet to UHC goals.
	Logistics management information system	Managed by KEMSA, mHealth Kenya developed a mobile and web-based system that is integrated to the LMIS in 47 counties in Kenya.

Digital Health Applications

Application	Description	Geographic scope	Standards Used
ThinkMD	Clinical decision-support tool used by private health care providers to triage and treat patients	Subnational: Kibera, urban slum	MEDSINC
Safe Delivery App	Learning and training system	Subnational	N/A
M-sawazisha/Medic Mobile	Community-based information system for MNCH	Subnational, Nairobi County	N/A
PROMPTS	Client communication system for MNCH	Subnational: 5 counties	RapidPro
Dawa Sure	Geographic and pharmacy information system, client application	Subnational	DICOM, HL7 FHIR, JSON, LOINC
BLIS	EMR, lab and diagnostic, client application, data interchange, disease surveillance	Subnational	OpenLIS
Addis Clinic telemedicine	COVID-19 response; remote physician support, training, and technical assistance	Subnational	N/A
cStock	CHWs and facility staff report stock levels	Subnational pilot	DHIS2
ConnDx	M-TIBA mobile health wallet: Diagnosis and financing for malaria	Subnational	N/A

Health Information System Data Flow

- Paper-based data are entered into DHIS2 at **subcounty level**; process varies by facility.
- **Facilities with EMR** can enter directly into DHIS2 but varies by connectivity and facility.
- **mHealth and telehealth initiatives** often happen at county level and rarely interface with DHIS2.
- A handful of mHealth initiatives were recently launched nationally and subnationally to address need for COVID data collection and health care support.



Digital Health Private Market in Kenya

- Government focus on ICT and openness to international market entry.
- The mHealth market is expected to grow from \$206M in 2018 to \$557M in 2022.
- Kenya's cloud services are driven by PaaS.
- Electrification problematic in rural areas.
- Lack of transparency and high level of bureaucracy in tender processes.
- Non-resident companies pay 37.5% tax rate.
- In 2016, the economy lost ~\$175M to cybercrime.

Proprietary Digital Health Products Deployed in Kenya

Product	Category
Alteryx	Data analytics
FrontlineSMS	SMS messaging
Magpi	Data collection
Mapbox	Custom maps
Mezzanine	Multiple
Tableau	Data visualization
Talend	Data integration
Teradata	Business analytics

Note: List may not be exhaustive.

Opportunities and Challenges to Kenya's Digital Health Ecosystem

Opportunities

- Kenya's Primary Healthcare Strategic Framework describes the UHC implementation pathway
- *Huduma Namba*, the government's National Integrated Identity Management System, presents an opportunity to develop a unique patient identifier (key issues around security and privacy must be addressed).
- Kenya has a well-developed private sector; it would benefit from increased data sharing of public- and private-sector data, and overall strengthening of interoperability.
- Steadily growing momentum for digital health in the East Africa region and increased interest in cross-border initiatives for data sharing.
- Strong collaboration between the Ministry of ICT and MOH supporting HIS and eHealth Technical Working Group made up of key digital health stakeholders.

Challenges

- Latest World Bank annual report ranks Kenya 56 of 190 economies in the ease of doing business.
- Weak regulatory environment; privacy/confidentiality concerns.
- Limited funding; high cost of eHealth systems/innovations.
- Inadequate technical expertise; low ICT literacy among users.
- Market fragmentation; lack of interoperability between systems.
- Poor infrastructure; unreliable power supply.
- Lack of government involvement in eHealth projects.

Uttar Pradesh Case Study

Market Maturity Level 2



India and Uttar Pradesh Health Overview



India

1.37 billion population



70% living in rural areas



1.3% of GDP budgeted for health



65% of health care expenditure out of pocket (private)



19%/14% health care insurance coverage in urban/rural areas



1:10K doctor to person ratio (WHO recommends 1:1K)



NCDs (heart disease, cancer, diabetes), TB leading health threats

Uttar Pradesh

200 million population (16.2% of total)

155 million living in rural areas

State expected to increase primary health care budget by 10% every year and spend 2/3 on PHC (2019–2020 budget **\$781M**)

70% hospitalizations in private facilities

PM-JAY and MMJAA offers universal health coverage to poor and vulnerable populations

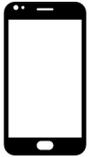
Maternal mortality **201K/100K** population; immunization coverage < 5 years old: **54%**

India and Uttar Pradesh Digital Health Overview

India



88% (1.2B) mobile penetration



25% (350M), 700M by 2023
smartphone penetration



12.3B app downloads
(#2 globally)



43% (560M), 800M by 2023
Internet subscriber penetration



88% (1.2B) of population enrolled in
unique digital ID program (“Aadhaar”,
#1 globally)

Uttar Pradesh

67% (158M) mobile penetration

> **50%** males, **42%** females use mobile
phones; **90%** ages 15–59 years

Uttar Pradesh Digital Health Context

- Increased investment in infrastructure, workforce capacity, data systems, etc. through National Health Mission, UP Health Systems Strengthening Project (WB), and state-specific programs.
- National HMIS is used in UP; Mother and Child Tracking System (transitioning to [RCH portal](#)) is also national system implemented in UP to collect pregnancy, immunization, and nutrition-related data.
- Weekly reporting from labs, facilities, HCWs into the national [Integrated Disease Surveillance Programme IS](#).
- [National digital health mission](#), expected to be launched by the national government, will mobilize resources at state level.
- Implemented Aadhar and uses it for delivery of financial incentives, social services (birth and death certificate, driving license, etc.), and health insurance (under [PM-JAY](#)).
- Expected to implement the national digital health blueprint and the national EHR standards.
- EMR adoption is very limited and only at the district level; health subcenters at the village level use paper-based systems to capture, report, and use health services data.
- EMR/EHR initiatives are largely government funded in the public hospitals.
- Clinical workforce capacity, technology, and physical infrastructure; state-level coordination and implementation support; adoption and use of standards; and state health information exchange architecture are some of the key drivers of DH but are missing in the state.

HIS Governance and Management Enabling Environment

Indicator	Status (Available/Links)	Notes
<p>National policies for eHealth, DH outline the vision, goals, and activities to support the health system</p>	<p>National Digital Health Blueprint (2019)</p>	<p>The <i>National Digital Health Blueprint</i> was finalized in 2019; implementation is yet to begin. It aims to create single EHR for each patient, which can be accessed and used anywhere in the country.</p>
<p>Data exchange standards</p>	<p>EHR Standards for India v2.0 (2016)</p>	<p>National-level standards (e.g., SNOMED CT, LOINC, DICOM, HL7, WHO-FIC) recommended and adoption is voluntary.</p>
<p>Architecture guides the synergistic links of all DH initiatives</p>	<p>National Digital Health Blueprint (2019)</p>	<p>A federated national health information architecture proposed in the <i>National Digital Health Blueprint</i>; state will have to initiate design and implementation at state level. This architecture will be aligned with the India Enterprise Architecture.</p>
<p>Leadership and coordination structure oversees implementation of policies and HIS/DH activities</p>	<p>Government of India's MOHFW is the nodal agency; State Department of Medical, Health and Family Welfare is the responsible entity in UP and receives ICT support from the National Informatics Centre's State Unit (and district counterparts)</p>	<p>Coordination and management led by the State Program Management Unit, which manages all health programs.</p>

HIS Subsystems

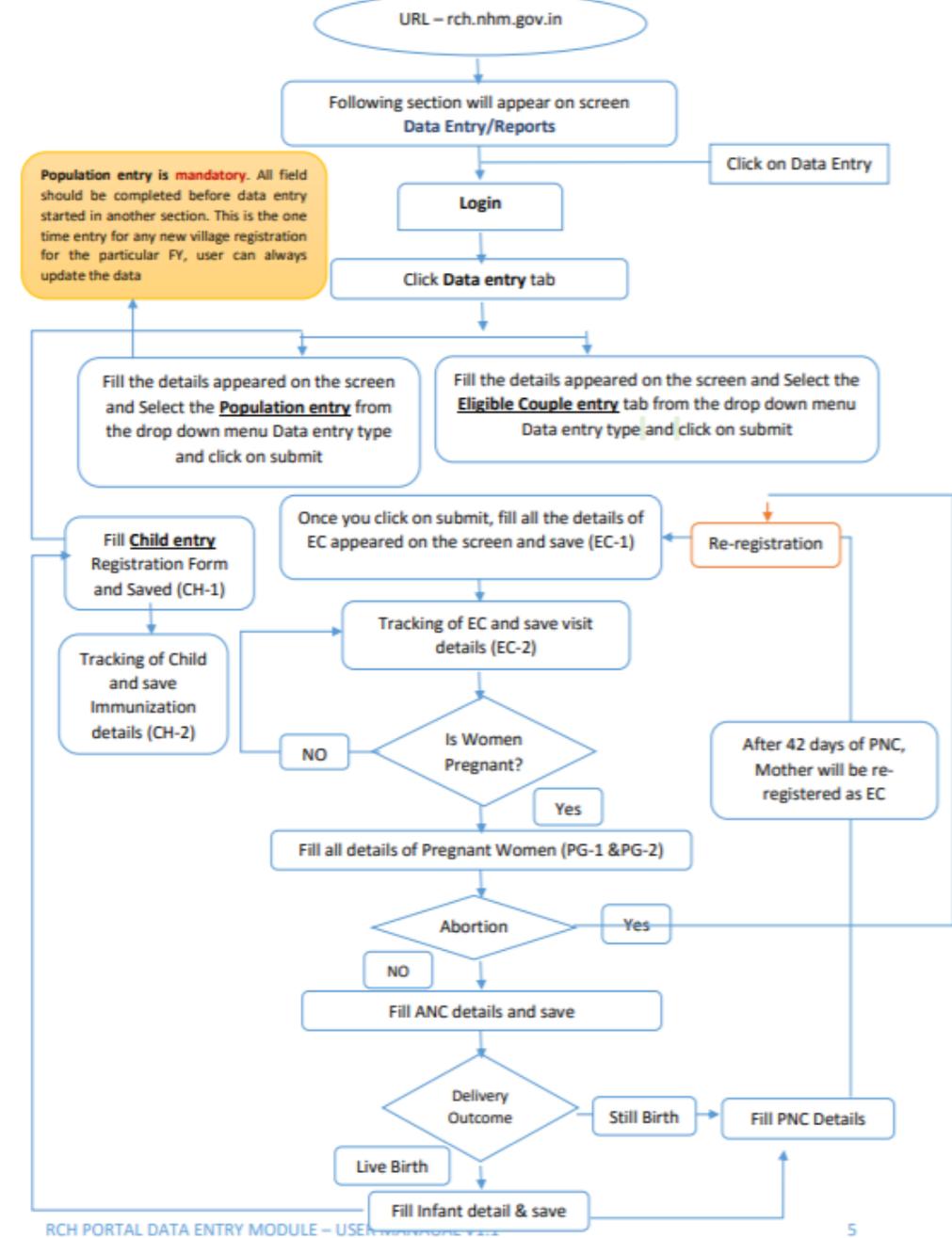
Category	Software Platform(s)	Notes
Laboratory IS	e-Hospital	<ul style="list-style-type: none"> Electronic hospital system was developed by the National Informatics Centre. It has lab, billing, and EHR modules. Lab module is yet to be implemented in UP.
Health workforce information system	Manav Sampada	<ul style="list-style-type: none"> An electronic human resource management system for government employees. UP has initiated its adoption and is in early stages.
Clinical information system	e-Hospital MCTS	<ul style="list-style-type: none"> About 48 state- and district-level hospitals have implemented e-Hospital system, especially the outpatient module. MCTS is a web-based, name-based tracking system that enables health workers to ensure timely delivery of full complement of maternal and child health care services to pregnant women (mothers) and children up to 5 years of age.
Home-based records	mSakhi and mSehat Management information system Health and wellness centers	<ul style="list-style-type: none"> mSakhi and mSehat applications used to support community health workers. To capture and report data in mobile-based systems to facilitate payments to Accredited Social Health Activists. Ensure delivery of comprehensive primary health care services; existing subcenters covering a population of 3,000–5,000 would be converted to health and wellness centers, where “time to care” will be no more than 30 minutes. Data systems are still paper based at the clinical care levels.
Other HIS implementations	PM-JAY and MMJAA Family Planning-LMIS Sampoorna clinics	<ul style="list-style-type: none"> About 12.66M families eligible for health insurance; 8.6M e-card generated to deliver hospitalization benefits. Family planning LMIS implemented in UP. Sampoorna clinics provide NCD screening services to women at district level.

Health IS Data Flow

Reproductive and child health example:

- RCH portal is a national portal collecting data from facilities in the states.
- Electronic data entry happens at the PHCs and higher-level facilities (starting at block level).
- Data from health subcenters are collected in paper and reported to PHCs for entry into the web portal.

Data Entry Process Flow Chart:



Digital Health Private Market in India

- India DH market is anticipating a 27% CAGR in the 2019–2024 period.
- Digital health care market in India was valued at INR 116.6B in 2018.
- EHR/EMR segment accounted for 18.7% revenue.
- mHealth segment is estimated to dominate the market, with 40.6% of revenue share in 2024, followed by telehealth.
- Government initiatives (e.g. Aadhaar, National Health Portal, e-Hospital, and Integrated Health Information Program) create a favorable market ecosystem.
- [US-India Strategic Partnership Forum](#) committed to invest in UP.

Private Company Involvement in Digital Health

Company	Category
HCL Foundation	Primary health care
Hospaccx Healthcare Business Consultancy	Inventory management IS private UP hospitals
Poorest Areas Civil Society, in collaboration with Google India and Tata Trusts	Internet Saathi program in UP.
Tata consultancy services	Collaborating with Tata Trusts in DH.

Note: List may not be exhaustive.

Opportunities and Challenges to UP's Digital Health Ecosystem

Opportunities

- Strong institutional mechanism to engage and coordinate with private sector.
- Increased political commitment (national and state) and investment for primary health care.
 - 10% annual increase in state health mission budget for primary health care.
 - UHC driving adoption of digital health technologies.
- National DH mission offering enormous potential to invest in DH technologies (especially at the patient level).
- Strong impetus to adopt and use standard-based health information exchange.
- Growth in demand for DH workforce.

Challenges

- Multiple departments/units within the MOHFW for managing medical education, training, service delivery, national programs, donor funding programs.
- IT initiatives by national and state health agencies, besides national IT agencies and their state counterparts.
- Market fragmentation in terms of multiple agencies from government and private sector.
- Limited ICT infrastructure at the facility/community level.
- Fragmented HIS/DH systems.
- EHR standard adoption is not mandatory.
- Erratic power supply.

Mozambique Case Study

Market Maturity Level 1



Mozambique Overview



29.5 million population



64% of population living in **rural areas**



48% mobile/cellular phone subscriptions

60% of men, 45% of women



9% of women and

22% of men use mobile Internet



50% of the population has **access to acceptable level of health care**



10.8% HIV prevalence

56% of people living with HIV on treatment



Highest **burden of malaria** is Southern Africa

Health and HIS Ecosystem

- Peace agreement was signed in 1992, ending **15 years of civil war**.
- External aid amounts to **73% of the total health budget**.
- Mozambique's *Health Sector Strategic Plan (2014–2019)* outlined a vision for **universal health coverage**.
- **Use of private health facilities and providers is low**, representing 12% of all health facilities.
- **DHIS2** is at national scale used by all districts; some facilities using DHIS2 on devices/tablets.
- **Outdated HIS policy** and no specific digital health policy or strategy; Health Sector Strategic Plan is in draft.
- MISAU (MOH) is currently working on a national architecture.

HIS Governance and Management Enabling Environment

Indicator	Status (Available/links)	Notes
<p>National policies for eHealth, DH outline the vision, goals, and activities to support the health system</p>	<p>National Health Strategy (2014–2019) HIS Strategic Policy (2009–2014)</p>	<p>Currently out of date; updated health sector strategic plan and HIS strategic policy are under development; projected release is end of 2020.</p>
<p>Data exchange standards organizational policies, procedures, and best practices related to HIS</p>	<p>From 2014–2018, the eSaúde community produced a collection of code, best practices, and interoperability tools</p>	<p>This community is not directly in coordination with MISAU, but support implementation of OpenMRS from 2014–2018.</p>
<p>Architecture guides the synergistic links of all DH initiatives</p>	<p>eSaúde EMR and Pharmacy Logical Architecture</p>	<p>Created by eSaúde OpenMRS community (no longer active).</p>
<p>Leadership and coordination structure oversees implementation of policies and HIS/DH activities</p>	<p>MISAU Department of Health Information</p>	<p>Responsible for development and maintenance of the HIS; HMIS Unit under new director with increased push for integration of data systems.</p>
<p>National HMIS</p>	<p>DHIS2, integrated disease surveillance and response system</p>	<p>Deployed nationally down to district level.</p>

HIS Subsystems

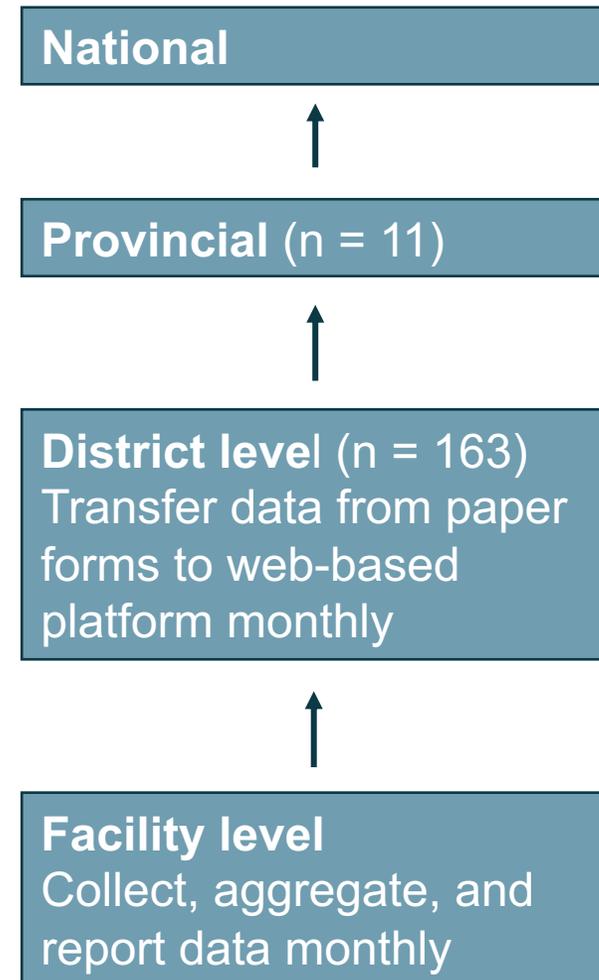
Category	Software Platform(s)	Notes
Laboratory information systems	LIS	Limited implementation of LIS as of 2017; challenge in linking rural health centers. There are a number of LIS in use. MISAU is pushing to roll all lab systems into OpenLDR .
Health workforce information system	eSIP-Saúde (electronic personnel information system for health)	Deployed nationally in 2011 to be part of the existing MISAU HMIS and to address the need for centralized HRIS.
Clinical information system	OpenMRS	EMR implemented in clinics and facilities that are providing HIV services.
Home-based records	CommCare	Community-based information system for ICCM under the upSCALE project. Data are stored in a DHIS2 module.
Other HIS implementations	Master facility list	A new version of this has recently been rolled out.
	OpenLMIS	LMIS in 2 distinct implementations (vaccine management and mobile stock management).

Digital Health Applications

Instance	Description	Geographic Scope	Standards Used
SIFIn	Academic registrar, GIS, HRIS, telemedicine	National public health training institute, some private	GML, SDMX, SVS
PENSA	Multichannel and bidirectional mHealth platform	National	JSON, links to DHIS2
PharmaDexMZ	Medicines registration workflows to issue marketing authorizations for pharmaceutical products	National	N/A
upSCALE/inSCALE Mz	Interactive platform for CHWs; collates CHW monthly reports	2 provinces	JSON
mAlert	Platform to produce epidemiological bulletins; can also be used for case-based surveillance	Subnational	JSON
DHIS2 for COVID surveillance	Includes standard metadata aligned with WHO's technical guidance on COVID-19 surveillance and has been adapted to local country context and language	National	N/A

Health IS Data Flow

- Paper forms are entered into DHIS2 at the district level.
- Paper forms are mainly used for routine reporting at facility and community levels, with some exceptions of high-volume facilities reporting directly into DHIS2.
- Community-level data are entered into DHIS2 using integrated community reporting tools.
- Data flow directly to server at national level, then can be accessed at other levels.
- OpenMRS facility data flow into provinces, but do not go to MISAU.



Digital Health Private Market in Mozambique

- Call from MISAU for a public-private framework in the Health Sector Strategic Plan (Plano Estratégico do Sector da Saúde).
- Use of private services is greater in high-income groups but is still very low compared to neighboring countries.
- Oversight of the private provision of services is limited; current regulation is from 1992.

Proprietary Digital Health Products Deployed in Mozambique

Product	Category
FrontlineSMS	SMS messaging
Magpi	Data collection
Mapbox	Custom maps
Mezzanine	<i>Multiple</i>

Note: List may not be exhaustive.

Opportunities and Challenges to Mozambique's Digital Health Ecosystem

Opportunities

- Strong commitment recently from MISAU to increase coordination and integration of data systems.
- eSIP-Saúde: HRIS allows HR data to be used for decision-making around health system staff.
- MISAU, donors, and private-sector representatives have expressed interest in engaging on public-private partnerships, especially around data sharing.
- Mozambique is committed to a vision of UHC but is challenged by lack of health system and health facility infrastructure.
- 3 mobile players in the country have increased network connectivity.

Challenges

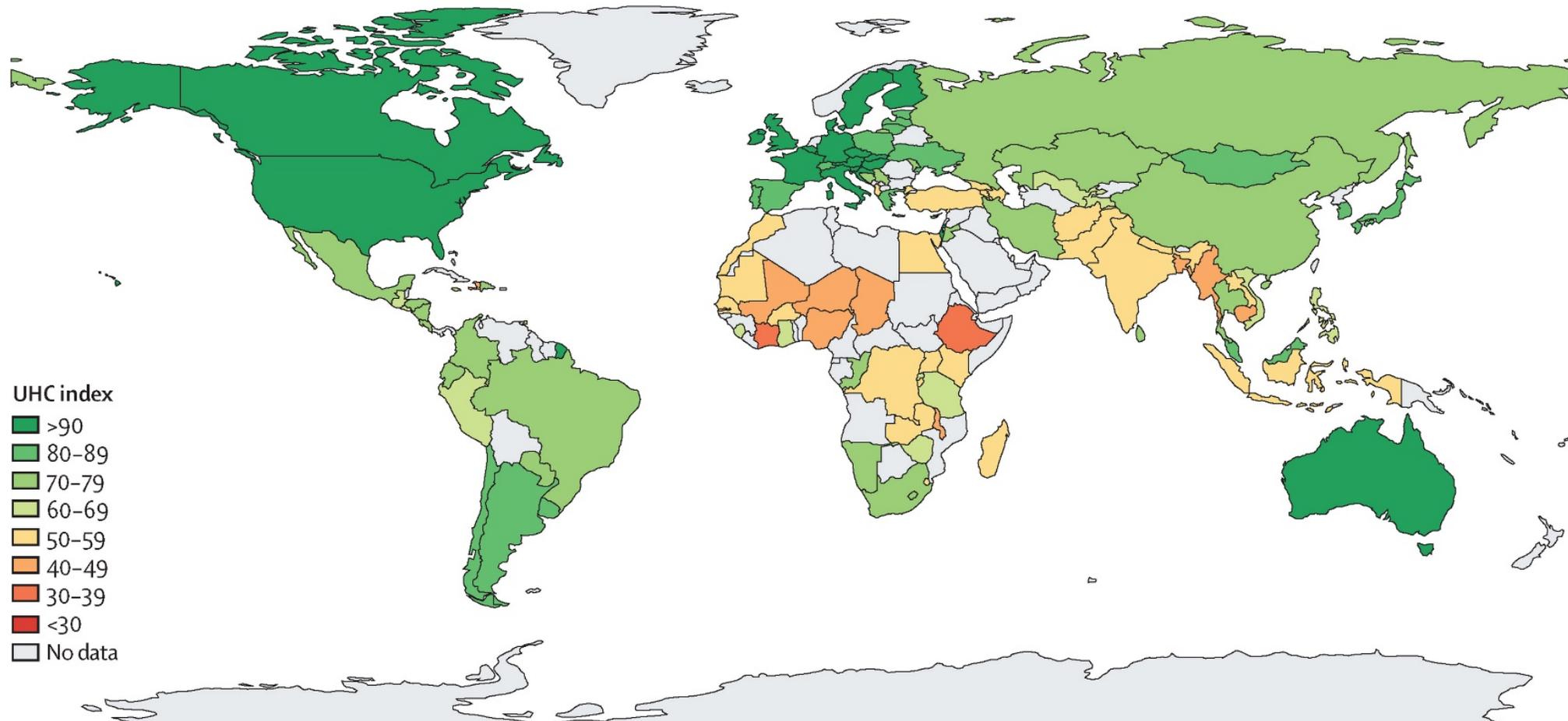
- Lack of up-to-date national governance for digital or eHealth in country.
- Lack of governance for health data has contributed to vertical data systems.
- Lack of coordination, policy, architecture documents, and several implementing partners supporting specific projects but without clear guiding policies.
- High burden of disease,
- Ranked [10th from bottom on the WHO 2010 list of countries with the greatest health workforce deficits.](#)
- Frontline health workers are also responsible for data entry.
- 50% of rural population has poor access to health facilities and services.

Link between Universal Health Coverage and Digital Health



Universal Health Coverage may serve as a key driver for investing in primary health care

Universal Healthcare Coverage Index by Country



Source: [A comprehensive assessment of universal health coverage in 111 countries: a retrospective observational study](#)

Dimensions of UHC across select LMICs

	Who is covered?		What is covered?		How much is covered?	
	Population(s) targeted by health insurance	Population enrolled (% of total)	Scope of services	Births attended by skilled health staff (% of total)	Out-of-pocket expenditure as % of THE in 2010	Decrease in out-of-pocket expenditure as % of THE since reform
Intermediate-stage reform countries						
Ghana (NHIS)	All	54%	Comprehensive	57%	27%	4%
Indonesia (BPJS)	All	63%	Comprehensive	75%	38%	2%
Philippines (PhilHealth)	All	76%	Inpatient, with outpatient for poor people	62%	54%	-4%
Rwanda (Mutuelles, RAMA, MMI)	All	92%	Comprehensive	52%	22%	3%
Vietnam (VSS)	All	42%	Comprehensive	88%	58%	6%
Early-stage reform countries						
India (RSBY being subsumed by PMGY)	People below the poverty line	8%	Inpatient (outpatient pilot)	53%	61%	2%
Kenya (NHIF)	Formal sector, expanding to informal sector	20%	Inpatient (outpatient pilot)	44%	43%	2%
Mali (Mutuelles, RAMED, AMO)	All	3%	Comprehensive	49%	53%	-1%
Nigeria (NHIS)	Civil servants, expanding to informal sector	3%	Comprehensive	39%	59%	3%

Source: [Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia](#)

Universal Health Coverage may serve as a key driver for investing in primary health care

Kenya

- National *Health Policy Strategy Plan 2014–2030* identifies UHC as the priority for 2018–2022 and includes measures such as increased health insurance coverage, reduced out-of-pocket household expenditure, increased access to an essential health services package, and strengthened coordination among stakeholders.

India

- *National Health Policy 2017–2020* emphasizes the need to increase health expenditure and achieve universal access to high-quality health care services.
- Developing SDGs/UHC framework mechanisms; implementing the National Health Protection Scheme to improve health financing, service delivery, and capacity building.

Mozambique

- Half the population was unable to access the health facility network in 2014; high rates of maternal mortality and of deaths due to malaria, HIV, tuberculosis, and NCDs.
- Health Sector Strategic Plan 2014–2019 emphasizes a “reform and decentralization agenda” with focus on women, children, and elderly.

Summary of Case Studies



Digital Health Case Study Summary

Mozambique



India (UP)



Kenya



Digital Health Maturity

Level 1

- 72% mobile use; internet 9.2kb/s/user
- No UHC
- eHealth Strategy 2009-2014
- Nascent DH architecture
- ICD only standard referenced
- Poor coordination, governance
- DHIS2 for reporting; eSIP-Saúde HRIS for HCW coordination
- No unique patient identifier established to date.

Level 2

- 95% mobile use; internet 5.7kb/s/user
- 8% UHC; commit to invest
- National Digital Health Blueprint 2019
- Gov. DH architecture
- SNOWMED-CT, LOINC, ICD
- Private sector growing in collaboration with gov't
- Fragmented HIS/DH systems; EHR recommended
- India's unique identifier (Aadhaar) has 88% enrollment

Level 3

- 89% mobile use; internet 25.2kb/s/user
- 20% UHC
- eHealth Strategy 2016-2030
- OpenHIE interop plan
- SNOWMED-CT, LOINC, ICD-10, etc.
- Private sector well-established
- HIS at near-national scale; DH infrastructure <25% in place
- *huduma namba* opportunity for unique patient identifier

Saturation and Gap Analysis for Interventions

Classification of Digital and Data Interventions in LMIC markets



- WHO created a digital health intervention taxonomy, anchored on the unit of a “digital health intervention” representing a discrete functionality of the digital technology to achieve health sector objectives.
- A shared and standardized vocabulary was needed to align the diverse actors involved in digital health, including public health practitioners and technology-oriented audiences.
- These classifications enable parties to articulate functionality requirements, evaluate and improve upon interventions.

Source: [WHO Classification of Digital Health Interventions v1.0](#). Accessed June 10, 2020.

Number of Global Good Investment Systems Covering DHI Classification Areas



1.0
CLIENTS

1.1	Targeted Client Communication (1)	3
1.2	Untargeted Client Communication	1
1.3	Client to Client Communication	0
1.4	Personal Health Tracking	1
1.5	Citizen-based Reporting	4
1.6	On-demand information services to clients	3
1.7	Client financial transactions	2

Fewer global good investments in client communication, personal health tracking, civil registries and health financing



2.0
HEALTHCARE PROVIDERS

2.1	Client identification and registration	10
2.2	Client Health Records	12
2.3	Healthcare provider decision support	11
2.4	Telemedicine	4
2.5	Healthcare provider communication	7
2.6	Referral coordination	10
2.7	Health worker activity planning & scheduling	7
2.8	Healthcare provider training	4
2.9	Prescription and medication management	3
2.10	Laboratory and Imaging Management Diagnostics	5



3.0
HEALTH SYSTEM MANAGERS

3.1	Human Resource Management	4
3.2	Supply Chain Management	7
3.3	Public Health Event Notification	2
3.4	Civil Registration and Vital Statistics	1
3.5	Health Financing	1
3.6	Equipment and Asset Management	6
3.7	Facility Management	6

Higher global good investments in data collection/use; data exchanges; and clinical registration, support, and referral



4.0
DATA SERVICES

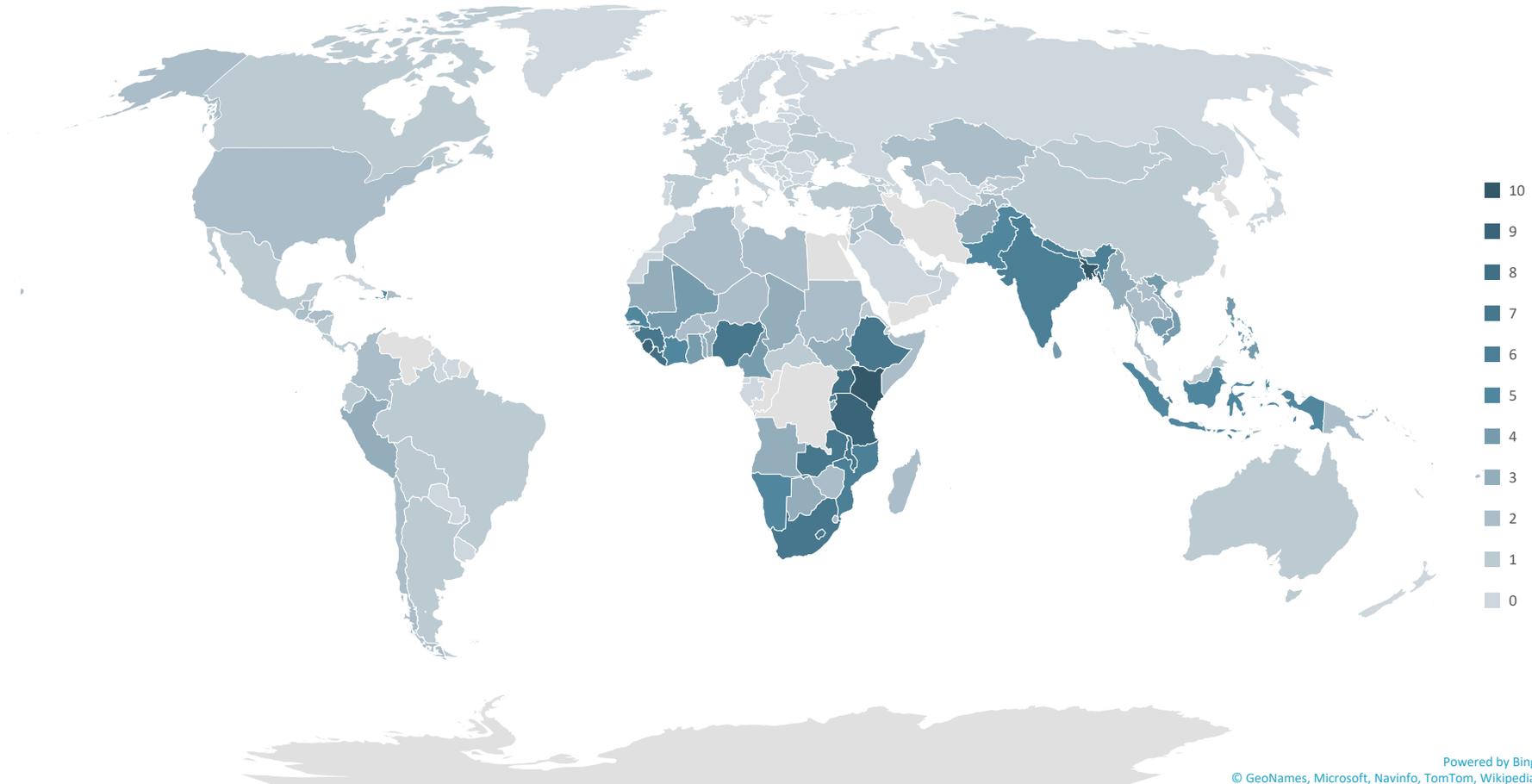
4.1	Data Collection, Management and Use (9)	16
4.2	Data Coding (1)	4
4.3	Location Mapping (6)	8
4.4	Data Exchange and Interoperability (4)	13

Legend

- **Shaded (#):** Global goods supported by Digital Square (approved by Digital Square Board)
- **White:** Not currently supported by Digital Square
- **Red:** two or fewer global goods
- **Yellow:** more than 10 global good products

Market Penetration Analysis of Global Goods Worldwide

Number of Global Goods Adopted by Country Globally

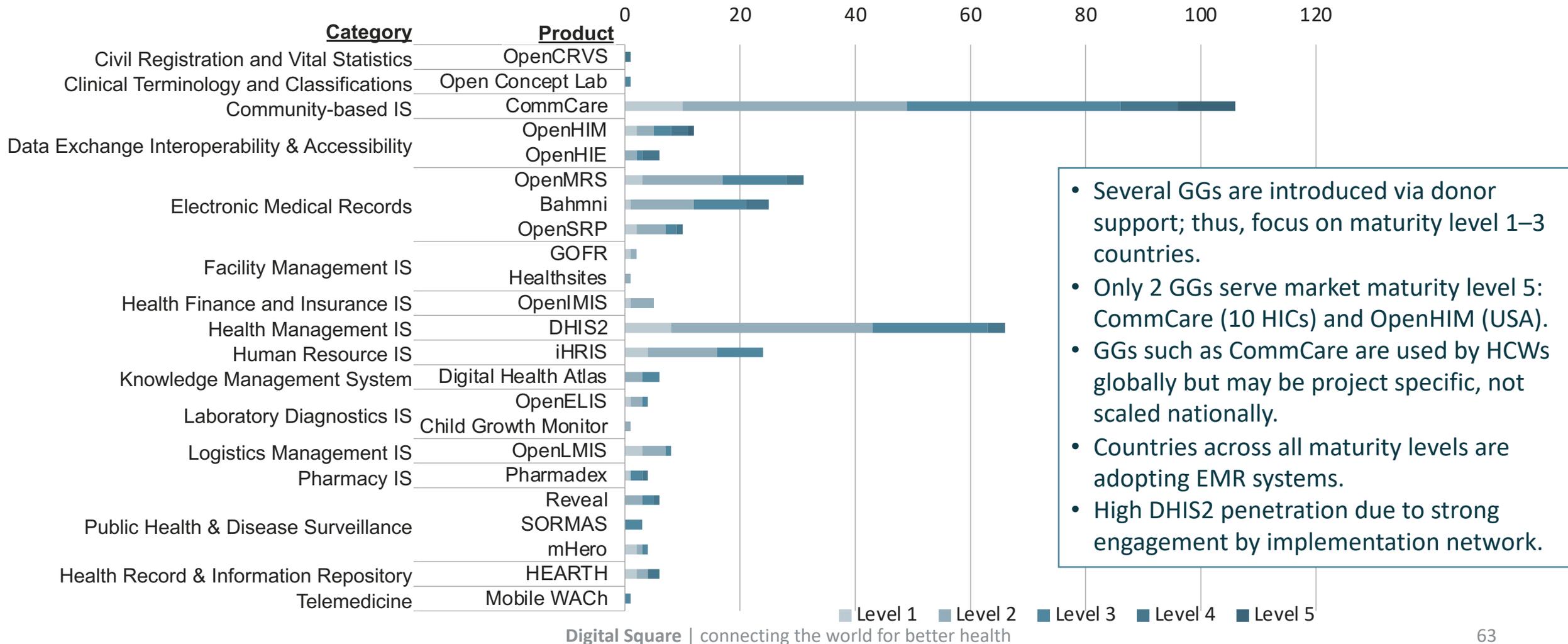


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Source: Digital Health Atlas and self-reporting from Digital Square global goods. A more thorough, complete analysis will be initiated following community input on the strategy and its metrics. Digital Square is working with the Digital Health Atlas to ensure that data are captured, including specific interoperability capabilities between systems that are deployed in a country.

Country Adoption of Global Goods by Market Maturity Level

Country Adoption of Global Goods by LMIC Market Segment



Saturation and Gap Analysis for Architecture Domains

Architectures and Standards Saturation Across 10 Countries of Interest—Details in Excel File

Leading Global Goods Adopted by Country of Interest

- Most countries have designed and implemented national health architectures and have a facility registry.
- OpenHIE is the recommended architecture for LMICs, although only Nigeria and DRC have implemented it; several countries are expressing interest.
- Countries have defined clinical care management standards for 1 or more disease areas.
- UP, Haiti, Nigeria are leveraging HL7 FHIR; Ghana, Kenya, Tanzania have expressed interest in FHIR adoption.
- Africa CDC is recommending FHIR as their standard.

Country	DRC	Ghana	Haiti	India*	Indonesia	Kenya	Mozambique	Nigeria	South Africa	Tanzania
National architecture	Yes	Yes		Plan		Yes	Yes	Yes	Plan	Yes
List of registries		Yes	Plan	Yes	Yes	Yes	Yes	Yes		Plan
OpenHIE	Yes	Plan	Plan	No		Plan		Yes		Plan
Care management standards		No	HIV	Yes	Covid	Yes		No	Yes	No
Semantic standards	Yes	Plan		Yes		Yes	Yes	No	Yes	Plan
<i>SNOMED</i>				X		X			X	X
<i>LOINC</i>	X			X		X			X	X
<i>ICD</i>				X		X	X		X	X
<i>DICOM</i>	X					X				X
<i>Other</i>	X			X		X				
Exchange standards	Yes	Plan	EMR only	Yes		Yes	Plan	EMR only	Yes	Plan
<i>HL7v2/3</i>				X					X	
<i>HL7 FHIR</i>	X	X	X	X		X	X	X	X	Plan
<i>IHE</i>	X								X	

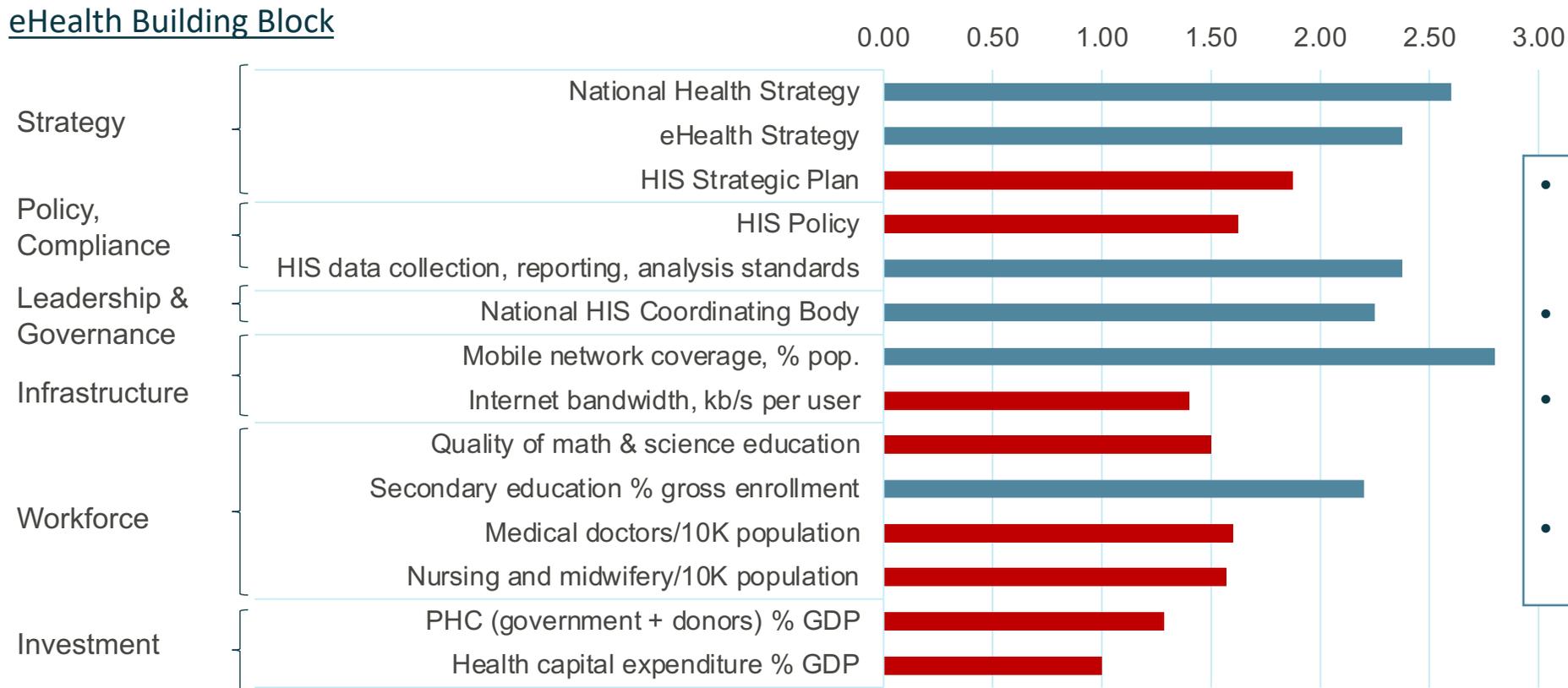
*Summary of Uttar Pradesh, Gujarat, Karnataka

Rating Key:

Does not exist
Under development
Established

Strategy and policy compliance score well while gaps remain in workforce, infrastructure and financing

HIS Indicators and Level of Development by Digital Health Building Block Across 38 MEASURE Countries

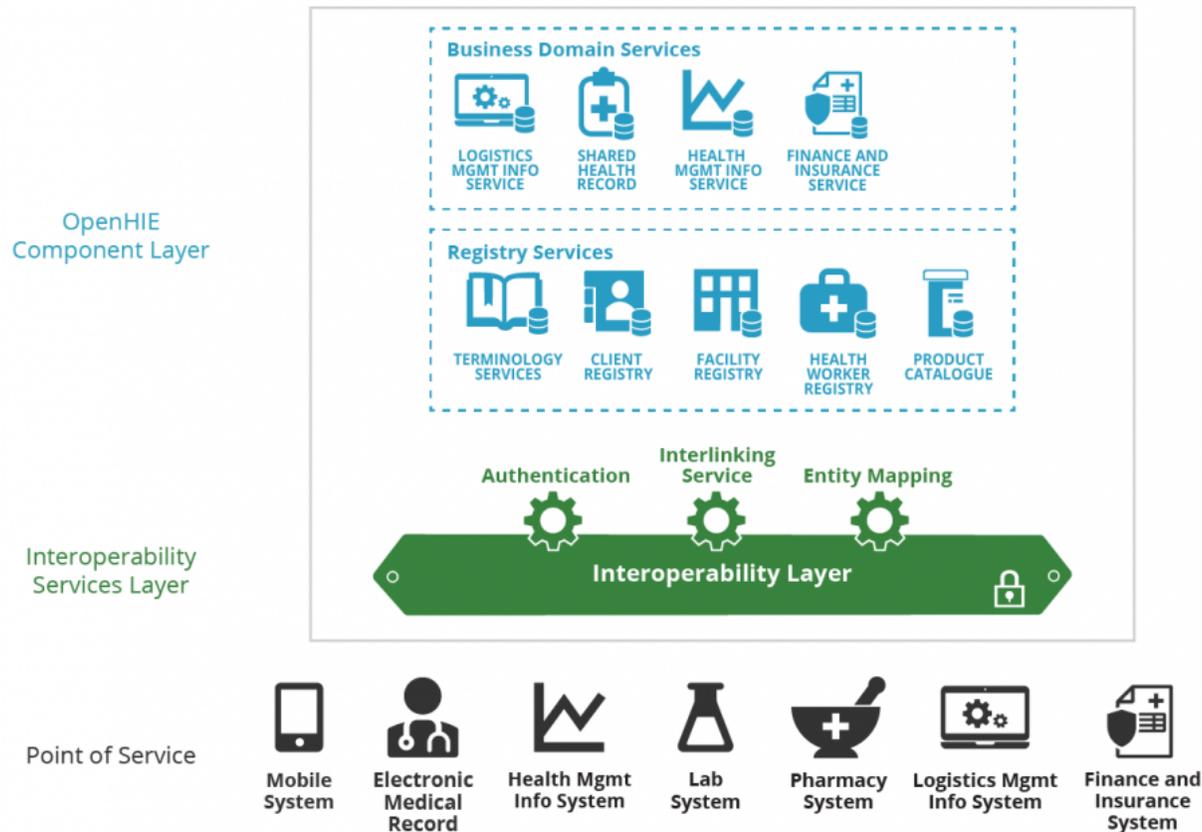


- Several countries have strategies and policies in place due to WHO and donor push
- Mobile infrastructure is strong, internet bandwidth poor
- Level of skilled workforce and investment is low across all countries
- Primary care has not received the focus or investment it deserves

*Score is based on country aggregated 3-point rating system of plans and development indicators with 1=none, dated, poor; 2=expired, moderate; 3=current, sufficient.

Red = gap in country digital health readiness

Common Digital Architecture in LMICs: Open Health Information Exchange (OpenHIE)



- Originally based on Canada Health Infoway architecture.
- Transitioning from HL7 v2/v3 to FHIR centric.
- Workflows between components prioritized by community and largely based on IHE profiles.
- Lead to development of multiple IHE FHIR profiles (mCSD, PRIM, mACM, SVCM).
- Encourages "swappable" components.

OpenHIE 2020-05-28; CC BY 4.0

Challenges and Gaps with OpenHIE Architecture (1 of 2)

Category	Current Challenges	Potential Solutions/Requirements
Identity and account management	No workflows and standards for identity management, user authorization, and authentication.	Leverage client and health worker registries.
Health workforce	No ability to automate user management and access control to digital health tools.	Ideally, automate user management and access control based on employment status, license/qualification, cadres, and/or competencies.
Client access & personal health records	OpenHIE has mainly served the HCW, back-office systems, and metadata registries with no support for client-centric workflows.	Adoption of SMART on FHIR.
Labs	Draft workflows being developed for FHIR interactions between EMRs and Lab IS.	Connected diagnostics have not yet been addressed.
Medical imaging	No representation of a DICOM server in the architecture.	Bring in open source tools, such as Orthanc, into the Instant OpenHIE Stack
Clinical care management	To date, no focus has been given to specific clinical workflows within health programs.	To be partially addressed through the WHO digital accelerator kits and computable/intelligent guidelines.

Challenges and Gaps with OpenHIE Architecture (2 of 2)

Category	Current Challenges	Potential Solutions/Requirements
Supply chain	Supply chain and health domain connections are limited to stockout reporting.	Nascent efforts to get product master data into health sector using FHIR—current IHE Pharmacy work item; may require substantive changes to FHIR resources (e.g., devices, medications, nutrition, immunization).
Payment systems	No payment or account management workflows have been identified to support institutional, health worker, or client-based payments.	Some promising tooling (Mifos, Mojaloop) exist that could be incorporated to support various use cases.
Mobile data synchronization	No tools or workflows established for merging updated records from mobile device back into SHR.	Looking at FHIR bulk API to push data down from central SHR or EMR to often disconnected devices; potential limitations have been identified.
Edge computing	No support to date to run logic (e.g., indicator calculations, decision-support services) at the edge of network or against the SHR.	Android FHIR + CQL SDK is being developed. Workflows for decision-support services are not fully defined.
Semantic standards	No appropriate open standards in some cases (e.g., health financing, classification of health services); licensing complicates the use of semantic standards. This is improving with ICD-11.	Value sets need to be identified for workflows and use cases.