Ministry of Health and Sanitation

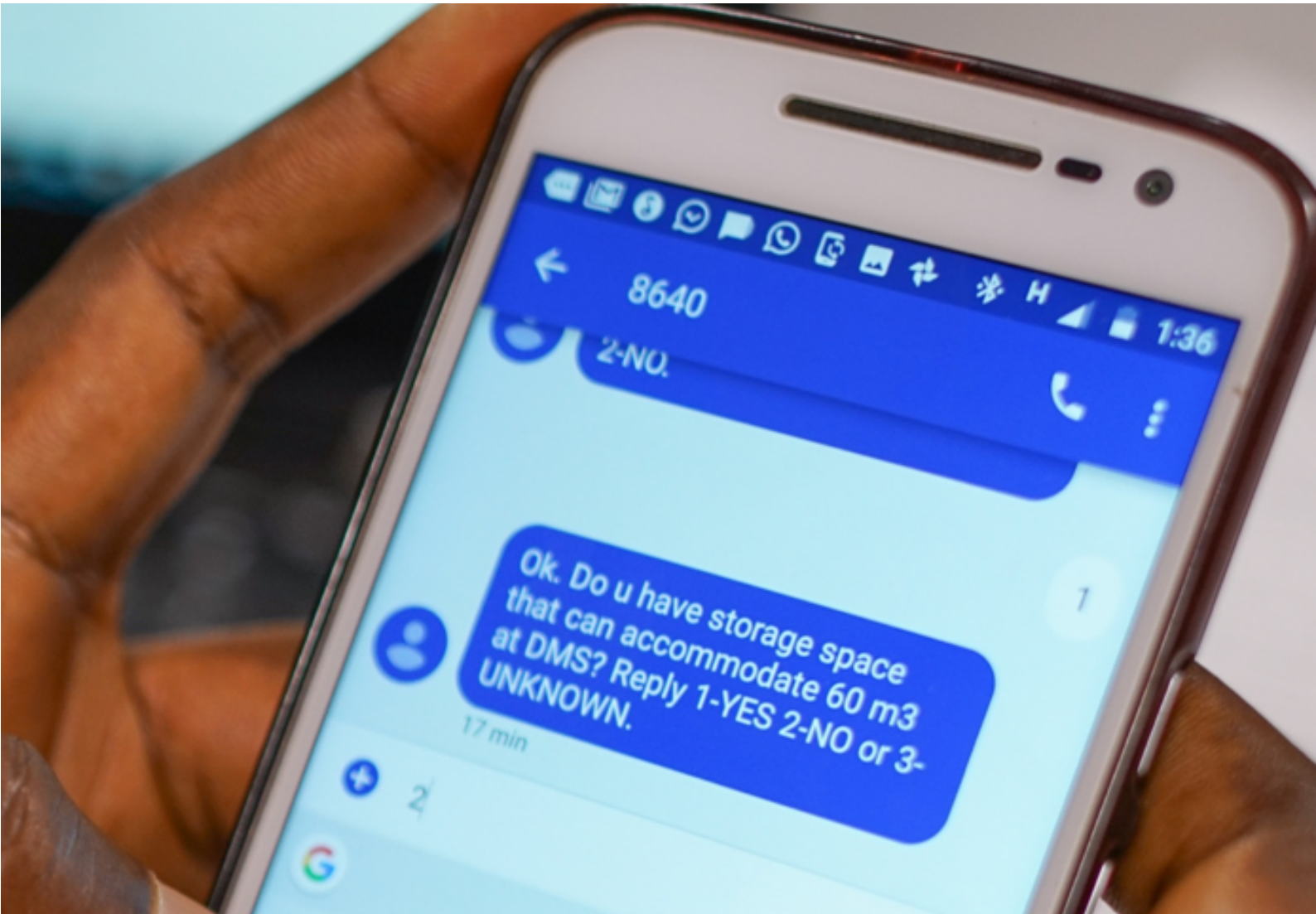
in collaboration with

Ministry of Information and Communication

The Republic of Sierra Leone

National Digital Health Strategy

2018 - 2023



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Foreword

The health system and related operations have made progress, albeit slow. We are now at the point where progress has to be fast-tracked to deliver on the health for all agenda of the government of Sierra Leone. The need for a new approach to increase our pace is no longer in contention.

When we implement this strategy, I look forward to a Sierra Leone health sector, where data-driven decision making is the new normal. I expect an efficient utilization of the limited human and material resources for essential care delivery. I look to an information communication technology driven logistics information up-to the last-mile at health facilities and community levels.

We will prioritize investments that help us save costs and drive up efficiency. Increasing utilization of information communication technology for client and health worker engagement will be on the spotlight. We are committed to drive through implementation of this strategy.

I am grateful to the numerous partners that supported the development of this strategic plan. We have not reached the destination, this is the first step, we look to you all to sustain this collaboration in the next few years as we join hands through its implementation. The vision of an integrated Sierra Leone health system with shared value for all stakeholders is certainly possible.

Thank you

Dr. Amara Jambai
Chief Medical Officer
Ministry of Health and Sanitation

Acknowledgment

Sierra Leone's health sector is at the verge of history by this collective resolve to leapfrog growth using Information Communication Technology (ICT) through this digital health strategy. We are grateful to stakeholders in the health and ICT sectors within and outside Sierra Leone for working with us to articulate a shared vision for Sierra Leone's digital health, detail the pathway to success and map-out measurement indices.

Specifically, we are most grateful to the American people through USAID for providing the funding support. Special thanks go to UNICEF for driving the collaborative development process to the logical conclusion. Appreciation go to organizations represented within the core strategy development task group: WHO, eHealth Africa, Focus1000, and PIH.

Our appreciation also goes to the members of the global digital health community for their time commitments in reviewing this plan. Finally, we acknowledge many other not for profit and private sector implementing organizations too numerous to list who participated in virtual or in person reviews of this document.

We are committed to a Sierra Leone were everyone have universal access to healthcare enabled by apposite application of Information Communication Technology. The partnership that birthed this digital health strategy will be sustained through its implementation.

Bakarr Tarawally
Director Communications
Ministry of Information and Communications

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Acronyms and Abbreviations

AeHIN	Asia Health Information Network
AMS	Attendance Monitoring System
CDMA	Code Division Multiple Access
CHC	Community Health Centre
CHP	Community Health Post
CHW	Community Health Workers
CHEW	Community Health Extension Workers
CMO	Chief Medical Officer
COBIT	Control Objectives for Information and Related Technology
CRV	Civic Registration and Vital statistics
DHIS2	District Health Information System version 2
DHMT	District Health Management Team
DIO	District Information Officer
DMS	District Medical Store
DMO	District Medical Officer
DPPI	Department of Policy, Planning and Information
EHR	Electronic Health Records
EMR	Electronic Medical Records
EVD	Ebola Virus Disease
FHCI	Free Health Care Initiative
GSM	Global System for Mobile communication
HF	Health Facility
HPI	Health Provider Index
HR	Human Resources
HRH	Human Resources for Health
HW	Health Worker
ICT	Information Communication Technology
IDSR	Integrated Disease Surveillance and Response
iHRIS	Integrated Human Resource Information System
IP	Implementing Partners
IoT	Internet of Things
ITU	International Telecommunications Union
LMIS	Logistics Management Information System
M&E	Monitoring and Evaluation
MAPS	mHealth Assessment and Planning for Scale
MCH	Maternal and Child Health
MCHP	Maternal and Child Health Post
MDA	Ministries Departments and Agencies
MFI	Master Facility Index
MIC	Ministry of Information and Communication
MNCAH	Maternal, Neonatal, Child and Adolescent Health
MoHS	Ministry of Health and Sanitation

MOU	Memorandum of Understanding
MPI	Master Patient Index
NDHS	National Demographic and Health Survey
NGO	Non-Governmental Organization
NHSSP	National Health Sector Strategic Plan
OOP	Out of Pocket Payment
OpenEHR	Open Electronic Health Records
OpenHIE	Open Health Information Exchange
PHU	Peripheral Health Units
PPH	Post-Partum Haemorrhage
SIM	Subscriber Identity Module
SLeSHI	Sierra Leone Social Health Insurance Scheme
SMS	Short Message Service
SOP	Standard Operating Procedures
STI	Directorate of Science, Technology and Innovation
TOGAF	The Open Group Architecture Framework
UHC	Universal Health Coverage
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WHA	World Health Assembly
WHO	World Health Organization
3G	Third Generation of wireless mobile telecommunication technology

List of Definitions

- **Action lines** are a broad grouping of national activities of similar focus and intent that are required to deliver the national digital health vision[1].
- **CHW hub** hosted at the ministry of health is responsible for coordinating community health workers in Sierra Leone.
- **Decision-support systems** are computing systems or software applications that assist healthcare providers in clinical and non-clinical decision making.
- District Health Information System **(DHIS2)** is an open source software for management of health information. It is best suited for managing aggregate information and cannot be used as electronic medical records system. It is currently being used in over 60 countries around the world.
- **Digital Registries** are Services and Application architecture components necessary for unique identification and validation of clients, providers, health facilities and devices. Uniquely identifying them facilitates seamless exchange of health information.
- **Digital health** and **eHealth** (electronic health) are used inter-changeably in this strategy, they are both broad terms used to refer to the use of Information Communication Technology (ICT) and related technologies to support health and healthcare undertakings such as service delivery, disease surveillance, knowledge acquisition, Human Resource (HR) management, and research.
- **Electronic health records (EHRs)** are real-time, patient-centred records that provide immediate and secure information to authorised users[2].
- **Electronic Medical Records (EMR)** is an electronic version of a patient's paper clinical information. The office of National Coordinator (ONC)[3] for health IT distinguishes an EMR from an EHR in that an EMR is specialty specific.
- **e-Prescription** is an electronic prescription and management system.
- **Enterprise Architecture** is the comprehensive framework used to manage and align an organization's IT assets, people, operations, and projects with its operational characteristics.[4] This spans the people, Workflow, Information, Application, and Technology Architectures. Each of these Architecture components is a conceptual framework that is used to address the collective process and product for shared value.
- District Health Management Teams **(DHMT)** is the body at the district level responsible for day to day operation and management of health programs within the districts. The team is headed by a district medical officer (DMO).
- **Health programs** in the context the national digital health strategy is a general term used to describe health unit areas like: Child health, Domestic Violence, FP, HIV/Aids, Infectious disease, Malaria & vector borne disease, Maternal health, Newborn health, NCDs, Nutrition, Parasitic diseases, Primary care, SRH, TB, Mental health, Water, Sanitation and Hygiene

[1] WHO/ITU eHealth strategy development toolkit
[2] WHO Global observatory on eHealth
[3] https://www.healthit.gov/buzz-blog/electronic-health-and-medical-records/emr-vs-ehr-difference/
[4] Definition adapted from the Asia eHealth Information Network (AeHIN) terminology booklet

- The Health Management Information System (**HMIS**) is the national repository for health sector service delivery, disease surveillance and program data. This repository is managed using the DHIS2 software.
- Internet of things **(IoT)** is the ever-growing network of physical objects that features an Internet Protocol address for internet connectivity and communication between these objects and other internet enabled-devices and systems[4]. They are mostly wearables and small form factor devices.
- **Interoperability** is ability of two or more systems or components to exchange information and to use the information that has been exchanged[5]
- **mHealth** (mobile health) is a subset of digital health most commonly used in reference to mobile communication devices to support healthcare. Mobile can be basic-phones, feature-phones, smart-phones, or tablet devices. This definition now extends to wearables and small Internet-of-Things (IoT) devices.
- **Principles of Digital Development**[6] are nine guiding principles recommended and endorsed by 88 leading development organizations to help digital solutions implementers adhere to best practice. They are: Design with the user; Understand the existing Ecosystem; Design for scale; Build for Sustainability; Be Data Driven; Use Open Standards, Open Data, Open Source, and Open Innovation; Reuse and Improve; Address Privacy and Security; Be Collaborative.
- **Quick-wins (low hanging fruits)** are early results that can help demonstrate quick intervention impact.
- **Solutions (**also **services and application)** is the digital health intervention deployed to solve one or more health system challenge or to improve efficiency and effectiveness of the traditional health system workflow or service delivery.
- **Telemedicine** refers to any process that facilitates remote consultation and care using electronic medium[7].
- The Open Group Architecture Framework (**TOGAF**) is the framework for enterprise architecture that provides an approach for designing, planning, implementing, and governing an enterprise ICT architecture implementation. As of 2016, the Open Group reported that TOGAF is used by 60% of Fortune 500 companies with over 600 diverse organizations.
- **Use-case(s)** are often employed in information technology systems design and engineering. "They describe the desired response of a system when it receives external requests. The technique is used to develop the behavioural requirements for a system by describing numerous functional scenarios. Each use case characterizes the interaction between an actor (which may be a human user, another system, or a hardware device that initiates an action) and the system. Use cases typically represent the function as a sequence of simple steps. Each use case is a complete series of events, as seen from the actor's point of view"[8]. In the context of this digital health strategy is an example of health system program or challenge that is prioritized or selected to be addressed using ICT (Eg. MNCAH, Nutrition, HIV/Aids, Data-quality).

[5] IEEE 1990
[6] www.digitalprinciples.org
[7] Digital health terminology guide (https://aehin.hingx.org/Share/Details/3819)
[8] Digital guidelines (http://www.digitizationguidelines.gov/term.php?term=usecase)

Executive Summary

Country context

Sierra Leone has a young population who are likely be more educated than the older population according to the Demographic and Health Surveys. Despite improvements, national health outcomes remain discouraging, with Sierra Leone experiencing some of the highest maternal and infant death rates globally. Malaria, Postpartum Hemorrhage, Sepsis, Malnutrition are major contributors. Sierra Leone has prioritized addressing these challenges with the inauguration of the free maternal and child health initiative.

Application of digital technology in support of health care endeavors has been shown to save costs and improve health outcomes[9]. This was demonstrated during the 2014 management and response to the Ebola Virus Disease outbreak in the country. Contact tracing and targeted client information dissemination were prominent. Doubling the use of electronic medical records in Canada, for instance, resulted in $1.3 billion in cost savings in six years[10]. Healthcare spending in Sierra Leone is mainly by out-of-pocket (OOP) settlement, as only less than 3% of the population are currently insured[11]. The national aggregate health management information system (HMIS) is hosted on the DHIS2 software platform. The HMIS has not realized its complete potential, as several health programs are still not linked and some parallel data collection systems still exist. The tele-density of Sierra Leone stands at 97% with mobile coverage and internet penetration estimated at 70% and 5% respectively[12]. Only 13% of the population currently has access to electricity[13].

The Sierra Leone National eHealth coordination hub, an inter-ministerial body hosted at the Directorate of Planning, Policy and Information (DPPI), was launched in 2017 with the mandate to coordinate and regulate digital health deployments in the country. The hub commissioned the assessment of the digital health interventions in the country and the development of a national digital health strategy to support these coordination efforts. This national digital health strategy document was developed using the WHO/ITU eHealth strategy development toolkit as a guide. A digital health atlas based inventory, coupled with informal stakeholder work-sessions, and the global digital health index survey[14] determined that Sierra Leone's digital health enabling environment was in the "developing and building up" stage of the WHO/ITU digital health enabling environment matrix. Similarly, based on global digital health index, the country is below the world average in all seven digital health enabling environment building blocks: Leadership and Governance; Strategy and Investment; Policy, Legislation, privacy and Compliance; Architecture, Standards and Interoperability; Workforce; Services and Applications; Infrastructure.

Digital health vision for Sierra Leone

The national digital health vision was arrived at through a collaborative and iterative process led by the eHealth coordination hub.

[9] http://www.afro.who.int/news/maximising-digital-health-technology-improve-quality-and-patient-safety-africa
[10] https://www.cbc.ca/news/politics/e-health-records-saved-medical-system-1-3b-in-6-years-1.1384119
[11] National demographic and health survey 2013
[12] ITU. Sierra Leone Country Telecommunications Profile. 2017; Available at: https://www.itu.int/en/ITU-D/LDCs/Documents/2017/Country Profiles/Country Profile_Sierra Leone.pdf.
[13] https://www.usaid.gov/sites/default/files/documents/1860/SierraLeoneCountryFactSheet.2016.09_FINAL.pdf.
[14] Global digital health index - https://index.digitalhealthindex.org/map

"By 2023 an effective and efficient ICT-enabled system supports delivery of quality, accessible, affordable, equitable, and timely healthcare services and moves Sierra Leone closer to achieving universal health coverage."

The chart in Figure 2 (on next page) visually summarizes the implication of the vision for the following key stakeholder groups:

- Individuals (vulnerable groups)
- Healthcare providers
- Researchers
- Healthcare managers and administrators
- Donors
- Private ICT service providers and Implementing partners

It highlights what happens today and how achieving the vision can change the future. Recommendations for achieving the digital health vision were derived through a mapping of health sector goals in the national health sector strategic plan to specific digital health outcomes.

Implementation plan

Recommendations for achieving the digital health outcomes were detailed and grouped by the seven digital health enabling environment building blocks. Drawing from the recommendations, the integrated action plan was developed and here summarized to highlight the key themes as shown in Figure 1. Estimated 53 billion Leones will be required to drive attainment of this national digital health vision.

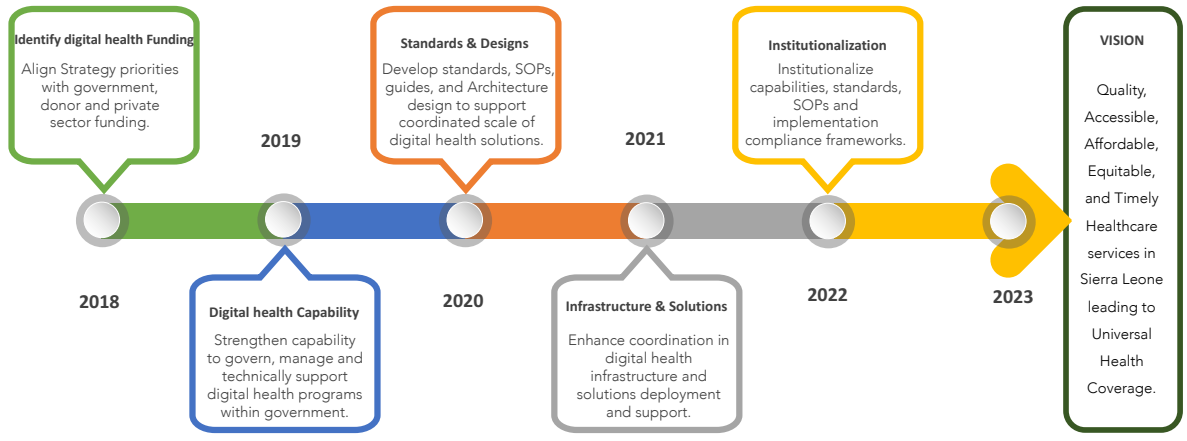


Figure 1 - Summarized implementation plan

Monitoring and Evaluation plan

The Monitoring and Evaluation (M&E) framework helps monitor the implementation plan and evaluate outcomes. The eHealth coordination hub will oversee the implementation and monitoring of the national digital health strategy. The M&E framework enables implementation monitoring for targets at year 2 and year 5.

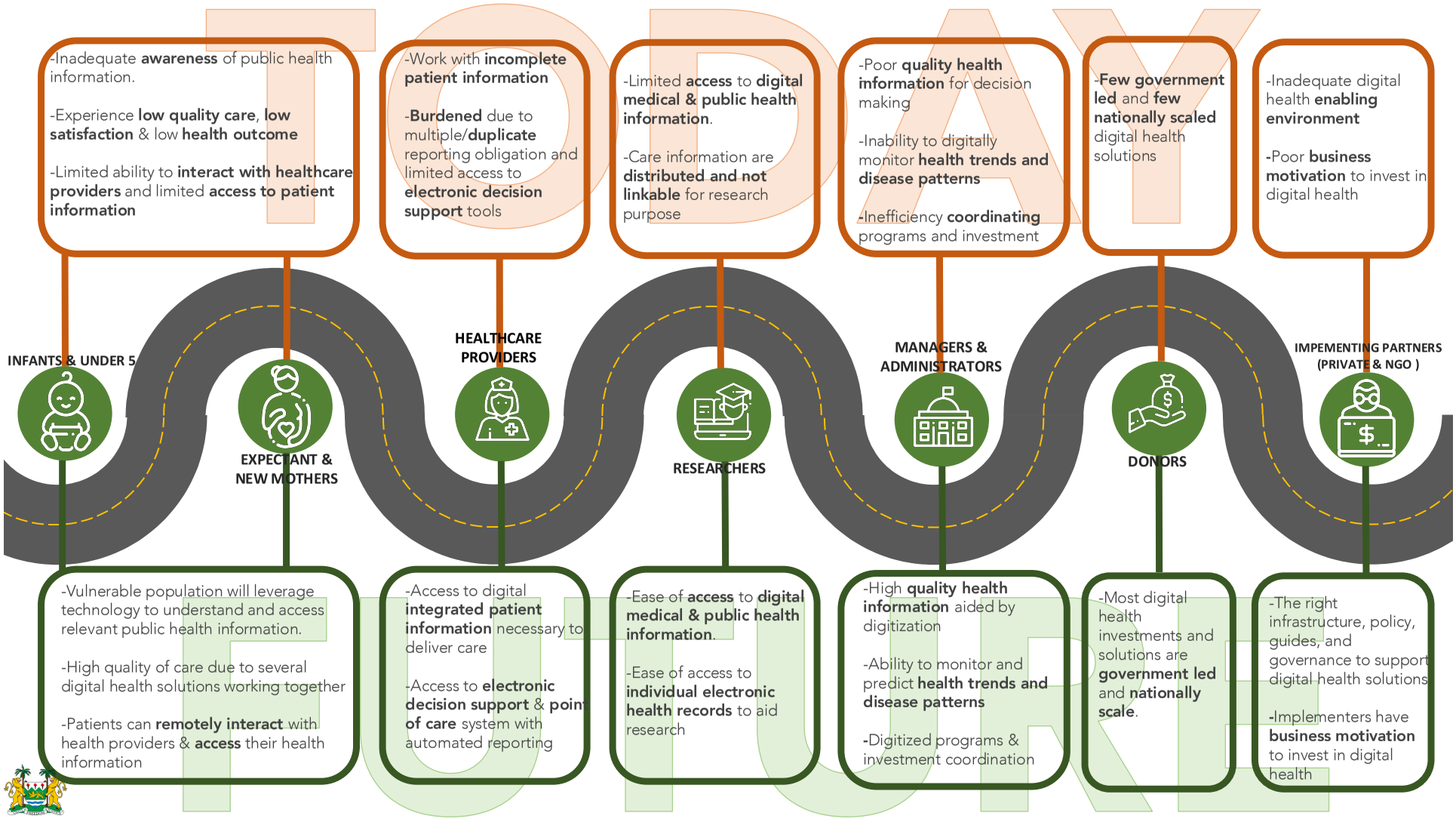


Figure 2 - Implication of vision for key stakeholder groups

Country Context

Health background

The population of Sierra Leone is over 7 million and they are evenly distributed across the four regions (Southern-20%, Western-21%, Eastern-23%, Nothern-35%)[15]. Life expectancy at birth is relatively low at 51.3 years[16]. Two thirds of the population live in rural areas, and an estimated 52% of the population live below the poverty line. Sierra Leone has a young population with those under the age of 20 years accounting for more than half of the population[17]. Younger people (both men and women) tend to be more literate, although a wide disparity in literacy levels exists between rural and urban dwellers. The disparity in literacy also exists between men and women, with literacy rates of 54% and 36%, respectively[18].

Sierra Leone's health statistics show poor health outcomes like many countries with similar socio-economic status. Malaria is still the leading cause of deaths in the country. According to the malaria indicator survey 2016, 27% of children under five years had fever in the 2 weeks before the survey. Four in ten children age 6-59months tested positive for malaria via microscopy[19]. Most maternal health indices have improved between 2008 and 2013 according to national Demographic and Health Surveys (DHS). These gains were reversed due to the country's recent Ebola epidemic, which impacted the health system and its limited health workforce. Stock-outs of essential health commodities have been recorded in some health facilities[20] in addition to inefficient delivery of health care and other interventions[21]. The 2013 DHS estimates maternal mortality ratio to be 1360 deaths per 100,000 live births with post-partum hemorrhage (PPH), eclampsia, hypertension, sepsis and post-abortion complications as leading causes. Antenatal service coverage and uptake is encouragingly high: 97.1% of pregnant women attended at least once. About 92% of antenatal services are provided by either nurses/midwives or Maternal and Child Health (MCH) aids. The percentage of newborns registered at birth has risen from 50.9% in 2008 to 80% in 2013[22] [23]. More than 10% of children born in the country still die before their 5th birthday[24]. Malaria, diarrhea and acute respiratory infections are the primary causes of infant and child mortality[25]. Immunization coverage is generally high, but hard-to-reach areas are still not covered, often due to inadequate workforce and infrastructure. Only 58% of children under the age of one are fully immunized. Malnutrition is still a major public health issue in Sierra Leone. Records show that high proportions of children under the age of 5 are stunted (38%), underweight (16%), and wasted (9%)[26].

[15] National Health Sector Strategic Plan (2017 - 2021), p11
[16] The World Bank. World DataBank. 2018. Available at: https://data.worldbank.org. Accessed June 3, 2018.
[17] GoSL, Sierra Leone Demographic and Health Survey 2013.; doi:10.4324/9780203403099
[18] GoSL, Sierra Leone Demographic and Health Survey 2013.; doi:10.4324/9780203403099
[19] https://dhsprogram.com/pubs/pdf/MIS25/MIS25.pdf pp. 45
[20] Sierra Leone Service Availability and Readiness Assessment (SARA) Report 2017
[21] Office of the President, Presidential Public State Opening Address on Thursday, 10th May, 2018. Sierra Leone; 2018. Available at: http://statehouse.gov.sl/wp-content/uploads/2018/05/Presidential-Public-State-Opening-Address.pdf
[22] GoSL, Sierra Leone Demographic and Health Survey 2013.; doi:10.4324/9780203403099
[23] GoSL Ministry of Health and Sanitation. Sierra Leone Demographic and Health Survey 2008
[24] WHO. WORLD HEALTH STATISTICS 2018: Monitoring Health for the SDGs. Geneva; 2018. Available at: http://apps.who.int/iris/bitstream/handle/10665/272596/9789241565585-eng.pdf?ua=1
[25] Ministry of Health and Sanitation. SIERRA LEONE NATIONAL RMNCAH STRATEGY 2017 TO 2021. 2017. Available at: https://portal.mohs.gov.sl/regulation/policies/
[26] GoSL, Sierra Leone Demographic and Health Survey 2013.; doi:10.4324/9780203403099

The health system in the country is mostly centralized at the Ministry of Health and Sanitation (MoHS), though functions are being devolved to the districts through the District Health Management Teams (DHMT). Most health services are delivered at one of about 1200 publicly managed health facilities distributed across the districts by population and distance. A network of peripheral health units (PHU) made up of a combination of Community Health Centers (CHCs), Community Health Posts (CHPs), and Maternal and Child Health Posts (MCHPs) constitute 98% of these health facilities, while district hospitals account for only 2%[27]. The 24 district hospitals provide secondary and referral care across the 14 districts and are often situated at district headquarters. A small number of clinics and hospitals are serviced by a combination of missions, NGOs and private providers. The government also recently revitalized the community health worker (CHW) program. The CHW hub estimates a total of 15,000 CHWs working across the country[28].

Coordination challenges between central MoHS, DHMTs, and district councils have hindered how health facility operations and services are managed. These challenges also manifest as some "implementing partners (IP) and donor-funded IPs occasionally embarking upon projects without the knowledge of the relevant DHMT in which the project is taking place." According to the 2017 human resources for health strategy, "approximately 42% of the workforce currently employed by the MoHS is active in Western Area and 10% in Bo district, the country's second largest city, while the remaining 47% are spread throughout the rest of the country"[29]. Figure 3 depicts the health facility structure, coverage and staff type.

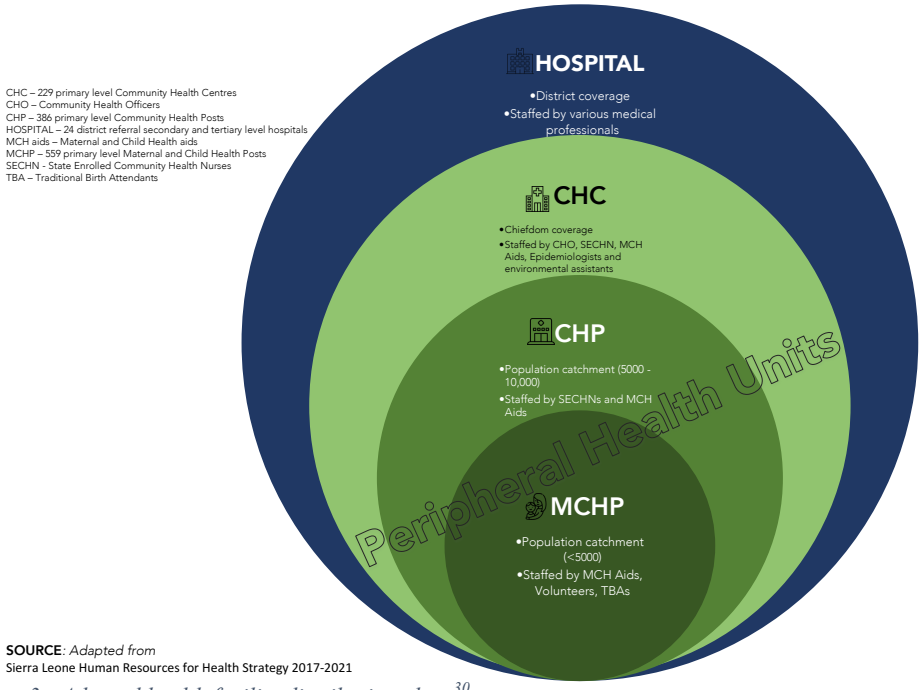


Figure 3 - Adapted health facility distribution chart[30]

The NHSSP (2017-2021) put the total health workforce wage bill at $20.5 million per annum. This bill for the over 10,000 salaried workforce accounts for 9% of total civil service cost.

[27] GoSL Ministry of Health and Sanitation Health Human Resources Directorate. Sierra Leone Human Resources for Health Strategy 2017-2021. Available at: https://portal.mohs.gov.sl/regulation/policies/.
[28] GoSL Ministry of Health and Sanitation Health Human Resources Directorate. Sierra Leone Human Resources for Health Strategy 2017-2021.Pp7
[29] GoSL Ministry of Health and Sanitation Health Human Resources Directorate. Sierra Leone Human Resources for Health Strategy 2017-2021.
[30] GoSL Ministry of Health and Sanitation Health Human Resources Directorate. Sierra Leone Human Resources for Health Strategy 2017-2021.

Health Financing

The national health accounts in 2013 estimated total health expenditure in Sierra Leone at $590m. Out of pocket (OOP) settlement for health service accounted for 61% of this expenditure. In 2013, the external resource available increased to 25%. The actual 2016 government expenditure on health stood at 6% of the national budget, far lower than the 15% proposed by the Abuja declaration[31]. In 2010, Free Health Care Initiative (FHCI) was introduced to reduce the OOP by new and expectant mothers and children under 5 years old. Data from a 2015 evaluation showed that $97m was spent on FHCI and 80% of that came from donor funding[32]. Performance-based health financing was introduced along with FHCI with mixed success. The 2013 DHS put male and female insurance coverage at 3% and 1%, respectively, highest in urban dwellings and among the more educated population. Sierra Leone Social Health Insurance Scheme (SLeHIS) was launched in 2017[33] and has recently become a law. When operationalized, the basic package covered by the scheme will be primary health care services. The health sector strategic plan 2017 proposes a distributed funding mechanism for the scheme – annual contribution from formal sector employees (6% of salaries), informal sector employees (LE 15,000); goods and services tax; a percentage of the MoHS budget; vehicle registration fees; and contributions from social safety net funds. There is currently no budgetary allocation for digital health or for Information Communication Technology (ICT) and innovation within the MoHS budget or budget for health innovation in the budget of Ministry of Information and Communication (MIC)[34].

Health Information System

The Ministry of Health and Sanitation (MoHS) of the Republic of Sierra Leone has faced serious challenges over the years in availing timely, complete and reliable data from the interventions and activities undertaken by the Ministry and its partners. The lack of accurate data has undermined effective health planning and monitoring, and efficiency in allocating funds for different health programs. In particular, the 2014 West Africa Ebola Virus Disease (EVD) outbreak further revealed the serious weaknesses of existing health information system (HIS) and Health Management Information System (HMIS) in Sierra Leone. While timely and accurate reporting is important for decision-makers to assess the health situation and guide swift responses to the epidemic, reporting of health data during the EVD outbreak was in most cases neither timely nor accurate. This was largely due to weak information system and limited capacity. As a consequence, a number of decisions made were neither evidence-based nor data-driven. However, significant progress has been made in addressing these shortcomings. For instance, there has been renewed investment and commitment in the HMIS and supporting structures by government and partners alike.

Routine health information data in Sierra Leone are aggregated into the HMIS hosted using the District Health Information System (DHIS2) software. Disease surveillance, health program and service delivery data from the communities and health facilities are collected, reported, and aggregated using a combination of paper and electronic systems. Health information is gathered for different programs and directorates using a combination of electronic and paper-based collection instruments. While majority of the information from community to health facility level are entered into the HMIS some are still collected in siloes

[31] GoSL, Ministry of Health and Sanitation. National Health Sector Strategic Plan. 2017
[32] GoSL, Ministry of Health and Sanitation. National Health Sector Strategic Plan. 2017
[33] GoSL, Ministry of Health and Sanitation. National Health Sector Strategic Plan. 2017-2021, p55
[34] List of stakeholders can be found in appendix A

at different levels of care. Health facility submission rate for service delivery data into the HMIS has recently increased to 98.6% and rate of timely reporting stood at 91.4% as of first quarter of 2018[35]. Every district has at least one Monitoring and Evaluation (M&E) officer who aggregates and enters service delivery summary data from PHUs within their domain. Similarly, each district hospital has an M&E officer responsible for entering hospital information from services across wards into the MHIS. Also, each district has District Information Officers (DIOs), who are responsible for aggregation of logistics information at the district level. Their aggregates are emailed to the central store in Freetown for further aggregation and validation. The DIOs, as part of their role, also provide network and ICT related support, though specific to logistics information systems. There is also a district surveillance officer who enters the weekly Integrated Disease Surveillance and Response (IDSR) summary forms into the HMIS. District human resource officers and other staff also exist at the district with potential roles in the information architecture.

District M&E officers and health facility officers-in-charge are expected to meet once every month to discuss health service delivery data and agree on corrective measures, if required. Similarly, a team of national level M&E staff from the MoHS conducts quarterly monitoring visits to a sample of health facilities across the country. Despite these efforts and progress, a recent evaluation revealed that data accuracy and use at last-mile remain a big challenge and are now being prioritized. RapidPro is an electronic Short Message Service (SMS) based reporting platform with 94% of health facilities reporting on various program indicators[36]. This process data from RapidPro is not currently captured in the HMIS. Health facility registration (creation, renaming and closure) information is currently stored and maintained within the HMIS-hosted DHIS2 system. However, "there is no process by which new facility openings or closings are approved across the central MoHS, DHMTs, and district councils. Anecdotal information suggests that new facilities are often opened by local politicians or other stakeholders, sometimes without MoHS awareness"[37]. The integrated Human Resource Information System (iHRIS) is the repository of health workforce in Sierra Leone. The System currently has over 80% of the human resource workforce basic information[38]. Current information flow architecture, including major actors, is depicted in Figure 4.

[35] Based on HMIS data from the National DHIS2 platform
[36] Information based on stakeholder interviews and report
[37] GoSL, Ministry of Health and Sanitation. National Health Sector Strategic Plan. 2017-2021, p24
[38] Based on stakeholders' interviews

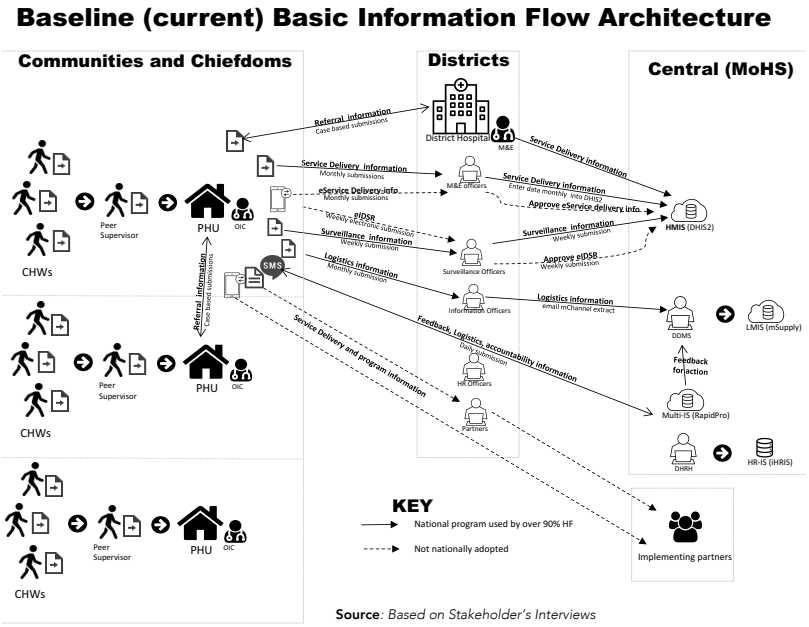


Figure 4 - Current Health Information Flow Architecture

Infrastructure for digital health

Sierra Leone has made significant improvements in the ICT enabling environment. The national ICT policy and strategy was first launched in 2009 and updated in 2017. Key objective of the ICT policy is to facilitate universal access to ICT services by bridging the digital divide between the rural and urban areas in Sierra Leone. Improved government efficiency and private sector competitiveness through transparency, compliance, and better accountability, are among the expected outcomes.

Since the advent of Global System of Mobile communication (GSM) technology 15 years ago, the number of connected Subscriber Identity Module (SIM) rose to 97.6 per 100 inhabitants[39]. Third Generation Internet broadband (3G) was first introduced in 2011 by Africell, followed by Orange (formerly Airtel) and SMART, in 2012 and 2014, respectively. Mobile phone coverage in Sierra Leone is over 70% of the 72,000 square kilometers, and overall broadband internet penetration is still 5%[40]. Government-owned SierraTel is the leading provider of fixed lines and Code Division Multiple Access (CDMA) wireless services. In contrast, a facility-based network readiness coverage commissioned by an implementing partner suggests about 96% of PHUs receive network coverage from at least one GSM service provider[41]. This was validated by interviews with other front-end implementing organizations. The assessment, however, only assessed network availability, but not the reliability of data service.

Sierra Leone's total installed electricity generation capacity is 100MegaWatts [42], this comes to 14 watts per capita, far below world (868 watts) and sub-Saharan Africa (133watts) averages[43].

[39] ITU. Sierra Leone Country Telecommunications Profile. 2017; Available at: https://www.itu.int/en/ITU-D/LDCs/Documents/2017/Country Profiles/Country Profile_Sierra Leone.pdf.
[40] GoSL Ministry of Information and Communication. The Sierra Leone National ICT Policy 2017.; 2017:1-77.
[41] Focus1000. Network Readiness Assessment (Internal Report). Freetown Sierra Leone; 2017.
[42] Ministry of Energy. Progress Report 2014 - 2017. 2017. Available at: http://www.energy.gov.sl/wp-content/uploads/2018/04/ProgressReportMoE.pdf.
[43] https://data.worldbank.org

As a result, only 13% of Sierra Leoneans currently have electricity access, though much lower (estimated at approximately 1%) in rural areas[44]. This has grave implications for digitization in general and for digital health in particular, which is evident in the majority of the health facilities being without electric power supply, as noted in the NHSSP 2017-2021.

Implication for digital health

Evidence from around the world shows that electronic health records (EHR), smart phones, e-Prescription, artificial intelligence, eLearning, and many other digital health solutions can improve health awareness and facilitate disease prevention[45]. Digital health adoption continues to play a vital role in cost-effective provider training and patient empowerment. A recent study in Canada indicated that national digital health solutions can offer significant savings. The study demonstrated that doubling the use of electronic medical records (EMR) from 2006 to 2012 resulted in $1.3 billion in savings. It also resulted in increased administrative efficiencies and better health system management, and improved communication among care providers and with patients[46].

The 71st World Health Assembly (WHA) in May 2018 approved a resolution on digital health for member states to prioritize technology and innovation in health systems strengthening approaches. This resolution was preceded by two others in 2005 and 2013 that urged member states to prioritize strategy development and digital health standards and interoperability frameworks. One of the many definitions of digital health is the use of ICT locally and at a distance to help address health sector challenges[47]. The 2005 resolution urged member states to adopt a "national outlook for digital health by drawing up cost-effective digital health strategies that reflect the principles of transparency, ethics, and equity". Similarly, in 2012, the World Health Organization (WHO) and International Telecommunications Union (ITU), both responsible for Health and ICT coordination at the United Nations, co-developed a toolkit to help nations design their digital health strategies[48].

Technology played an important role in containing the Ebola outbreak, particularly for contact tracing[49], and still presents several opportunities. As more and more digital health initiatives are introduced and deployed into the country's health system, it has become imperative to ensure there is adequate government-led coordination and regulation of these digital health initiatives, and to ensure that they address targeted health systems challenges and yield meaningful results. Adequate regulation will guarantee there are no adverse health consequence from inappropriate deployment of digital health solutions. In view of these goals and priorities, the MoHS, in close collaboration with the Ministry of Information and Communication (MIC), has led the effort to establish a national coordinating and regulating structure that will support the advancement of digital health in Sierra Leone. The partnership for MoHS to work with MIC was cemented with a Memorandum of Understanding (MOU) in

[44] Power Africa. Sierra Leone Energy Sector Review. Sierra Leone; 2016. Available at: https://www.usaid.gov/sites/default/files/documents/1860/SierraLeoneCountryFactSheet.2016.09_FINAL.pdf.
[45] http://www.afro.who.int/news/maximising-digital-health-technology-improve-quality-and-patient-safety-africa
[46] https://www.cbc.ca/news/politics/e-health-records-saved-medical-system-1-3b-in-6-years-1.1384119
[47] Executive Board. WORLD HEALTH ORGANIZATION eHealth Report by the Secretariat. EB115/39. 2004;115th Sess(1):1-6.
[48] WHO, ITU. WHO-ITU. 'National EHealth Strategy Toolkit'.; 2012. Available at: https://www.itu.int/pub/D-STR-E_HEALTH.05-2012.
[49] Call Detail Record (CDR) Analysis. ITU; 2017. Available at: https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Documents/2017/Reports/SL/D012A0000CA3301PDFE.pdf.

2017[50]. The MOU details the digital health governance mechanism with health sector leadership. The structure includes a steering committee, a coordination hub, a strategy team, a technical advisory group, and national digital health working groups. Their terms of reference and membership have been well documented in the MOU. The steering committee provides strategic oversight. The coordination hub has been central to day-to-day operationalization and institutionalization of digital health in the country. The technical advisory group is made up of subject matter experts who provide guidance as necessary. Sierra Leone's digital health strategy was developed using the WHO/ITU eHealth strategy toolkit as a guide.

The eHealth coordination hub commissioned a mapping of digital health initiatives in the country using the digital health atlas adapted from the WHO mHealth Assessment and Planning for Scale (MAPS) toolkit[51] [52]. Sierra Leone's digital health landscape was assessed based on the output from this assessment, coupled with stakeholders' working session and interviews[53]. The global digital health index provided an electronic and simple approach to determine the country's digital health maturity level and readiness. The maturity level of Sierra Leone, according to the attributes that make up the seven building blocks of the digital health enabling environment, was benchmarked against the world average using the index shown in Figure 5. This assessment found that Sierra Leone's digital health is in the "developing and building-up" phases and will transition to the "scaling-up" phase with the appropriate ICT environment, as shown in Figure 6 [54]. This strategy is meant to guide the deliberate and systematic scale-up of ICT adoption within Sierra Leone's health sector towards an inter-connected health system.

[50] Ministry of Health and Sanitation, Ministry of Information and Communication. Memorandum of Understanding for Joint Working by Ministry of Health and Sanitation, Ministry of Information and Communication on the Government of Sierra Leone eHealth Coordination Hub Dated 3rd of November 2017. 2017.
[51] https://sl.digitalhealthatlas.org/landing
[52] WHO. The MAPS Toolkit: mHealth Assessment and Planning for Scale.; 2015. Available at: http://www.who.int/reproductivehealth/publications/mhealth/maps/en/
[53] See full list of stakeholder organization in Appendix A
[54] This is based on the WHO and ITU framework for categorizing national context for eHealth

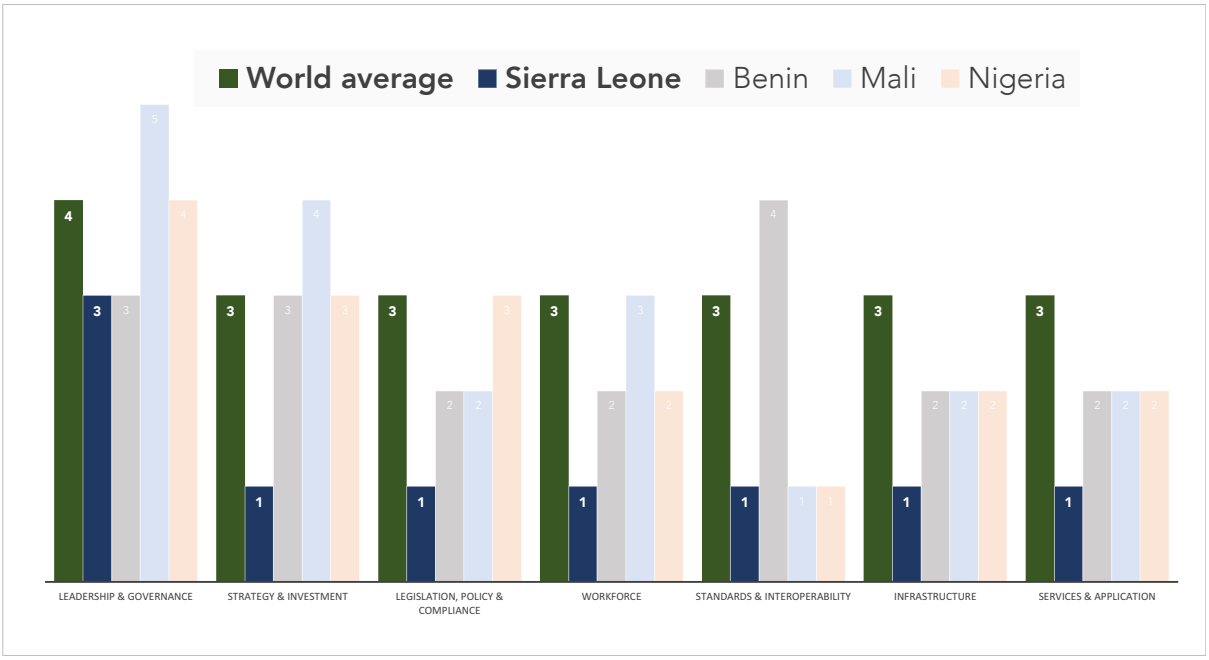
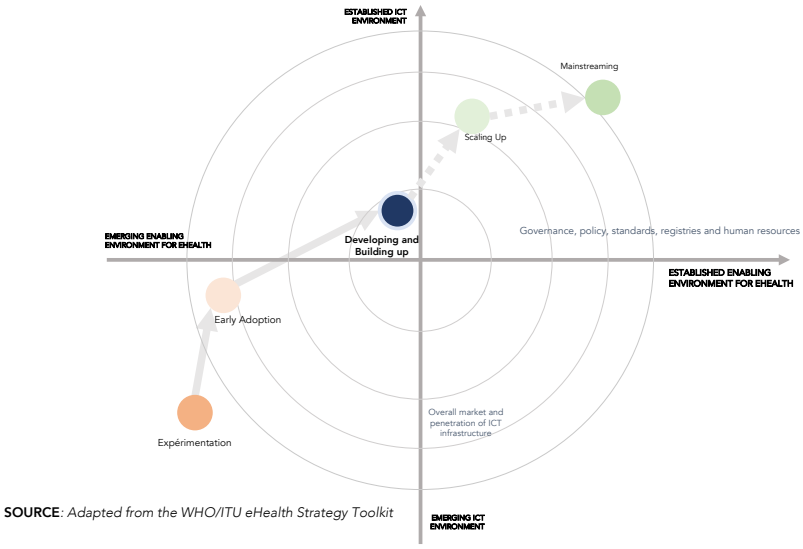


Figure 5 - Sierra Leone baseline digital health index benchmarked by world average[55]



SOURCE: *Adapted from the WHO/ITU eHealth Strategy Toolkit*

Figure 6 - The state of Sierra Leone digital health and ICT enabling environments

[55] https://index.digitalhealthindex.org/map

Digital health vision for Sierra Leone

National digital health vision

The eHealth coordination hub, co-led by the MoHS and MIC, initiated the collaborative drafting of this strategy as a first step towards a push for an integrated ICT-enabled health system in Sierra Leone. The process involved consultations, meetings, and a workshop with stakeholders from across the Health and ICT sectors at national and district levels, as well as some implementing partners. This process yielded a shared vision for Sierra Leone's digital health.

By 2023 an effective and efficient ICT enabled system supports delivery of quality, accessible, affordable, equitable, and timely healthcare services and moves Sierra Leone closer to achieving universal health coverage.

Key components of the national digital health vision are aimed at addressing the government's health-for-all agenda, which closely follow the sustainable development goal (SDG3).

Vision implication for stakeholders

Achieving the vision will mean that different health sector stakeholder groups will benefit from the key components of the vision. Table 1 illustrates possible benefits that will be derived by key stakeholder groups. The stakeholder groups here are the healthcare providers, individuals, healthcare managers and administrators, researchers, donors and ICT service providers.

Table 1 - Vision implication for key stakeholders

What achieving the digital health vision means for health providers	
It will enable timely access to and exchange of health information, ability to make more informed decisions at the point-of-care, and efficient and accurate reporting on service delivery and other health data.	
What happens today?	What will change look like?
a. Work with incomplete or delayed information while providing care b. Reporting health facility data to the district and onward to the central system is burdensome and time consuming c. Inefficient coordination among care providers with exchange of incomplete patient information d. Duplicate collection of patient information and treatment activities e. Difficulty in monitoring adherence or response to treatment and medication f. Limited means to monitoring effectiveness of service delivery outcomes g. Limited ability to remotely interact with patients h. Limited access to decision support tools despite low skillset of multi-disciplinary care providers	a. Health providers have an integrated, timely and complete patient information they need. b. Reduced burden and ease of reporting of all relevant health data by care provider. c. Connected care through an efficient and functional health information exchange will be possible d. Shared access to collected patient health information across health programs and institutions e. Ease of monitoring and response to treatment and medication adherence f. Easily track effectiveness of service delivery outcomes g. Ease of interaction with patients using tele-medicine and other remote access systems

i. Inefficient, little or no performance and supervision management metrics	h. Access to automated decision support tools by health programs and care providers i. Digital and data-driven supervision and performance management for providers

What achieving the digital health vision means for individuals (including vulnerable groups)	
It will enable individuals to access health information they need for improved quality of services and ensure affordable and efficient healthcare. Patients will have improved satisfaction with healthcare services and health outcomes.	
What happens today?	**What will change look like?**
a. Low levels of public health knowledge among the general population b. Patient health information is distributed in siloes across the different health system locations and repositories, or not stored at all c. Patients currently get low quality health service due to skill, knowledge, and work burden of care providers d. Limited ability to remotely interact with care providers e. Limited access to personal health information (if any) f. Majority of patients settle health bills through out-of-pocket payment resulting in only a small fraction of citizens accessing appropriate care g. Individuals do not derive maximum satisfaction or health outcomes	a. Patients will have access to health information they need through a variety of digital channels b. Appropriate patient health information is digitally stored, integrated and accessible at point of care c. Patients will receive higher quality care due to improved efficiency, skills and knowledge of care providers d. Patients can seamlessly interact with care providers, not limited by location e. Individuals will have adequate access to their own personal health records and share with whom they choose to f. Most Sierra Leoneans can access quality care irrespective of their economic status or location with majority enrolled for health insurance g. Individuals seeking care will enjoy maximum satisfaction of service and improved health outcomes

What achieving the digital health vision means for managers and administrators	
It will ensure that policy makers and managers can monitor and evaluate health program implementation and make effective and efficient decisions through an informed data-driven approach.	
What happens today?	**What will change look like?**
a. Inefficiencies due to duplicate data collection channels b. Health outcomes remain discouraging owing to difficulty and cost of monitoring evaluating programs c. Difficulty in tracking health investment (eg. Free Healthcare initiative) d. Limited and often low-quality information available to aid timely decision making e. Slow feedback mechanism to frontline health workers f. Inability to effectively and efficiently coordinate among health programs g. Limited data on digital health implementations h. Inability to use data to monitor trends and disease patterns	a. Integrated health system will eliminate duplicate data collection within the health system b. Improved national health outcomes as a result of cost-effective monitoring and evaluation strategies c. A digitized health system will reduce oversight burden on health managers and decision makers d. Policy and decision makers will have the right information they need in close to real-time for decision making e. Health administrators can send automated feedback to frontline health workers for timely action f. Health administrators and managers will better coordinate digitized health programs g. Adequate evidence of digital health implementations and their outcome h. Analysis of big data using intelligent learning algorithms for predicting disease patterns

What achieving the digital health vision means for researchers	
It will ensure access to high fidelity anonymized data for research that contributes to growing evidence base on health service delivery, inform best practices for strengthening health systems.	
What happens today?	**What will change look like?**
a. Researchers have access to only limited medical or public health information. b. Patient health information exist in paper forms and are often difficult and expensive to extract and analyse c. Patient health information is often local and distributed across multiple health facilities d. There is no clear direction for how digital patient information can be accessed for funding purpose	a. Researchers will have access to all relevant health statistics b. Researchers will have access to relevant anonymized digitized health information c. Integrated care will reduce research burden and result in more evidence-based medicine for improved health outcomes d. Researchers interested in health data for funding purpose know what to do and where to go because there is clear guideline for accessing relevant health information.
What achieving the digital health vision means for Donors	
It will ensure that donors' investment in Sierra Leone's health sector in general and in digital health in particular will yield maximum and sustainable impact on health outcomes.	
What happens today?	**What will change look like?**
a. There are few examples of nationally implemented and government led digital health interventions	a. Most digital health implementations are nationally scaled and government led
What achieving the digital health vision means for ICT service providers (Private and NGO partners)	
It will ensure that ICT service providers (NGOs and private implementers) will have an enabled digital health environment that supports feasible and scalable digital health implementation.	
What happens today?	**What will change look like?**
a. ICT service providers do not have the right digital health enabling environment (infrastructure, policy, capacity, governance, standards) to operate b. ICT service providers do not have business motivations to invest in health	a. The right enabling environment - infrastructure, standards, legislation, governance and workforce will be available to support sustained and scalable ICT investment. b. Digital health solutions implementers will leverage business drivers as investment incentives

Vision in practice

The government of Sierra Leone has long prioritized maternal, neonatal and adolescent health (MNCAH) and related services with the launch of the Free Healthcare Initiative in 2010. Despite this bold initiative, little progress has been made in MNCAH outcomes, owing to inefficiencies and wastages, among other factors. Also, the President, his excellency Julius Maada Bio, in his speech to parliament on the 10th of May 2018 pledged to re-engineer the FHCI for improved efficiency. This is the rationale for the following scenarios targeted at bringing the vision to life through the hypothetical experience of three stakeholder groups – the individual, the healthcare provider, and the healthcare decision maker (or administrator).

Table 2 – Scenario: The vision in practice

The vision in practice: MNCAH example
This scenario depicts three characters, the client Asuma, a care provider Amie, and the district M&E officer Alusine in a hypothetical district in Sierra Leone. These characters are used to describe what occurs in the current health system and what a connected health system where the vision has been achieved can deliver to these three characters. This scenario will help drive home the vision and potential impact on stakeholders. Their current health system experience: Asuma has been having fever and dizziness for one week. She thought of going to the nearest clinic available to her (7 km away), but hesitated because of the distance, as well as the lack of trust in the quality of care she would receive there . In addition, her earnings from the petty trading business was only sufficient to provide for her and her six children, though a neighbour had mentioned to her the government's free healthcare initiative for women and children. She was not sure she was eligible even if she could get to the clinic. Eventually, her husband agreed to accompany her on the 3-hours journey to the health facility, and on arrival, she was found to be in her second trimester of pregnancy. This was after an hour of waiting, as the health facility was manned by only one MCH aide, Amie, with over 30 patients waiting in line to be attended to. Amie had to alternate between entering data into several registers and attending to the women in the queue. Amie suspected malaria, but had been out of essential drugs and commodities, including rapid diagnostic malaria testing kits for weeks now. Her next batch of medical supplies was not due to arrive until three weeks later. In addition, Amie's last training was a year ago and it addressed just one of the many disease areas she was accustomed to seeing in the clinic every day. She wished she could get a reference manual, or remote help, to aid her in diagnosing the patients. Asuma went home with the knowledge that she is pregnant and without a solution for her fever and decided to purchase an anti-malarial drug from a local pharmacy. Luckily, the fever subsided and she continued with her lifestyle, without accommodating her pregnancy. She was not even aware that the occasional bleeding was a pregnancy danger sign. She wanted to continue working to save money for after delivery, but did not have a reliable and trusted method to save, as the closest bank was 30 km away at the district headquarters, and she did not even have a bank account. She was afraid, as many of the pregnant women in her community had died recently, often attributed to some spiritual beliefs. She wondered, if she had her way, could she have stopped this pregnancy from coming in the first place? She did not know how and was still not certain about how to prevent future pregnancies. Back at the DHMT, decision makers get information on aggregates submitted every month and discussed a month after they have been submitted during the monthly meetings. There is no time to discuss individual cases. Amie, on the other hand, dreads the beginning of every new month as she has to complete the various summary sheets, in addition to her daily documentation requirements. Sometimes, she feels she may have made errors in her computations. How digital health will change their experience: Asuma understands through several radio programs the importance of child spacing. She had adopted a long-acting reversible contraceptive (LARC) method after the birth of her second child, and had it removed two months earlier after four years, as she was ready to have her next baby. She is aware of her pregnancy early, after the community health extension worker gave her a pregnancy test. She enrolled for a pregnancy stage-based messaging service that sends her critical information on how to behave during each stage of her pregnancy. She can now deposit a specific amount into her mobile money wallet in preparation for her baby. She has her basic medical history, including information on services she has received during her past antenatal visits, and knows how to securely access it online.

Part of the information she receives is the contact of the health facility closest to her, and she is able to interact with the provider and schedule future antenatal visits. There have been testimonies of improved care quality at the facility as she enquires.

On antenatal visit days, Amie receives Asuma, one of the few cases she was expecting for the day. She pulls their health information record from a mobile device. Asuma's bio-data and health history had been captured by the visiting community health worker. That information was automatically available to Amie, she only validated Asuma using her unique identification matrix. Amie attends to Asuma and provides her with the relevant essential drug she needs until her next antenatal visit. As she gives the drugs, the health facility stock management system is automatically updated, and a notification is sent to the district store keeper when a drug supply reaches a predetermined low level. Amie is now more confident as she has a senior nurse and doctors in Freetown on speed-dial on her tablet, who can provide remote support to her. Amie's work is even easier as she can get reference or full training from her health facility tablet when there are no clients to attend to. Amie is relieved, she does not have to do the laborious monthly summaries, rather she gets real-time summaries of her patients and can even compare how she is doing against other providers and health facilities. In fact, the system flags and notifies her of high risk patients and data quality issues.

Meanwhile, Alusine, the district M&E officer is now free of the burden of entering over one thousand forms from all the PHUs in the district. He now uses his time to monitor trends and perform targeted supervision visits to PHUs. Frequency of face-to-face meetings with PHU in-charges has reduced to every quarter, as most health and capacity-building information are sent electronically. At the MoHS in Freetown, quality of data has improved and disease surveillance is less of a problem because of the connected health system. Large volumes of data are now available at the central government data repository and can be used for trend analysis and disease pattern predictions.

Identified Risks

While developing this strategy, several risks were identified; risks that if not addressed or mitigated could pose a challenge to achieving the national digital health vision. This list is not meant to be exhaustive. Some of them are:

Table 3 - Identified risks and mitigation strategies

Potential Risks	Mitigation strategy
Funding – mobilizing the necessary funding to implement this strategy is critical for attaining the vision	All key stakeholders, particularly government decision makers and the donor community will be identified and engaged at every stage of development and implementation for their willingness and participation
Donors and implementing stakeholder competing interests, if not properly managed, may affect the vision of a connected Sierra Leone health system	The digital health coordination hub is already dealing with this by providing an open and transparent level playing field and collaboration framework, particularly for digital health implementing partners. The digital health governance will be strengthened to continue to play this role
Availability of human resources with expertise in health informatics to implement critical components of the strategy (e.g., standards	Required technical skills needed to implement the strategy have been mapped and prioritized in this plan. In addition, a few

and interoperability) may be limited	MoHS staff are being trained on health informatics abroad and due to return soon.
digital health infrastructure at rural and some urban health facilities, if not improved quickly, may delay deployment of some services and applications to areas that need it most	Key infrastructure (electricity and connectivity) partners are being engaged to align investments to benefit the health sector. Key computing infrastructure sharing strategy has commenced among implementing partners
If the political support is not sustained, the vision may not be fully realized.	Policy and decision makers at all levels are kept up to date at every stage of implementation
Digital health requires multi-sectoral collaboration. If current collaboration is not sustained, can result in significant risk.	To mitigate this risk, regular engagement and meetings by the digital health leadership will be ensured.

Recommendations

Strategic objectives and outcomes

The national digital health vision draws from the health sector goals and objectives as detailed in the NHSSP (2017 – 2021). Key health system goals have been categorized by health system pillars and mapped onto their corresponding digital health outcomes. The health systems pillars are: Leadership and Governance, Service Delivery, Human Resources for Health, Health financing, Medical Products and Health Technologies, Supply chain, Health Information Systems and Research, Health Security and Emergencies, Community Engagement and Health Promotion. The leadership and governance health system pillar refers to the health sector specific leadership and governance structures as described in the Health Systems pillar according to WHO[56]. This in contrast differs from the digital health Leadership and Governance building block required to address the digital health outcome. In addition, Service Delivery here refers to the cross-cutting health service delivery components and health program objectives to be addressed. This is also different from the digital health Services and Applications required to address health system goals and outcomes. The key digital health outcomes that an integrated and digitally supported health system will result in are as follows:

- Integrated authentication and validation of clients, providers and health facilities using established and recognised Master Patient Index (MPI), Health Provider Index (HPI), and Master Facility Index (MFI), respectively
- Increased use of telemedicine to bridge provider skill and availability gap
- Effective use of priority Services and Applications such as point-of-care, EMRs and other decision support tools for health service delivery.
- Better coordination of ICT solutions for data-driven decision making and feedback.
- Effective use of ICT for health finance resource mobilization, management, and distribution to ensure individuals access health services on the basis of need and ability to pay.

Strategic recommendations

This section details the seven building blocks required to progress towards achieving the national digital health vision.

Leadership and Governance

Leadership and Governance in this context refer to health sector and digital health leadership required to achieve a coordinated national digital health "ecosystem". The benchmark in Figure 5 shows that the Leadership and Governance digital health component is close to the world average. This is because MoHS and MIC inaugurated a national governance for digital health in March of 2017. The structure has a steering committee made up of leaders from both ministries, aimed at providing strategic oversight. The digital health coordination hub currently hosted by directorate of planning research and statistics (DPPI) serves as the secretariat and provides regulatory and operational guidance for systematic implementation of digital health solutions in the country. The coordination hub also has the

[56] GoSL, Ministry of Health and Sanitation. National Health Sector Strategic Plan. 2017-2021

mandate to facilitate the establishment of appropriate enabling environment for scalable digital health implementation across the country. The program management for successful implementation of the digital health strategy is also the responsibility of the digital health coordination hub. The technical advisory group acts as a source of subject matter expertise and is open to individuals and organizations. The proposed structure is shown in Figure 7.

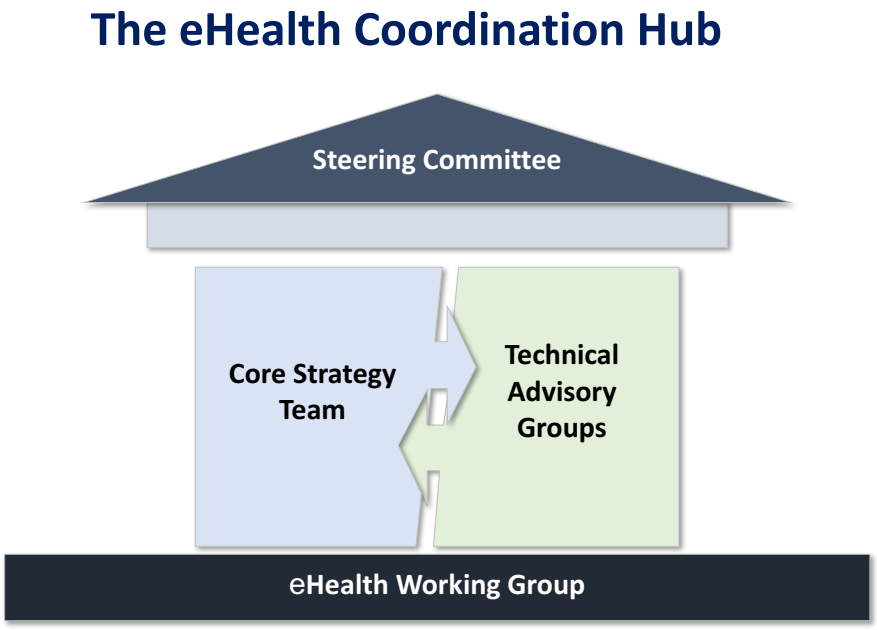


Figure 7 - The national digital health governance structure

To achieve the digital health vision, the following are recommended:

- Strengthen the capacity of the eHealth coordination hub for management, governance, and support of enterprise health ICT services
- Establish a government digital health support structure at the district level for effective monitoring of implementation
- Nominate Ministries Departments and Agencies (MDA) representatives into the national eHealth coordination hub to facilitate the changes across the MDAs

Strategy and Investment

This component is considered foundational and closely tied to governance and coordination. digital health investment can come from a variety of sources - government, donors, implementing partners, and the private sector. According to the national strategy on financial inclusion, less than 20% of Sierra Leoneans 15years and above are banked[57]. This digital health strategy, combined with the appropriate funding, will serve to catalyze the digital health enabling environment. To guarantee the necessary funding, it is recommended to:

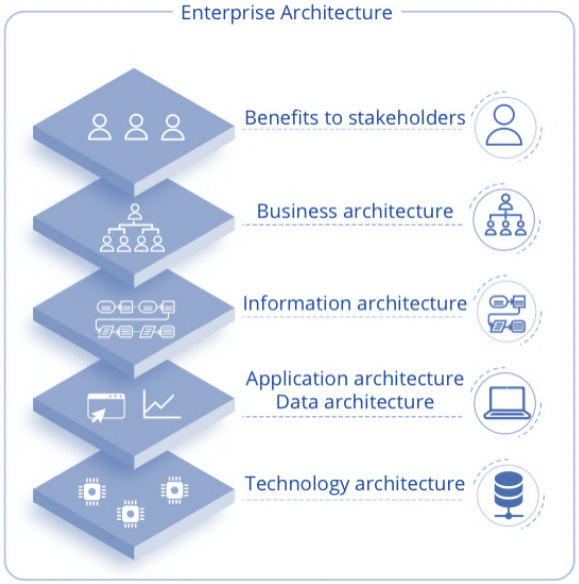
- Publish and disseminate the digital health strategy and monitor its implementation
- Implement resource mobilization specifically for digital health resources
- Support last-mile adoption of digital financial services in remote locations

[57] National Strategy on financial inclusion - https://www.bsl.gov.sl/SL%20FI%20Strategy%202017%20-%202020.pdf

- Advocate for an digital health budget line in the national budgets/plans for MoHS and MIC
- Support and plan for regular review and revision of the strategy

Architecture and Standards Framework

Architecture and standards framework is the digital health enterprise blueprint for an interoperable health system in Sierra Leone. The enterprise architecture will be composed of: Information architecture, Application architecture, Workflow (Business) architecture, and Technology architecture. Seamless integration/interoperability of Sierra Leone's health system can only be achieved by addressing interoperability within and across these architectural components. The Asia health information network (AeHiN) enterprise architecture shown in Figure 8 is proposed for Sierra Leone.



Source: *AeHIN SIL*

Figure 8 – Proposed Sierra Leone enterprise architecture[58]

Sierra Leone's standards and interoperability component is benchmarked to 1 on a scale of 5, as there are currently no processes in place geared towards standards adaptation or guidelines for adoption. All stakeholders engaged are not aware of any digital health standards in use in Sierra Leone. Each step in the architecture development process should be iterated through each of the enterprise architecture components in Figure 8, starting with the business architecture (workflow) and expected stakeholder benefits.

The next step in this definition process is to map the existing shared services and registries (client, provider, health facility, and device identifiers). This should be followed by a review of identified key services to determine what can be reused, outsourced, or built. This will depend on the current status of the existing systems. Developing standards for electronic data structures for referrals, health event summaries (eg. HMIS), prescriptions, care plans, test orders and results, and clinical data, etc. should precede deployment of electronic Solutions to ensure seamless integration and interoperability. In addition, depending on

[58] SIL-Asia A eHealth IN (AeHIN). Digital Health Terminology Guide.; 2017. Available at: https://aehin.hingx.org.

other features of these solutions[59] to be deployed, standards for clinical-terminologies, messaging, secure-messaging, appointments, imaging, clinical events may have to be defined and agreed to. Standards development process will have to consider separate but complementary processes in the context of Sierra Leone: strategic-direction, capacity-building, adaptation, ratifying, certification, testing and distribution.

Figure 9 illustrates the current Services and Applications architecture of Sierra Leone's digital health landscape. The application type layer shows key Services and Applications types in use within a health system. This layer will access the interoperability layer to read and update shared resources. The 'stakeholder feeds' layer is the resources presentation accessed by stakeholder groups. Several interoperability components are largely missing in this conceptual architecture, which explains in part the absence of a 'secure exchange'. The WHO classification of digital health intervention v1 provides a much more detailed list of interventions. See details in annex C under Sierra Leone digital health component map.[60]

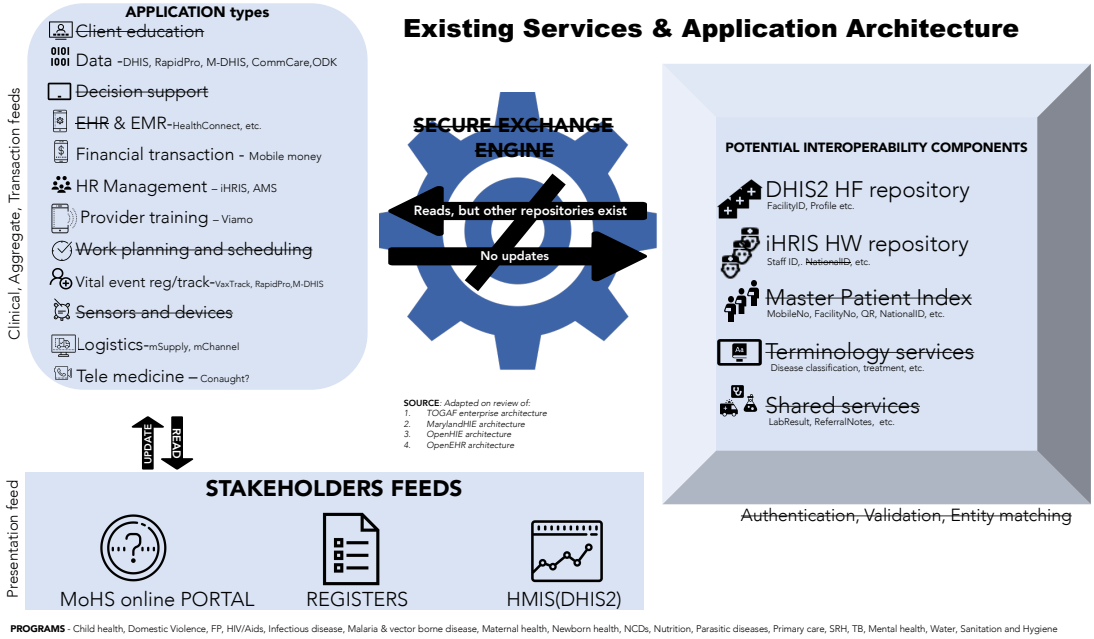


Figure 9 - Current SL Services and Application Architecture

Due to the sheer complexity of standardizing and ensuring interoperability of the different components of health systems architecture, it is recommended to:

- Adopt a 'use-case' based approach. This approach has many advantages: first, it guarantees early quick win, and second it ensures that the process is manageable. It is recommended to start with one or two, and maximum three, use-cases that support the country's major health system priorities
- Map and update the enterprise architecture components (Information, Application, Workflow, and Technology)[61] around the use-case(s)

[59] Another name for Services and Application
[60] http://apps.who.int/iris/handle/10665/260480
[61] Adapted from AeHIN and TOGAF recommended enterprise architecture frameworks

- Identify and document standards requirements of the identified use-case(s) necessary across architecture components. This will include identifying and defining standards protocols for relevant registries to facilitate a connected digital health experience for stakeholders through the use-case(s)
- Implement the enterprise architecture framework one component at a time towards the expected benefits. This process will continue for each identified use-case while keeping in mind the need to re-use relevant components as the need arises.
- The architecture design and integration should pilot interconnection of the registries with selected use-case(s).

The proposed conceptual Service and Applications architecture component in Figure 10 illustrates and proposes designing the structure using The Open Group Architecture Framework (TOGAF)'s principles of understandability, actionable, completeness, consistency, and stability[62]. Similar architecture components will have to be agreed to by the stakeholders for workflow, and developers for technology as the strategy is implemented.

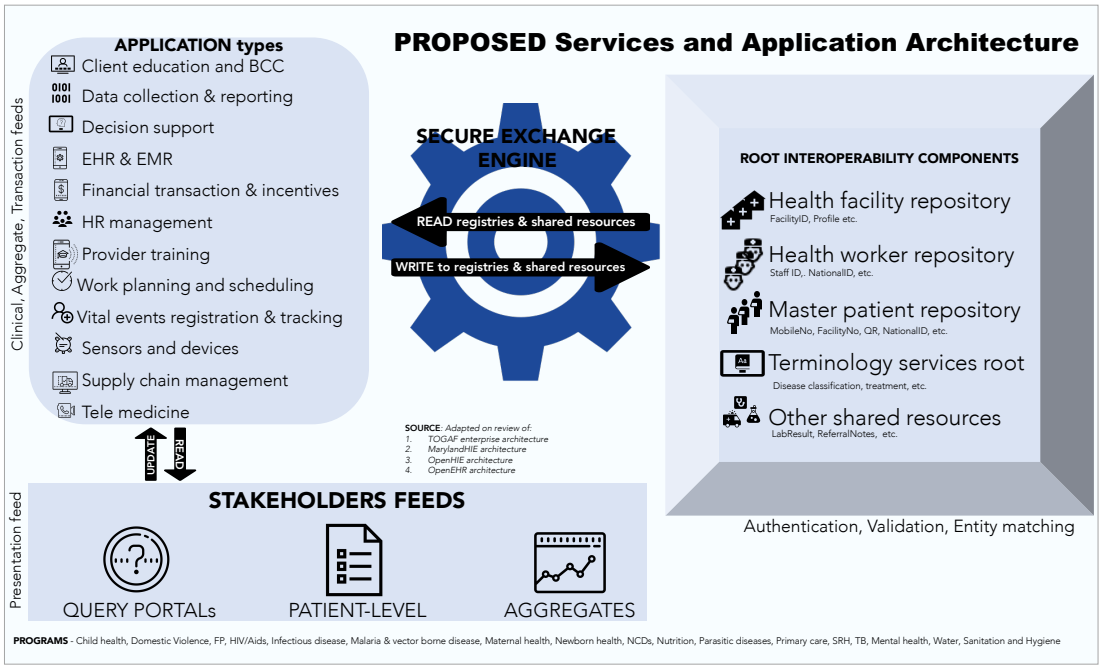


Figure 10 - Proposed Application Architecture for integrated SL information system[63]

Policy, Legislation, and Compliance

Currently the regulatory environment for digital health via existing health and ICT policies (ICT policy 2017 and Cyber Security Policy 2016), legislation, and compliance, was indexed to 1 in a scale of 5. Though the NHSSP 2017-2021 provides a framework for health sector integration, it is inadequate for providing a robust policy framework for this strategic plan. Essential recommendations will be to:

[62] Open Group. TOGAF 9 Certified Study Guide. 3rd ed. (Harrison R, ed.).; 2013. Available at: https://github.com/pankajchopra/togaf.
[63] This architecture was adapted from TOGAF 9 Application, Maryland HIE, OpenHIE, OpenEHR Architectures coupled with stakeholders' priorities

- Facilitate incorporation of the digital health components into the national health policy under review, or develop a separate digital health policy for Sierra Leone, depending on stakeholder preference.
- Ensure the relevant privacy and security regulations are applied (from health and ICT to digital health) and applied for the benefit of patients and providers.
- Develop a clear, easy-to-read and interpret compliance mechanism for these regulations at the foundational stage. The compliance framework must address transparency and accountability needs.

Workforce (digital health Capacity)

This component of the digital health building blocks in the context of Sierra Leone refers to the knowledge of two stakeholder categories: the frontline healthcare providers and the health ICT systems support. To achieve the national digital health vision, the digital health skills, knowledge and efficiency of these two groups must be improved. The frontline healthcare providers require improved skills and competencies for using digital services and applications. These can be acquired at the point of deployment. However, embedding the training materials into existing curricula of the relevant training institutions is recommended for easy regulation and institutionalization. Use of technology can also help providers refresh their clinical skills through eLearning initiatives that employ the low dose and high frequency learning strategy. The global digital health index ranking shows that the digital health capacity building strategy and efforts are mostly non-existent. The MoHS currently manages the health workforce using the iHRIS platform and an Attendance Monitoring System (AMS), both managed by the Human Resources Directorate.

The government of Sierra Leone approved an ICT cadre of civil servants through an act of parliament. This is a critical first step in making available the ICT support skills required for deployed services and applications. Specifically, the recommendations to enable the digital health workforce environment will be able to:

- Determine the workforce needs for digital health and ensure functions represented at all levels are aligned with relevant ministries
- Deliberately invest in digital health expertise needed to implement the strategy and beyond. The required skills vary from standards development, to management and governance of enterprise IT, to systems application support and administration
- Adapt mainstream digital health training for health institution curricula. This will help increase awareness of digital tools among the health workforce
- Develop a protocol to guide digital health support and digital health user capacity building plans for new service and application deployment
- Strengthen the community health promotion services with digital health
- Develop a protocol for digital health cadre similar to the ICT cadre in the federal civil service
- Assess, standardize and strengthen iHRIS to ensure linkages with other health information systems to facilitate interoperability and shared value

Infrastructure

The infrastructure referred to here could mean the computing, connectivity, or electric power infrastructure. The computing infrastructure is the physical hardware required to successfully

deploy digital health solutions, and could be computers, tablets, mobile devices and related accessories. Connectivity infrastructure has improved rapidly in the last few years. Despite the widespread internet coverage, internet availability at rural health facilities is still far below average. The MIC indicated a future plan to extend already deployed fiber mesh at districts to health facilities. This plan can help bridge the connectivity gap at the district hospitals, paving way for broadband-based interventions like telemedicine.

On the other hand, the electric power coverage at health facilities and communities remain inadequate. Some partners have explored renewable-solar energy sources, while others have tried storage cells (power-banks) as forms of alternative sources of energy, particularly for tablet based PHU interventions. Partners have deployed tablets at PHUs across the country for data collection and disease surveillance. In this regard, the WHO is procuring about 800 tablets for PHUs to aid digitization at the PHUs for select partner applications in support of the government. Recommendations for building a robust infrastructure for digital health are to:

- Prioritize deployment of alternate electric power sources in health facilities and communities in Sierra Leone
- Strengthen collaboration with and among partners to sustain hardware (eg. Tablets and computer) sharing and support
- Prioritize deployment of fiber infrastructure at the district health facilities.

Services and Application

Services and Applications refers to the solutions deployed to tackle health system programs challenges. Health system programs here include: Child health, Domestic Violence, family planning, HIV/Aids, Infectious diseases, Malaria & vector borne diseases, Maternal health, Newborn health, non-communicable diseases, Nutrition, Parasitic diseases, Primary care, SRH, TB, Mental health, Water, Sanitation and Hygiene. Services and Applications can be solutions designed for engagement by digital health stakeholders (e.g., clients or providers) through basic phones, feature phones, smart devices, or computers. Typical examples of solutions are electronic health information dissemination systems, patient reminder systems, treatment adherence systems, point of care decision support systems, electronic medical records systems, and many more. The list of solutions was not meant to be exhaustive as new solutions continue to be implemented in place of traditional approaches to solving health system challenges.

Services and Applications currently deployed in Sierra Leone address data collection, vital event registration and tracking, mobile money for health worker payment and reimbursements, human resource management, remote consultation, and logistics management. Solutions supporting client education or provider training were not identified as being in use. Electronic medical records have also been piloted in several locations in the country. There are several other digital health implementations, some government led, and others led by different implementing partners at different levels and scales.

Due to government prioritization of MNCAH services, The MNCAH use-case (Table 2) with all relevant components could constitute the priority element of this strategic plan. Whilst

strengthening the other national systems, Services and Applications targeting this priority area may constitute a quick-win. Recommendations to ensure scalable solutions are to:

- Design and implement interoperable digital registries (provider, client, health-facility).
- Develop a protocol for solutions testing and certification to facilitate connection to the HMIS data repository is required.
- Prioritize Services and Applications for adoption in use-case designs.
- Strengthen key critical nationally scalable Services and Applications
- Define a protocol for Services and Applications certification and standardization
- Deploy new prioritized services and Applications.
- Continue support of existing national systems (e.g., HMIS). Relevant change management is required to achieve sustained deployment.
- Disseminate lessons and best practices.

Implementation Plan

Overview

The implementation plan helps government map, coordinate, fund and govern components of the national digital health strategy. It ensures that results are achieved at national, district, and chiefdom levels. It also details how digital health, which is multi-sector in stakeholder distribution, can help achieve the desired health objectives. Key components of the health-for-all agenda (e.g. quality, access, and equity) can be supported using appropriate use of digital health interventions. The road from digital health enabling environment components to the vision can be shown in the logic framework in Figure 11. The theory of change illustrates how addressing different components can result in a strengthened health system with shared value for all.

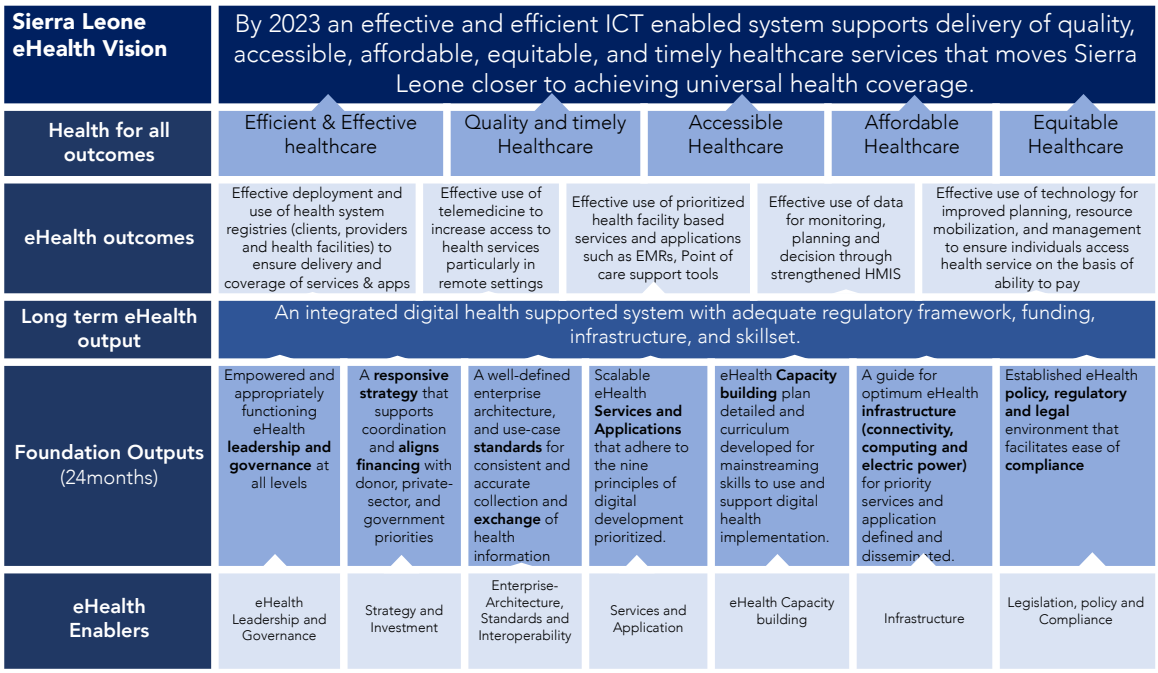


Figure 11 - Theory of change for the national digital health vision

Facilitating the enablers (i.e., the seven building blocks of the digital health-enabling environment) will lead to key foundation outputs. Progress markers are the development of an digital health capacity institutionalization roadmap, key solutions prioritized with appropriate infrastructure, and adequate policy and regulations developed. These will collectively yield a long-term integrated digital health-supported health system. The resulting digital health outcomes will be:

- Functional and integrated patient, provider and health facility identification systems
- Increased adoption of telemedicine, EMR and other point of care services for various health programs at all levels
- Effective use of data from several sources for monitoring, decision making, and evaluation
- Effective use of technology for health financing and communication

Achieving these outcomes will address the key components of health-for-all agenda, which will ultimately lead to the realization of the national digital health vision and eventually put Sierra Leone on the path to universal health coverage (UHC).

The Plan

This plan provides a high-level array of activities mapped over five years into an integrated implementation plan. It outlines the major areas of work required to deliver the recommendations for achieving the national digital health vision. The action plan is organized by four work areas, herein referred to as action lines: Governance, Foundation, digital health Solutions, and Change and Adoption.

The urgent and immediate foundational steps that may not show immediate impact are grouped under Governance and Foundations. The governance action line addresses the high-level activities required to address recommendations from the leadership and governance and the strategy and investment digital health-enabling environment components. The digital health governance will ensure monitoring and adequate regulation of digital health solutions implementation. High-level action items necessary to address the standards, interoperability, architecture, and infrastructure building blocks are detailed in the Foundations action line.

In addition, the digital health Solutions with the Change and Adoption action lines capture activities that show immediate health outcomes and health system improvement. The digital health solution is focused on steps to support appropriate and scalable deployment of digital health Services and Applications. Appropriateness and scalability means such implementation adheres to country context and the nine principles of digital development, are a set guidelines considered best practice for scalable digital solutions[64]. Ongoing support of existing scaled national systems must be provided for and maintained. The change and adoption action line details steps to address the digital health capacity challenge and mainstreaming them in practice through pre-service and in-service digital health capacity deployment. Capacity here includes capacity to use and capacity to deploy and support solutions. These two-broad capacity categories are critical for sustained implementation of nationally scalable digital health solutions.

The details of each high-level activity are in Annex C and can be further broken down during implementation into more specific sub-activities.

[64] https://digitalprinciples.org

Sierra Leone National digital health Integrated Implementation plan 2018 - 2023

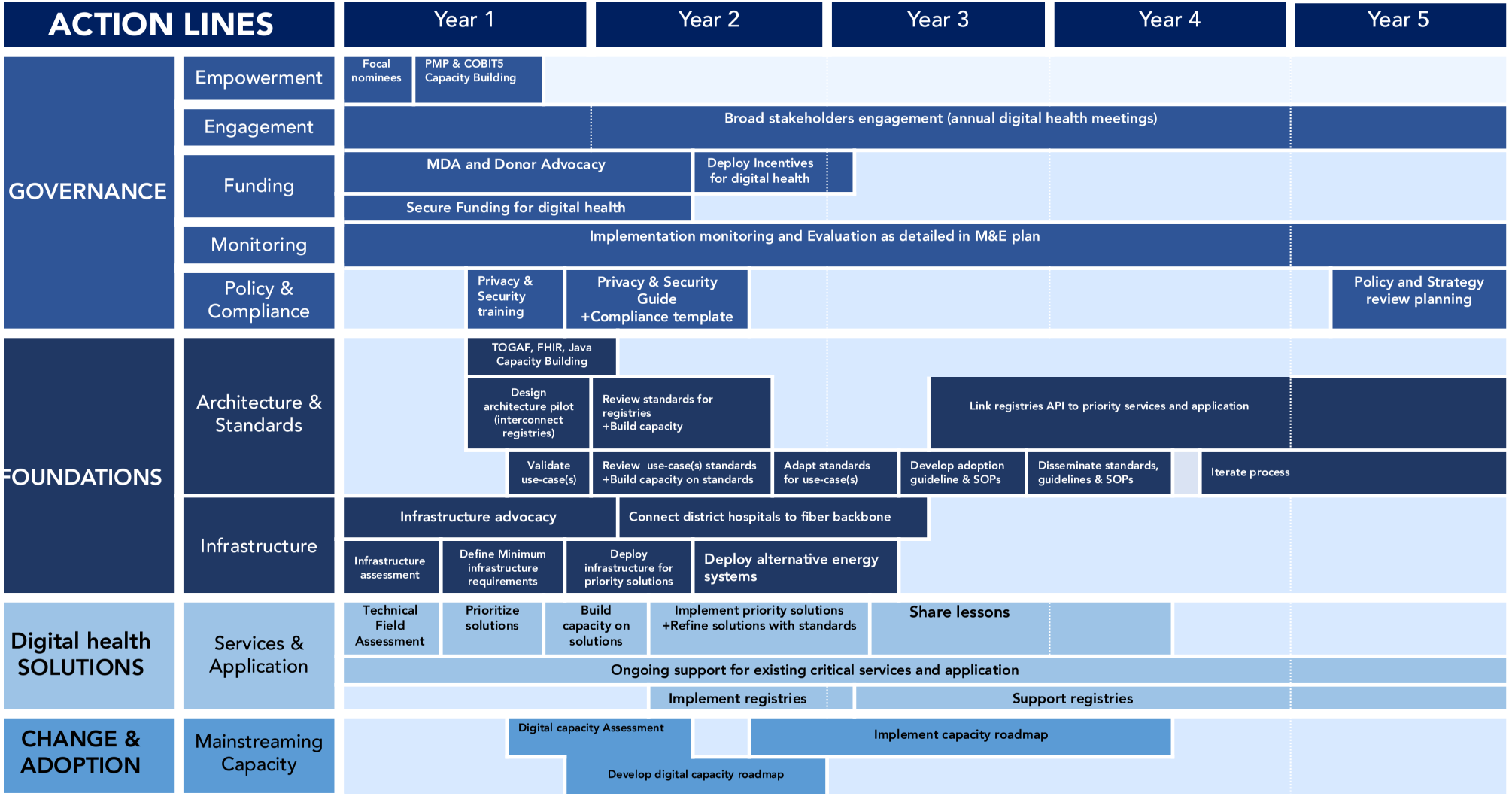


Figure 12 - Integrated action plan

Human and Financial Resources

The human and financial resources required to implement the national digital health vision have been determined from the detailed implementation plan in Table 5. These resource estimates were derived through consultation and consideration of existing and planned investments by the government, donors, and private implementers. Successful implementation of this plan will require high-level government and partner coordination and investments. This multi-year costed plan was developed based on if resources are sourced locally or externally and according to present realities. The cost and availability of human and other resources may change over time and can influence specific funding estimates. The total five-year indicative direct cost estimated to help achieve the national digital-health vision is 53 billion Leones (~$6.15 million). This is exclusive of indirect-digital-health costs required to implement the digital health vision. The detailed cost is as in Annex B. The annual estimates are as detailed in the budget.

Monitoring and Evaluation Plan

Overview

The M&E plan provides a way to assess the country's progress towards achieving the national digital health vision. It provides indicator measures for tracking progress over time. This monitoring process will be supervised by the existing digital health governance structure. The baselines and targets were derived through stakeholder consultation and work group sessions, and approved by executive management at MoHS and MIC. The framework ultimately provides a transparent approach to track and show result of digital health investment by stakeholders.

Monitoring and Evaluation framework

The monitoring and evaluation activities complement the program management by checking if the implementation is on the right track and is delivering the right outcomes, impact, and anticipated change. The monitoring action line in the integrated action plan is unpacked here. Key indicators and frequency of reporting are detailed in Table 5. Each indicator can be further broken down into sub-indicators during implementation. For example, the indicator "Percentage certified", dealing with percentage of eHealth coordination hub team members certified on either of COBIT5, TOGAF, or PMP, can be broken down to measure percentage certification for each of the target skill sets. Overall, targets have been determined for year 2 and year 5. Each indicator will be measured against this target quarterly or annually.

Additionally, the target will be to have all digital health services and applications implemented in Sierra Leone captured in the digital health atlas[65]. Each digital health component will be re-evaluated against the global digital health indexes at target measures. The Leadership and governance will sustain the current progress, while the other six components are expected to improve marginally in year2 and perform above average by year 5.

[65] https://sl.digitalhealthatlas.org/dashboard

Annexes

Annex A: List of contributing organizations (Table 4 - List of organizations)

1. 34 Military Hospital
2. CDC, USA
3. Clinton Health Access Initiative (CHAI)
4. Doctors with Africa (CUAMM)
5. DFID
6. Directorate of Science, Technology and Innovation
7. District Council Chairmen/Admin
8. District Medical Officers
9. District Medical Superintendents
10. eHealth Africa
11. Focus 1000
12. GIZ
13. Health Connect
14. HealthEnabled
15. IDT Labs
16. John Snow, Inc. (JSI)
17. Kings Sierra Leone Partnership
18. Living Goods
19. Ministry of Information and Communication
20. Select MoHS Directors and Programme Managers
21. Partners in Health
22. PHU In-Charges
23. Sensi hub
24. UNICEF
25. USAID
26. World Bank
27. World Health Organisation
28. World Vision Sierra Leone

Annex B: digital health Strategy 2018 – 2023 indicative costs (Table 5 - Indicative costs)

National digital health strategy budget

Detailed National digital health strategy budget					SLL 52,926,550,000		
1 Oct 2018 - 31 Dec 2023						$6,154,250	
Line Item	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**TOTAL**
A. GOVERNANCE							**$666,750**
Operational costs							
eHealth coordination hub staff time (1 MoHS, 1 MIC, 2 part-time experts)	$6,500	$80,000	$80,000	$80,000	$80,000	$80,000	$406,500
Communications	$250	$1,000	$1,000	$1,000	$1,000	$1,000	$5,250
Yearly M&E activity - digital health mapping, progress tracking and benchmarking	$0	$9,000	$9,000	$9,000	$9,000	$9,000	$45,000
Explore sources of fund and align with strategy	$0	$0	$0	$0	$0	$0	$0
eHealth coordination hub and district focal point capacity building on COBIT5	$0	$15,000	$0	$0	$0	$0	$15,000
Convene National digital health stakeholder workshop with district representatives	$0	$20,000	$20,000	$20,000	$20,000	$20,000	$100,000
Digital health conferences for peer learning and success dissemination	$0	$15,000	$15,000	$15,000	$15,000	$15,000	$75,000
Policy, Privacy and Security training for national digital health leadership	$0	$20,000	$0	$0	$0	$0	$20,000
Policy Review and template development	$0	$0	$0	$0	$0	$0	$0
B. FOUNDATIONS							**$1,512,500**
Training and Capacity building on Architecture/Standards & Interoperability (TOGAF)	$0	$20,000	$0	$0	$0	$0	$20,000
Training and Capacity building on Architecture/Standards & Interoperability (FHIR)	$0	$5,000	$0	$0	$0	$0	$5,000
Training and Capacity building on Architecture/Standards & Interoperability (JAVA)	$0	$10,000	$0	$0	$0	$0	$10,000
Training and Capacity building on Architecture/Standards & Interoperability (DHIS2 advanced)	$0	$8,000	$0	$0	$0	$0	$8,000
Web technologies training - HTML, CSS, JavaScript and related frameworks training	$0	$4,000	$0	$0	$0	$0	$4,000
Design enterprise architecture	$0	$0	$4,000	$1,000	$0		$5,000
Consultant to support design of enterprise architecture with use-cases	$0	$25,000	$25,000	$0	$0	$0	$50,000
Select and validate digital health use-cases based on priority and funding	$0	$0	$1,000	$1,500	$0	$0	$2,500
Develop standards for identified usecases	$0	$0	$20,000	$15,000	$0	$0	$35,000
Design use-case and standards development/adaptation guideline and SOPs	$0	$0	$0	$10,000	$15,000	$0	$25,000
Digital health Infrastructure and solutions Assessment/Mapping	$0	$15,000	$0	$15,000	$0	$0	$30,000
Extend fibre connectivity for 14 DHMT and 14 district hospitals	$0	$0	$49,000	$49,000	$0	$0	$98,000
Annual Internet subscription for DHMT and district hospitals	$0	$0	$28,000	$28,000	$28,000	$28,000	$112,000
Deploy alternative solar energy solutions to 14 DHMT and 14 district hospitals	$0	$49,000	$49,000	$0	$0	$0	$98,000
Deploy alternative solar energy solutions to 1000 PHUs	$0	$100,000	$300,000	$300,000	$300,000	$0	$1,000,000
Media & Marketing including dissemination activities	$0	$5,000			$5,000		$10,000
C. SOLUTIONS							**$3,875,000**
Identify Priority services and Applications	$0	$15,000	$15,000	$15,000	$0	$0	$45,000
Implement digital registries (identifiers systems)	$0	$250,000	$50,000	$0	$0	$0	$300,000
Develop/Revise requirements & Design for prioritized services and application	$0	$30,000	$0	$0	$0	$0	$30,000
Ongoing Technical Assistance for Scale-up of prioritized services and applications	$0	$0	$0	$0	$0	$0	$0
Pilot and domesticate Prioritized digital health Solutions as may be determined	$0	$500,000	$1,500,000	$1,000,000	$500,000	$0	$3,500,000
D. CHANGE and ADOPTION							**$100,000**
Workforce Assessment (practice, training changes, accreditation)	$0	$20,000	$0	$0	$0		$20,000
Develop a digital health capacity institutionalization plan (competency framework, practice standards, accreditation)	$0	$0	$25,000	$0	$0	$0	$25,000
Establish digital health knowledge repository	$0	$0	$35,000	$20,000	$0	$0	$55,000
TOTAL (USD)	$6,750	$1,216,000	$2,226,000	$1,579,500	$973,000	$153,000	
TOTAL (LEONES)	SLL 58,050,000	SLL 10,457,600,000	SLL 19,143,600,000	SLL 13,583,700,000	SLL 8,367,800,000	SLL 1,315,800,000	

Annex C: Sierra Leone digital health component map

Annex D: Detailed plan (Table 6 - Detailed integrated implementation plan)

ACTION LINE			ACTIVITY	ACTIVITY DETAILS	DELIVERABLES	PRIMARY RESPONSIBLE	IN COLLABORATION WITH
GOVERNANCE	1.1	Empowerment	Focal Nominee	Designate district technical focal contact	District focal points nominated	eHealth Hub	DHMT
	1.2			Designate health program focal persons	MDA focal points nominated	eHealth Hub	All health programs including CHW hub
	1.3		Capacity building	Capacity building for Project Management, **COBIT5**, and M&E	Percentage of staff trained to project manage, monitor, and govern the enterprise digital health	eHealth Hub	STI
	1.4	Broad Engagement	Broad stakeholder engagement	Annual digital health stakeholder's meeting. Engage broader stakeholders on digital health and provide implementation report	Stakeholders engaged and annual workshops held	eHealth Hub	All stakeholders
	1.5	Funding	MDA advocacy	Advocate for inclusion of digital health within directorates and line ministries' budgets	Increased directorates and agency awareness of value of digital health services and application	eHealth Hub	Health Directorates, Health Agencies and programs
	1.6		Donor advocacy	Advocate for coordinated donor investment in SL digital health	Increased donor coordination aligned with the strategic plan	eHealth Hub	All Donors and health directorates
	1.7		Secure digital health funding	Secure funding for digital health foundational activities and align stakeholder digital health investments with the strategy.	Funding secured for digital health strategy implementation	eHealth Hub	CMO and Donors
	1.8		digital health Motivation	Design & implement an incentive mechanism to catalyse appropriate digital health services and application uptake at all levels	Incentives program for digital health uptake designed and disseminated to all directorates, partners, agencies and districts	eHealth Hub	Health Directorates, Health Agencies and CHW program
	1.9	Monitoring	Monitoring and Evaluation	Track implementation progress of the digital health strategy using the M&E plan	Quarterly progress report available for digital health steering committee	eHealth Hub	Health Directorates, Health Agencies, CHW program and DHMTs
	1.10	Policy & Compliance	Capacity building	Training on emerging trends in patient privacy and security	Privacy and Security capability	eHealth Hub	Cyber Security MIC
	1.11		Privacy and Security Guide	Develop privacy and security guide for patient health information (paper or/and digital)	Guideline for protection of patient privacy and Security developed	eHealth Hub	Cyber Security MIC

	1.12		**Disseminate guide**	Disseminate guideline to all relevant stakeholders	Awareness of guideline by stakeholders	eHealth Hub	Cyber Security MIC
	1.13		**Policy and plan review**	Ensure digital health inclusion in health and/or ICT relevant policy and strategy reviews	Strategy and policy always up to date	eHealth Hub	eGovt. MIC
FOUNDATIONS	2.1	**Architecture & Standards**	**Capacity building**	Capacity building for **TOGAF**, **FHIR**, and **standards** adoption processes	Capability for architecture modelling and standards development acquired	eHealth Hub	Local and International eHealth expert groups
	2.2		**Design architecture pilot**	Design architecture and standards to support interconnection (linkage) of patient, provider and health facility registries. The design should include process, information, services/application and technology.	Architecture model developed	eHealth Hub, HRH, M&E, CRV, STI	All health programs including CHW hub
	2.3		**Validate Use-case(s)**	Validate use-case(s) for which standards development will be based and align with available funding	Use-case(s) selected	eHealth Hub	All health programs including CHW hub
	2.4		**Review standards**	Map and review relevant international standard in context of selected use-case(s): observation, disease classification, messaging, etc.	Relevant standards selected	eHealth Hub	Programs or directorates leading the use-case
	2.5		**Standards Capacity**	Build capacity on Identified standards	Capability to domesticate standards acquired	Health programs & eHealth Hub, STI	Relevant implementing and private-sector partners
	2.6		**Adapt standards**	Model and adapt standards regime for selected use-case(s)	Standards developed	Health programs & eHealth Hub	Programs or directorates leading the use-case
	2.7		**Standards guidelines**	Document process and apply to other selected use-case(s)	Generic standards implementation guidelines developed and disseminated	Health programs & eHealth Hub	Relevant implementing and private-sector partners
	2.8		**Develop SOPs**	Develop relevant standards implementation guidelines per use-case.	Standards guideline per use-case developed	Health programs & eHealth Hub	Relevant implementing and private-sector partners
	2.9		**Disseminate standards**	Create awareness on availability of use-case specific standards and advocate for more use-cases and standards	Stakeholder awareness	eHealth Hub	All health programs including CHW hub
	2.10	**Electricity, Connectivity and**	**Infrastructure advocacy**	Advocate for digital health infrastructure	Stakeholder awareness	eHealth Hub	
	2.11		**Infrastructure Assessment**	Assessment of status of current digital health infrastructure at health facilities	Assessment report on status of eHealth infrastructure	eHealth Hub	

	2.12	Computing	Minimum Infrastructure	Define minimum infrastructure requirement for prioritized services and application	Guide for infrastructure deployments developed and disseminated	eHealth Hub	
	2.13		Fibre Connection	Extend fibre connectivity last-mile to district hospitals and thus provide seamless connectivity for other services	District hospitals are connected to the national fibre backbone	MIC	NATCOM
	2.14		Deploy Alternative Energy	Explore and deploy alternative energy systems at health facilities	Alternative energy deployed at health facilities	TBD	
	2.15		Deploy Infrastructure	Deploy infrastructure in support of priority services	Infrastructure enabling environment addressed	MIC, Health Programs	eHealth Hub
SOLUTIONS	3.1	Services and Application	Technical Assessment	Field assessment of digital health implementation	Report of field digital health implementation	eHealth Hub	
	3.2		Implement Registries	Implement digital registries for patient, provider and health facilities	A fully functional system with provider, client and health facility APIs available and tested	HRH, M&E, CVR, STI, eHealth Hub	
	3.3		Prioritize solutions	Prioritize services and application (Example use-case(s))	List of priority services and application endorsed by decision makers (eg. CMO)	Health Programs	eHealth Hub
	3.4		Capacity building	Strengthen capacity specific to use and support priority services and application	Strengthened capacity to use and support priority services and application	Health Programs	eHealth Hub
	3.5		Implement solutions	Implement new priority services and application and support existing ones	Prioritized services and application deployed. Support available for existing national digital health solutions (eg. DHIS2)	STI, Health Programs	eHealth Hub
	3.6		Share lessons	Disseminate best practice and create awareness of successes	Best practice documented and disseminated	Health Programs, eHealth Hub	
CHANGE AND ADOPTION	4.1	Capacity building	Capacity Assessment	Assessment to identify digital health skills gap across the country	Report of current digital health skills mapping in Sierra Leone	HRH	eHealth Hub
	4.2		Capacity integration plan	Develop a plan to integrate digital health in the pre-service and in-service curriculum of healthcare providers	Digital health capacity plan developed	STI	HRH
	4.3		Implement Capacity plan	Implement the capacity integration plan as appropriate for CHEWs, Nurses, Midwives, Doctors, Pharmacists, and	Digital health courses integrated into the curricula of pre/post service training of health workers	HRH	eHealth Hub

Annex E: M&E (Table 7 - Sierra Leone digital health Strategy M&E Framework)

ACTION LINE			INDICATOR	SOURCE/FREQ	BASELINE	TARGET	
					2018	2020	2023
GOVERNANCE	1.1	Empowerment	Percentage of districts with focal person	eHealthHub/Yearly	0%	100%	100%
	1.2		Percentage of MDAs with focal person	eHealthHub/Yearly	0%	100%	100%
	1.3		Percentage certified	eHealthHub/Yearly	0%	100%	100%
	1.4	Broad Engagement	Percentage of scheduled stakeholder meetings held	eHealthHub/Yearly	100%	100%	100%
	1.5	Funding	Percentage of MDAs participating	eHealthHub/Quarterly	NA	100%	100%
	1.6		Percentage of donors engaged and participating	eHealthHub/Yearly	NA	100%	100%
	1.7		Percentage of required funding secured	eHealthHub/Yearly	0	30%	80%
	1.8		Strategy designed? (Yes/No)	eHealthHub/Yearly	No	Yes	Yes
	1.9	Monitoring	Percentage of planned activities conducted	eHealthHub/Quarterly	0	100%	100%
	1.10	Policy & Compliance	Percentage with privacy and security capacity	eHealthHub/Yearly	0	100%	100%
	1.11		Guideline developed? (Yes/No)	eHealthHub/Yearly	No	Yes	Yes
	1.12		Guideline disseminated? (Yes/No)	eHealthHub/Yearly	No	Yes	Yes
	1.13		digital health Strategy updated? (Yes/No)	eHealthHub/Yearly	No	No	Yes
FOUNDATIONS	2.1	Architecture & Standards	Percentage of staff trained	eHealthHub/Yearly	0%	60%	100%
	2.2		Detailed architecture model has been developed? (Yes/No)	eHealthHub/Yearly	0%	50%	100%
	2.3		Percentage of use-cases validated	eHealthHub/Yearly	0%	100%	100%
	2.4		Percentage of standards	eHealthHub/Yearly	0%	100%	100%
	2.5		Percentage of persons trained on selected standards	eHealthHub/Yearly	0%	60%	100%
	2.6		Percentage of standards developed	eHealthHub/Yearly	0%	20%	100%
	2.7		Generic standards implementing guidelines developed? (Yes/No)	eHealthHub/Yearly	0%	0%	100%
	2.8		Percentage of standards guidelines developed	eHealthHub/Yearly	0%	0%	100%
	2.9		Percentage of stakeholders aware of standards guidelines	eHealthHub/Yearly	0%	10%	80%
	2.10	Electricity, Connectivity and Computing	Percentage of stakeholders aware of digital health infrastructure needs	eHealthHub/Yearly	0%	80%	80%
	2.11		Infrastructure mapping conducted (Yes/No)	eHealthHub/Yearly	0%	100%	100%
	2.12		Percentage of guidelines developed	eHealthHub/Yearly	0%	100%	100%
	2.13		Percentage of district hospitals connected to the Fibre network	eHealthHub/Yearly	0%	30%	80%
	2.14		Percentage of alternative energy solutions deployed	eHealthHub/Yearly	0%	30%	60%
	2.15		Percentage of use-cases with adequate infrastructure	eHealthHub/Quarterly	NA	70%	100%
SOLUTIONS	3.1	Services and Application	Percentage of eHealth coordination hub members aware of Services and Application field assessment report?	eHealthHub/Yearly	0%	100%	100%
	3.2		Percentage of registries interconnected	eHealthHub/Yearly	0%	30%	100%
	3.3		Percentage of priority services and application endorsed	eHealthHub/Yearly	0%	100%	100%
	3.4		Percentage of priority services and application with adequate man-power	eHealthHub/Yearly	NA	100%	100%
	3.5		Percentage of priority use-cases at scale Percentage of use-case(s) supported	eHealthHub/Yearly	NA	50% NA	100% 100%
	3.6		Percentage of best-practice dissemination activities	Health program owners/Quarterly	NA		100%
CHANGE AND ADOPTION	4.1	Capacity building	Digital health skills mapping conducted? (Yes/No)	HRH/Yearly	No	Yes	Yes
	4.2		Digital health capacity upscale plan developed? (Yes/No)	HRH/Yearly	No	Yes	Yes
	4.3		Percentage of pre/post service integration for digital health	HRH/Yearly	No	No	Yes