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MINISTRY OF HEALTH-ETHIOPIA

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HEALTHIER CITIZENS FOR PROSPEROUS NATION!

Digital Health Blueprint

Final Draft

April, 2021

MESSAGE FROM STATE MINISTER

MESSAGE FROM DIRECTOR (HITD)

PREAMBLE

Cognizant of the inevitable digital revolution that has already started to happen in several fields over many countries, the Ethiopian government has set an ambitious agenda of envisioning a DIGITAL ETHIOPIA by 2025. In light of this umbrella initiative and based on global digital innovation leaders' assessment that the health sector would be the most likely sector to highly benefit from digital revolution, the Ministry of Health decided to proactively embrace the digital solutions and services to catch up with the booming digital era. One huge measure taken in this regard is the preparation of the Digital Health Blueprint for Ethiopia (DHBP-E), the guiding and parent document.

This Digital Health Blueprint for Ethiopia, the governing document of the digital health endeavours in Ethiopia, is prepared to guide and support MOH, regions, agencies, partners, donors and private sectors in the implementation of digital health in the coming 10 years. The DHBP was developed in compliance to the “Digital Ethiopia 2025: A digital strategy for Ethiopia Inclusive Prosperity” – and tailored to the technologically booming health sector. The Blueprint will unpack – the gaps in the digital health ecosystem that are required to be tackled; the current status of eHealth and digital health implementation in the Ethiopian health system, and level of readiness of the sector for adopting emerging technologies; the ways the Ethiopian health system could change and be affected in the next ten years as a result of the boom of digital health technologies; priority focuses of the Ethiopian health sector in the digital health; the main building blocks and enablers tailored for the Ethiopian digital health; and, strategic priorities and considerations that should be in place to effectively embrace and transform the Ethiopian health system through digital health technologies.

It is necessary that all digital health stakeholders refer to this Blueprint before they jump into the investment, and adhere to the highlighted vision, goals, guiding principles, pillars, priorities and recommendations before and during implementation of the digital health endeavours.

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ABBREVIATIONS

AI	Artificial intelligence	IRR	Information revolution road map
CPD	Continuous professional development	ISO	International standard organization
DHBP	Digital health blueprint	IT	Information technology
eCHIS	Electronic community health information system	KM	Knowledge management
eHA	Enterprise health architecture	LAN	Local area network
eHMIS	Electronic health management information system	LOINC	Logical Observation Identifiers Names and Codes
EHR	Electronic health record	MFR	Master facility registry
ERP	Enterprise resource planning	MPI	Master patient index
EWS	Early warning system	NHDD	National health data dictionary
FHIR	Fast health interoperability resource	NHWA	National health workforce account
GIS	Geographic information system	PHEM	Public health emergency
HIS	Health information system	RIS	Radiology information system
HITD	Health information technology directorate	RPM	Remote patient monitoring
HSTP	Health sector transformation plan	SHR	Shared health record
ICT	Information Communication technology	SNOMED	Systematized Nomenclature of Medicine -- Clinical Terms
IR	Information Revolution	TMS	Terminology management system
		UHC	Universal health coverage
		VPN	Virtual private network

PART I: DIGITAL HEALTH BLUEPRINT FOR ETHIOPIA

1.1 ETHIOPIA DIGITAL HEALTH ECOSYSTEM ANALYSIS

The ultimate purpose of crafting health-related policies, strategies, and blueprint is to improve the quality of life by providing equitable, affordable, and quality health services. The application of appropriate technologies stands tall among the interventions that influence health delivery. In the near future, digital technologies have the potential to revolutionize how people interact with digital health services and solutions. Therefore, all initiatives related to digitization and digitalization of healthcare should be aligned with the digital advancement that continues to reshape health delivery.

Digital health strategies should be aligned with the digital health blueprint for realizing the implementation of standard digital systems that ease access to health information and data sharing thereby improving decision-making. The ambition of any strategic plan shall be to realize the integration of national, regional, and local level digital frameworks and infrastructural components by sharing data across different geographic locations and health sectors in a distributed structure.

The Ethiopian Health Sector Transformation Plan (HSTP I, 2015-20) has identified information revolution out as one of the four transformational agendas along with 1) Woreda Transformation, 2) Compassionate, Respectful and caring, and 3) Quality and Equity. These four transformation agendas were continued as the transformation agendas in the second health sector transformation plan (2020-25). To translate the information revolution transformation agenda into practice, the ministry of health has issued a detailed information revolution roadmap (IRR). As it is clearly stated in the roadmap, information revolution refers to the phenomenal advancement in the methods and practice of collecting, analysing, presenting, and disseminating information that can influence decisions in the process of transforming economic and social sectors. It entails a radical shift from traditional methods of data utilization to a systematic information management approach powered by a corresponding level of

technology. The Information Revolution is not only about changing the techniques of data and information management; it is also about bringing about fundamental cultural and attitudinal change regarding perceived value and practical use of information (*Information Revolution Roadmap I/ 2016-20*). The roadmap envisions connected woreda and identified two pillars for the information revolution agenda: 1) Cultural Transformation for health data use and 2) Digitalization and scale-up of priority health information systems. The rationale for developing this Information Revolution Roadmap is that all functions of the health system rely on the availability of timely, accurate, and dependable information for decision making. Revolutionizing the availability, accessibility, quality, and use of health information for decision-making processes, through the appropriate use of information communication technology, can ultimately impact the access, quality, and equity of healthcare delivery at all levels in Ethiopia.

Even though they are not formally endorsed, the Ministry of health has also been working on the development & cascading of health information systems and digital health related national documents. These include information revolution roadmap II (2020-2029?), Information revolution strategic plan (2018 -2025), Ethiopia eHealth architecture (2019), and ICT policy and digital health strategy (2021-29).

The Ethiopian eHealth architecture(eHA) redefines the obsolete state and operating procedure with a defined enterprise architecture blueprint that designates business, data, technology, and process principles in every component and participating systems. The architecture encourages implementers to use any technology and innovation as long as they use agreed business processes and profiles with uniform terminology and messaging data standards. It shall also play a vital role in making the eHA functional, realizing its goals, adding governance, ownership, socializing it, and thereby creating government buy-in.

The draft Ethiopia Digital Health Strategy 2020-29 envisions the overall organization and application of Information Communication and Technology for the service delivery, application development and infrastructure improvement of the health sector to improve the health delivery system. It involves the strategic objectives addressed by the Health sector transformation plan II.

The ICT policy prepared by the Health Information Technology Directorate of MOH in 2017 was significant for underlining that ICT is a fundamental component of digitalization of the health sector as a whole. This policy sets up the basic requirements for implementing ICT-supported health services. Also, it is supposed to provide a framework that enables Health Information Technology Directorate (HITD), enhance security of the ICT infrastructure, make sure regional and international standard compliances are attained, and avail efficient IT support.

Different policy, strategy, roadmap, and directive documents were produced by the MoH at different directorates in recent years which focused on improving eHealth. Analysis of these documents showed that the documents are developed in line to global recommendations and toolkits. They focus on health information systems and data use for decision making. They are prepared for decision makers and implementers in the health sector. Most of the documents have proposed feasible solutions to improve the existing disparate and fragmented digital health systems and on-going implementations and scale-ups in eHealth. However, they are either on the initial draft or unpublished to date. This created unclear implementation and scale-up plans; a lack of binding policies and roadmaps among stakeholders; and a rework of the same document. Furthermore, these documents do not give much attention to the rapidly changing and booming digital health technologies.

1.2 UNDERSTANDING AND FORECASTING THE FUTURE

The Ethiopian government has already incorporated new technologies in different sectors such as banks, security, and governance. This shows that there is an appetite and aptitude to leverage the benefit of emerging technologies to leapfrog Ethiopia to the digital era which will realize health system transformation. However, it will require focused leadership, innovative private sector, committed international stakeholders, and civil society for Ethiopia to realize the potential of the rapid rise of digital health technology.

The introduction of Digital health in Ethiopia will support different aspects of health sector activities such as management of patients, public health data, healthcare workers capacity building, remote health service delivery, health information provision using mobile

technology. Mobile technology and Internet use would accelerate the implementation of the health Sustainable Development Goals (SDGs) and Universal Health Coverage (UHC).

Though digital health has already been proven to advance health service delivery in different countries such as Korea, Canada, and other, in Ethiopia it is yet to be harnessed because of several inevitable challenges such as highly fragmented initiatives, poor coordination, scarce of prepared health workforce ready for digital health, poor power and Internet infrastructure, lack of sustainable financing, and others. To look forward and bring about quick decisions by the leadership for rapid, cost-effective, and sustainable development of digital health in Ethiopia, the introduction of the digital health blueprint document will have a significant game-changing effect on the staggering appetite and aptitude of the government to transform the country to digital space.

From a policy-making perspective, emerging technologies are of interest as they shape future investment. Being an early adopter in technology creates the basis of modern competitive strategies that are destined to have a profound and long-lasting impact on existing businesses and create opportunities for new ones. For a technology to be considered as emerging it needs to have radical novelty, relatively fast growth, coherence, prominent impact, and uncertainty and ambiguity. Emerging technology generally refers to a new technology or a continuing development of existing technology expected to be available within the next ten years and create significant social or economic effects. In healthcare, they have great potential in transforming health service delivery. Such technologies that have a significant effect on the digitization of health systems include but are not limited to Cloud Computing, the Internet of things, blockchain, data science, artificial intelligence, mobile and pervasive computing. These technologies have a disruptive effect on the way service is delivered and can be harnessed towards productively and creating a healthy population.

Healthcare has already become dependent on technology and repurposing of health data to bring new insights for improving health service delivery. The Application of healthcare technologies has brought healthcare professionals and patients closer regardless of their physical distance. This is because of emerging digital technologies and their application in healthcare to realize better and more affordable healthcare services and personalized healthcare services.

Some of the Applications of emerging digital technologies as of today in healthcare are:

- Mobile Health - empowered by AI to detect or prevent health issues.
- Robot-assisted surgery - improve flexibility, control, and precision during complex surgical procedures.
- Predictive Analytics - uses patient data, statistical algorithms, and machine learning approaches to predict imminent diseases.
- AI-based Check-ups and care planning - with the aid of patient digital ID and digital payment.
- Analyze and predict infectious disease using AI-based surveillance systems.
- 3D printing: impacts the healthcare in 3D-printed orthopedic implants, Personalized surgery and Medical & Dental devices.
- Cybersecurity - Securing patient data using trusted AI models over Blockchain in digital health.

Health service delivery has been progressing by strengthening strategic interventions, engaging the community as a centrepiece of the process, and investing in capacity building in collaboration with universities. The introduction of the Ethiopian eHealth Architecture (eHA) provided a clear picture of the current state and future direction of the country's health sector in the digital space envisioned by the government. The eHA is designed to accommodate existing and emerging technologies as health needs, priorities, and interventions of the country grow and change.

Therefore, the MoH and stakeholders have an astonishing appetite to advance the healthcare access and service that is aligned with the trends that shape the health systems of the future. For the next 10 years, the health system will be changing under the influence of booming technologies such as mobile technology, Artificial Intelligence, genomics revolution, blockchain, and others. Also, the global demographic dynamics, sustainability of the health systems, and capacity building of the healthcare workforce are determinant factors for changing the health system.

With the advent of the fourth industrial revolution, the health system context is not going to be the same. The way patients and doctors interact, how diagnosis and treatment are done are all going to be affected by technology. With patients becoming aware of their medical condition through the support of Internet-enabled medical devices their choice for a medical professional and the demand from the health sector is going to be vast. The health system needs to be ready and resilient to accommodate changes. A learning health system enabled by digital health technology should also be created to ensure continuous improvement and innovation and provide quality, equitable and affordable health care. The Ethiopian health system shall thus be cognizant of this global change and adapt to cope with changing needs and be ready for national and global challenges related to outbreak and pandemic needs.

Paradigm shifts are mostly caused by the emergence of disruptive technologies or unavoidable crises. For example, the COVID-19 pandemic has brought a significant havoc to the business as usual globally. The pandemic overturned the conventional process in the healthcare system. It is mandatory to understand the very nature of health care dynamics in order for the blueprint to be fit-for-purpose. The increasing demands, constantly evolving processes, and other influences that potentially shape how healthcare will be provided in the future are the things the health sector needs to consider. Given the vast constraints for the health sector, the opportunities for implementation of digital health solutions are extensive where the appropriateness of the solution and involving emerging technologies shall be prioritized.

The digital health blueprint preserves the overarching prospect of previously crafted policies, strategies, plans, and roadmaps. This would encourage existing and ongoing developments to be part of the blueprint and eliminate reinventing the wheel. Digital health blueprint will lay significant emphasis on leveraging digital technologies for improving health delivery services, bringing cultural shifts on information use, introducing emerging technologies, and empowering the health workforce to seamlessly shift the paradigm.

1.3 WHY DIGITAL HEALTH BLUEPRINT FOR ETHIOPIA? AND WHY NOW?

In the digital health era, when solutions and services are being disrupted by digital health technologies, countries need to have a way of tapping the potential of such technologies.

Ethiopia has taken an ambitious and bold country wide flagship strategy ‘Digital Ethiopia 2025’ with the aim of benefiting from the opportunities of digital revolution and emerging technologies such as Artificial Intelligence, the Internet of Things, Nanotechnology, Big Data, and other cutting-edge technologies.

The health sector is one among those that are highly influenced by services leveraged by digital technologies. Having an overarching strategic guidance that will lead the investment and implementation of digital health is vital. Thus, the digital health blueprint would have a paramount importance for the health sector to align its eHealth and digital health initiatives with the country’s bold and courageous move.

Whilst the Information Revolution guided the implementation of electronic health during HSTP-I, there are several grey areas left off, including the contribution of digital health for health services is not bold enough to address the emerging role of digital technologies in health care and services. Hence, this blueprint is meant as a way of adapting to local and global digital health technological dynamics by leapfrogging to the digital health era. Given the current situation of the health system in Ethiopia, digital health might seem to be a luxury. In practice, countries should not reinvent the wheel and pass through all the development of digital health.

The digital health blueprint will be the guiding document from which other initiatives emanate and expected to be aligned with. The blueprint shall not in any way replace the information revolution roadmap or other existing eHealth policies and strategies. It rather gives a lens with which it has to be seen i.e., from the perspective of digital health instead of eHealth. It should inform its priorities, values, and strategies for implementation by creating alignment with the blueprint and other policies. The blueprint shall also add patterns of implementation by unifying initiatives and gearing them towards the desired vision. By Unpacking digital health domains placing them in respective pillars, the blueprint will insure ignored areas are included and bring equitable service.

The blueprint is broadly meant to harness the huge potential of digital health technologies by building on the lesson learned and progress made through the works of the information revolution. To be able to leapfrog and catch up with emerging and disruptive digital health technologies, there needs to be a framework for architecting and deploying digital health solutions along with considerations for design choices and strategic planning. It shall also

guide digital health solution provision and transformation from the eHealth era to the digital health era. Though the available policy documents are of paramount importance to digitize the health information systems in the country, they needed to be forward-looking in the sense of encompassing emerging technologies. The blueprint shall elevate those initiatives and make them mainstream agendas in the health sector.

The blueprint has to bring fundamental cultural and attitudinal change regarding the perceived value and practical use of digital health solutions. This can be done by bringing together the lessons and plans put forward in the various documents stated earlier to create a national digital health blueprint that can act as the foundation on which the national digital health ecosystem can be built. There is also a visible demand by patients, health workers, and various stakeholders for innovative digital health solutions. The blueprint thus intends to create a holistic and comprehensive digital health ecosystem.

The blueprint can also lay a foundation for a strong ICT infrastructure, reliable solutions and service, and sustainable access and delivery for patients. This would help streamline the delivery of healthcare services and related information. It illustrates how current and emerging technologies can be incorporated into health care delivery processes to enrich the functionality, generate greater efficiencies, and enhance the experience for health service providers and consumers.

The digital health ecosystem in Ethiopia is thus in need of synchronization of various initiatives through the development of a digital health blueprint which will be acting as an overarching guiding document to create a clear vision. Thus, this would provide guidance and insight into the use of emerging technologies and new digital health opportunities. In a nutshell, the scope of the blueprint is to create an overarching foundational plan for digital health in Ethiopia and will serve for 10 years (2021-30).

PART II: VISION, OBJECTIVES, GUIDING PRINCIPLES AND PRIORITIZED INITIATIVES

2.1. VISION

To bring quality, affordable, equitable, and technology enabled health service delivery by 2030.

2.2. MISSION

To avail effective, reliable, secure, and innovative digital health systems to support policy & strategic development, clinical decision making, patient management, healthcare provision, education and research functions of the health sector .

2.2 OBJECTIVES

The objectives of the blueprint are to:

- Have an overarching document that should govern the fragmented initiatives
- Guide leaders to oversee ongoing progress in the digitization of the health sector
- Create alignment of initiatives and thereby avoiding duplication of effort
- Coordinate and strengthen initiatives to boost the impact
- Bring about a shared vision of current and emerging digital health solutions and services
- Foresee challenges that could come along with the application of new technologies and prepare a mitigation scheme
- Put forward the priorities and opportunities
- Create scalable ICT infrastructure taking into account the current and future demand with the engagement of stakeholders
- Help leapfrog to the next era while being cognizant of current challenges and harnessing opportunities
- Improve the quality of healthcare access and service delivery using digital health solutions.

2.3 GUIDING PRINCIPLES

The following are the values of the blueprint which defines the core philosophy of the digital health ecosystem:

Synergy - create combined actions among different initiatives by creating a clear vision of current and emerging initiatives and also inform and harmonize HIS documents.

Alignment with the the sectoral objectives:- The digital health system should follow the priority areas of the health system strategic objectives

Mainstreaming - digital health blueprint objectives shall be carried out as part of mainstream health system activities as digital health technologies are the means, not the end.

Patient/Client centered:- Digital health priorities are geared towards the benefits of patients/client.

Local contextualization - to realize sustainability, the digital health blueprint should be adaptable to local contexts by providing due consideration to the human, financial, cultural situations on the ground.

Multi Sectoral Engagement - collaboration between organizations in different sectors public or private to achieve policy outcomes.

Leveraging Global Goods - are digital health tools that are adaptable to different countries' context. Implementers need to start with global goods that have open architecture.

2.4 PRIORITIZED DIGITAL HEALTH TECHNOLOGY ENABLED HEALTHCARE FOCUS AREAS

Although digital technologies bring huge and countless opportunities for transforming the health care, all possible opportunities cannot be piloted and implemented at larger scale at the same time because of financial and human capacity constraints. Selection and prioritization of high impact digital health interventions considering the country's context would be mandatory. So far in the past couple of decades, the Ethiopian health system has been giving priority to

digitalization of health information. However, in the digital health era, much can be done beyond in parallel to digitizing health data depending on the actual need of patients, health care workers, managers and the community at large.

In this section, the potential high impact digital health investment focus areas are highlighted. The areas have been identified by consulting the Digital Ethiopia 2025 and WHO recommendations of digital health interventions. Consultative meetings with the national advisory group (NAG) for digital health and representatives taken into account. Moreover, a health system perspective of MOH was reviewed and included.

1 Health System Leadership and Governance: Digital Performance Management

One of the critical challenges in the Ethiopian health system is creating accountability and merit-based performance evaluation. The work of healthcare managers and healthcare workers is usually evaluated through meetings and supervisors - and they are all paper-based. This paper-based method of evaluation often depends on the supervisor's judgment. It doesn't evaluate processes and outcomes as intended and it also doesn't show the quality of work or performance of the health worker and manager. Because of the capabilities of digital technologies to collect real-time and objective data, having a digital health intervention for monitoring and evaluation of the performance of health care workers and managers would significantly improve the leadership and governance of the Ethiopian health system.

2 . Health Service Delivery: Remote Health Care Delivery

Two of the nine WHO minimum digital health recommendations for developing countries are client-to-provider telemedicine and provider-to-provider telemedicine. These two digital health interventions can be effectively implemented in Ethiopia given the right commitment and follow up are in place. In particular, provider-to-provider telemedicine can be effectively and easily scaled up in the next ten years as almost all health care providers own mobile phones.

3 . Health Workforce: Digital Decision-making Support and Learning

Despite the massive improvement in access to health services, Ethiopian health care remains to be of poor quality. This is mainly due to the poor quality of health workers training and low level of health workers' knowledge and skill retention, particularly, among mid-level and frontline health care workers. To address this critical problem, the country has been investing millions of dollars in capacity building and refresher trainings for health workers. However, the effectiveness of these in-service trainings and sustainability of such trainings in the absence of donor money is daunting. Supporting and partly replacing these onsite and in-service trainings with digital decision-making support and learning tools and approaches is commendable. By doing this, the cost for trainings and continuous professional development can be reduced significantly and gives health workers the freedom to learn anytime and anywhere at their own pace, need, and convenience.

4 . Healthcare Financing: Digital Health Payment

Introducing and scaling-up of digital payment is one of the highly prioritized projects in the Digital Ethiopia 2025. The government is committed to have digital payment in all sectors and institute e-commerce as it aspires to benefit from the digital economy. So far, in Ethiopia, the banking sector is pioneering and has gone far in transforming its services to electronic, including ensuring digital payment. The health sector has equal opportunities of benefiting from introducing and scaling up of digital payment schemes. The community-based health insurance is one mentionable service of the health sector that can be practically digitized. Although currently the revenues that the government collects from health services is low compared to other sectors, health care is the future industry that can generate huge revenues for government and private companies. Thus, modernization and digitizing the payment and revenue collection of the health system is one of the leapfrogging areas that will open several opportunities for the private and government sectors.

5 . Digital ID

As noted earlier, most of the efforts of the Federal Ministry of Health have been in digitalization of the health data and health information system. As a result massive improvement has been achieved. Under the umbrella of connected woreda strategy, the

implementation of the likes of HMIS and community-based information systems is making promising progress. However, because of the lack of unique ID for every citizen and patient, making the systems interoperable has been one of the areas of struggle - and as such, better use of data collected through these platforms is greatly hampered. Having a unique digital ID for every citizen in the country is a prerequisite for transforming the electronic health information system. Thus, it should be a top priority digital health focus area in the health sector, as underpinned in the Digital Ethiopia 2025. Meaningful and strong collaboration with relevant sector offices, particularly Immigration, Nationality and Vital Events Agency (INVEA), is necessary in this regard.

6 . Healthcare Medical Products, Vaccines and Technologies: Point of Care Disruptive and Diagnostic Technologies

Four main manifestations of the fourth industrial revolution are autonomous vehicles, 3D/4D printing (additive manufacturing), advanced robotics, and smart materials. The applications of these four manifestations coupled with rise of nanotechnology, artificial intelligence and advancement of sensors opens for new disruptive medical products and technologies. Medical technologies are expensive and are unaffordable for many developing countries. The cost of maintenance, electricity needed and reagents for such medical equipment is even beyond the initial cost. Thus, looking for alternative disruptive technologies is essential. Nowadays globally there is a shift from the development of high cost and complicated medical equipment that can be operated by highly skilled professionals to simple point of care tests that can be operated by mid-level and frontline health care workers. In the near future, point of care tests that would replace the current MRI, CT scan and Ultrasound would be available not only at referral hospitals but across all levels of health facilities. A typical example is the development of portable and mobile ultrasound which was unthinkable some years ago. Ethiopia shall focus on the investment and development of such disruptive point of care tests as its benefit is multiple and transformative agendas.

7 . People: Digital Literacy

The ultimate purpose of technology should be to improve people's life and serve humanity - so do digital health technologies. From the health care perspective, technology is a means. It is not an end by itself. Any digital health intervention shall be seen

and judged from its usefulness to improve patient's experience, the work of healthcare workers, healthcare managers and improve health outcomes. On the other hand, no matter how a digital health technology is well designed, it can't achieve the desired outcome without adequate use and adoption of the people in need. For this digital literacy of the whole society and users is imperative. Needless to say, Ethiopia's digital literacy among the general population is low. Much has to be done to improve digital literacy of Ethiopian people.

One avenue that the health sector can contribute to the improvement of digital literacy is through the health extension program and other tailored community-based programs. Through these community based programs, social mobilization can be done for digital literacy. Basic and innovative trainings can be considered as part of the health extension program and school health program to improve digital knowledge and skills of the people. In this regard, the issue of local language shouldn't be forgotten - as one of the critical barriers for adequate usability and adoption of digital health technologies is language. Thus, having devices that can handle local languages and development of digital health contents in local languages is mandatory in terms of both improving digital literacy and enhancing effective use and adoption of digital health interventions.

8 . Research and Development: Digital Health Research and Development Centre

The Ethiopian government, through Digital Ethiopia 2025 has highlighted science, technology, and innovation as key enablers in promoting the ability of Ethiopia to realize its full potential in the digital space. Thus, MoH with local and international stakeholders should focus on strengthening research on the application of emerging technologies for realizing digital health in Ethiopia. Locally driven research outputs would help the leaders and policymakers to understand the country's contexts. Engaging universities, private technology companies, donors and strategic digital health partners will have a paramount advantage in terms of translating insights gained from research. This could be realized by creating centres of excellence at academic institutions and technology incubation centres at the national and regional levels.

PART III: BUILDING BLOCKS/PILLARS OF THE DIGITAL HEALTH BLUEPRINT

3.1. DESCRIPTION

Building blocks/pillars of the digital health blueprint constitute the significant elements which are crucial for the realization of the objectives of the blueprint. The main principles for the selection of these pillars are that it should be of high impact for the success of the ecosystem, key/critical component for the blueprint, require high focus and attention from all stakeholders. Each Building block has a specific functional scope and that can be integrated with other pillars and enablers to create a digital health ecosystem.

By adopting the pillars under WHO ICT and enabling environment [¹] to our current needs and also conducting a detailed review of other countries' experiences and practices, four building blocks or pillars and five key enablers were identified. Thus, the pillars are Access and Delivery, Solutions and Services, ICT Infrastructure, and Data Hub. These pillars more or less match both the HSTP II's classification of digitalization activities and WHO's foundational ICT environments. The classification of the interventions is based on the WHO recommendation [²].

3.2. DIGITAL HEALTH BLUEPRINT CONCEPTUAL FRAMEWORK

Based on the identified pillars and enablers, a conceptual framework for DHBP is designed to demonstrate how the building blocks of the DHBP are interlinked and interact with each other. Moreover, enablers of these building blocks are also mapped, adapted from WHO's toolkit for developing eHealth strategy and ITU's toolkit for building Digital Health Platform (DHP)[³], and shown as in the diagram below.

¹ National eHealth Strategy Toolkit

² recommendations on digital interventions for health system strengthening

³ [Digital Health Platform Handbook: Building a Digital Information Infrastructure \(Infostructure\) for Health](#)

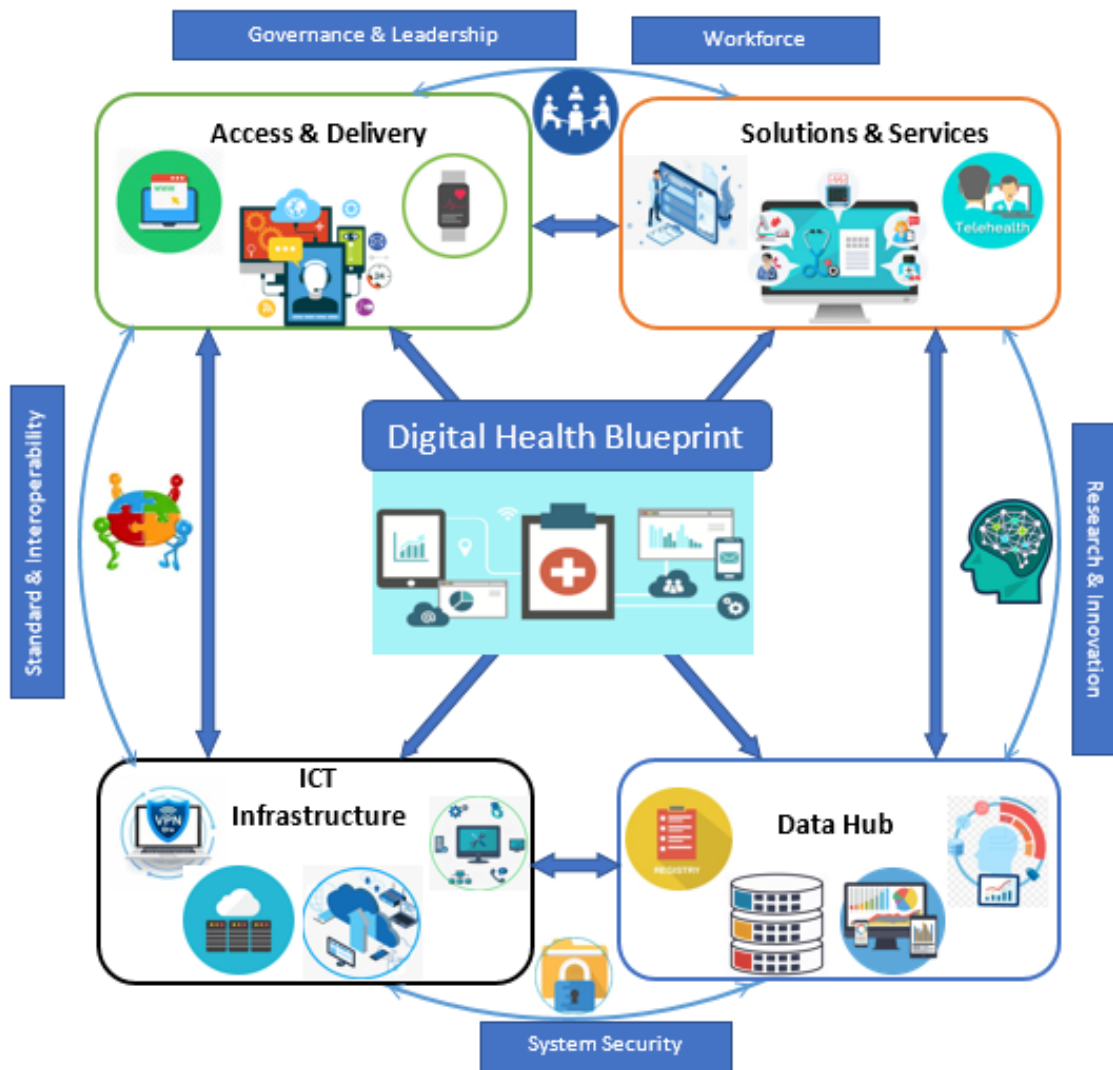


Fig 1. Conceptual framework of the Blueprint

3.3. PILLAR 1: ICT INFRASTRUCTURE

ICT infrastructure includes the hardware, software, networks, facilities, etc., that are required to develop, test, deliver, monitor, control or support IT services. The ICT infrastructure here refers to Servers, Computers, Printers, Tablets, Network Connectivity Components, Software, Firmware and facilities, among others – that we use in the health sector to support or improve health service delivery mechanisms with a diverse set of digital health solutions and services to foster interaction amongst different stakeholders. This pillar allows one to facilitate, govern and establish, secure, accessible and manageable ICT infrastructure that can run solutions, services and access of data in the Ethiopian health sector. This includes facilitation and governance of infrastructure establishment in public and private sectors; development and endorsement of the policy for health ICT infrastructure; and continuous assessment and amendment of the current and emerging ICT infrastructure technology needs.

Focus Areas

This pillar focuses on establishing, expanding and maintaining a highly secure, scalable and compatible ICT Infrastructure that is capable of accommodating Ethiopia's digital health initiatives at all levels. Specifically, its concern with:

- Creating scalable ICT infrastructure, and enforcing workable implementation and scale up approaches.
- Deploying infrastructure accommodating current and future needs;
- Establishing operational support at all levels;
- Establishing comprehensive and efficient policy, procedures and regulation for governing ICT infrastructure;
- Establishing collaboration and support mechanisms in infrastructure development with stakeholders – including the private sector;
- Establishing emerging technology infrastructure adoption and regulations mechanisms for leapfrogging.

Recommended interventions under the Digital Health Infrastructure Pillar are further unpacked in the “Digital Health Blueprint Pillars Action Plan” part of the Annex(Annex 1).

3.4. PILLAR 2: SOLUTIONS AND SERVICES

This pillar deals with digital health solutions and services that integrate the digital health ecosystem participants (clients, health delivery centers, practitioners, policy makers, solution creators and providers) through a systematic and seamless development of digital health technologies to improve service quality and accelerate ease of access to health services. The solutions and services will be (and should be) based on the real business requirements and priorities of the health sector. The digital health solutions and services are categorized based on primary target user groups: Client-oriented, Provider-oriented, Manager-oriented and Data-services-oriented solutions and services. Strategies are proposed in a bid to implement high-impact and sustainable digital health solutions and services.

Focus Areas

The main focus of the Solutions and Services Pillar is expediting digital health usage and adoption through identification, classification, and prioritization of digital health solutions and services following a holistic and principled approach so as to improve service quality and enhance Universal Health Access (UHA). The Digital Health Solutions and Services have mainly to do with:

- Ensuring the implementation and/or adoption of globally acceptable and contextually tailored digital health solutions and services for the health sector;
- Adapting eHealth standards and systems architecture to ensure harmonized and interoperable eHealth applications;
- Promoting the development and use of enterprise-class health application system;
- Promoting the development and adoption of state-of-the-art and remotely accessible technology solutions to enhance equitable access to health services;
- Identifying and defining/setting standards and regulation mechanisms for the proper implementation and use of digital health solutions and services;
- Defining appropriate implementation arrangements for the implementation of digital health solutions and services;

- Conducting/Assessing the maturity of solutions and services and promoting improved maturity status.

This can be achieved through: an integrated approach to stakeholder management and alignment of priority initiatives; raised awareness and improved confidence for utilization of digital health solutions and services; strong interoperability platforms to support sharing of health information across fragmented systems, geographical and health ecosystem boundaries; enforcement of community and human-centered design principles; and, establishment of a platform to develop capacity and technical know-how amongst stakeholders.

Recommended interventions under the Digital Health Solutions and Services Pillar are further unpacked in the “Digital Health Blueprint Pillars Action Plan” part of the Annex(Annex 1).

3.5. PILLAR 3: DIGITAL HEALTH ACCESS AND SERVICE DELIVERY

Data access and service delivery pillar of the digital health Blueprint encompasses programs to create and improve data access to various audiences and actors including public/citizens, clients/patients, health care providers, health care managers, researchers, academic institutions, donors, implementing partners and other health sector stakeholders. It also deals with facilitating health service delivery by creating and deploying apps for clients /patients, and health care workers. Accordingly, it improves client-provider interaction, increases health literacy and decision support by health data users.

Focus Areas

The Data Access and Service Delivery Pillar mainly focuses on improving service quality and wellbeing of citizens by making data easily accessible for decision making by all stakeholders and enhancing the use of digital health technology by clients/patients and health care providers to improve health service provision processes. Specific focus areas include, but not limited to:

- Identification of different data sources, pulling and integrating the data/information from the sources and repositories and making it suitable for access by the users;

- Assessing the existing and emerging technologies used for data/information access and service provisions to the clients;
- Proposing, adapting and framing the data, information and service delivery technologies to suite local contexts and situations;
- Promoting the health data to be made accessible for assimilation by the tailored audiences.

Recommended interventions under the Digital Health Access and Service Delivery Pillar are further unpacked in the “Digital Health Blueprint Pillars Action Plan” part of the Annex(Annex 1).

3.5. PILLAR 4: DIGITAL HEALTH DATA HUBS

The Digital Health Data Hubs Pillar aims at creating interconnected health information/data systems to support health care informed decision and service delivery. The basics of this pillar are data transformation, exchange and integration, data archiving, data management and analytics to generate reliable information and evidence for decision. It encompasses identifying relevant data sources, extracting data from the sources, transforming and harmonizing data, and making them analysable, establishing and managing data repositories and securities, putting in place data governance standards and regulations, enhancing standards for data exchange/sharing, and applying robust data analytical tools. The pillar functions at all levels of the health sector and relevant actors that include government sector, non-government institutions, donor organizations, private institutions and other relevant stakeholders. It is concerned with all health and health related data with their respective data sources and institutions, data standards and regulations, building state of the art data systems and capacities to produce reliable evidence for all relevant users.

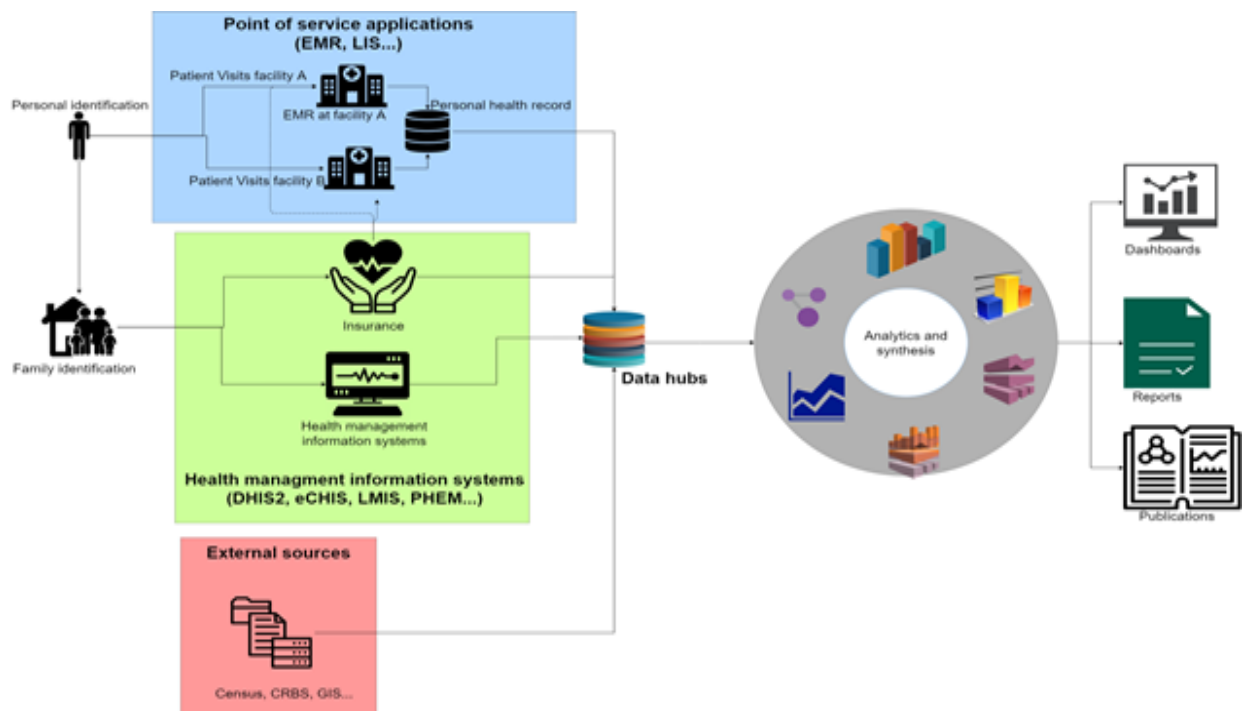


Fig. 2: Workflow of data exchange between multiple sources, data warehouses store massive amounts of data generated from various sources, data processing using analytic pipelines to provide information for access and delivery.

Focus Areas

The major focus of this pillar is building and strengthening interconnected data systems through interoperability framework, governance, workforce development and capacity building. This includes establishing a robust information exchange between actors, improving health data quality and integrity, implementing research and innovation, applying data analytic tools and methods (such as machine learning/artificial intelligence, and big data analytics) and fostering health intelligence. Some of specifics include the following:

- Making data systems interoperable and interconnected, facilitating data exchange and access for seamless data sharing between endpoints;
- Ensuring data governance through standards and regulations to enhance open data systems and data access;
- Establishing and strengthening national and subnational data repositories with appropriate security systems;

- Applying computational techniques and methods such as machine learning/, artificial intelligence, big data analytics and fostering health intelligence;
- Building data capacity including the workforce;
- Promoting and advocating for data use and incentives;
- Enhancing research and innovation on data systems, applications and services;
- Generating quality and reliable evidence and disseminating with different formats such as publications, reports, dashboards.

Recommended interventions under the Digital Health Data Hubs Pillar are further unpacked in the “Digital Health Blueprint Pillars Action Plan” part of the Annex(Annex 1).

PART VI: ENABLERS OF THE DIGITAL HEALTH BLUEPRINT

4.1. DESCRIPTION

Enablers of the blue print constitute elements which are essential for the successful implementation of the building blocks. They are cross functional in their nature and due emphasis is given for their consideration in each pillar. They are equally important for the successful implementation of the blue print along with the building blocks and proper analysis should be made when considering implementation of digital health initiatives.

The following enablers have been identified for the digital health blueprint.

4.2. STANDARDS AND INTEROPERABILITY

Healthcare applications in Ethiopia usually offer different sets of features and functionalities with different structures and data formats. However, most of these applications do not use common data elements or data exchange standards. There should be a mechanism to enforce a consistent use of standards and adoption of them on a regular basis to guide the newly developed digital health solutions. By so doing, we can address the gaps and support interoperability and information sharing across various healthcare applications and systems.

Focus Areas

This Enablers focuses on adopting and promoting the globally recognized and nationally adopted standards which enable interoperability among eHealth applications to meet international norms and standards as a cornerstone for integrated health information systems in the health sector. Specifically, this Enabler has a lot to deal with:

- Promoting a central curation mechanism for data, indicator and unique identifiers;

- Adapting an enterprise service bus layer/interoperability solution to make applications interoperable;
- Promoting the usage of health data exchange standards;
- Developing and operationalizing a digital health inventory system/Digital Health Atlas to be used as a clearinghouse for compliance and standards;
- Improving capacity building and creating a knowledge sharing platform;
- Defining and implementing metrics for evaluating the values added to the health system by implementing an interoperability solution;
- Setting up a regulatory body that follows up and enforce data exchange standards.

Recommended interventions under the Standards and Interoperability enabler are further unpacked in the “Digital Health Blueprint Enablers Action Plan” part of the Annex(Annex 2).

4.3. SYSTEM SECURITY

System Security is one of the cross-cutting enablers that should be taken into consideration in all identified pillars and enablers of this Digital Health Blueprint. Based on ISO 27001, it is described as vital to the business and daily operation of any organization related to research, administration, and management. Information that is collected, analyzed, stored, communicated, and reported upon may be subject to theft, misuse, loss, and corruption. It may also be put at risk because of poor education and training, and the breach of security controls. Information security incidents can give rise to embarrassment, financial loss, non-compliance with standards and legislation as well as possible judgements being made against an organization/institution. System security encompasses all facets of accessing information assets from authentication, to software updates, anti-virus protection, and modifications. System security also is a key component to a device operating at its optimum. Hence a defined level of system security and its supporting controls, processes and procedures will be applied to all individuals and stakeholders who access the health sector’s ICT infrastructure, solutions and services and the data hub.

Focus Areas

The primary considerations of System Security in digital health system are:

- Identifying possible Information risks, management options and treatment procedures in all initiatives;
- Establishing all physical, procedural, and technical control mechanisms to address the security concerns of all the Digital Health Pillars;
- Ensuring that appropriate tracking measures are put in place for the authorized users to securely access and share health information.
- Establishing secure information exchange across the digital health ecosystem.
- Ensuring that contractual and legal obligations relating to information security are met.
- Enabling that research, innovations, and administrative activities consider relevant information security protocols.

Recommended interventions under the Digital Health System Security enabler are further unpacked in the “Digital Health Blueprint Enablers Action Plan” part of the Annex(Annex 2).

4.4. RESEARCH AND INNOVATION

Digital health interventions should be supported by suitable research in all aspects, from conception to development and deployment of new models, services and products. It also helps to generate innovative ideas and solutions, incorporate risks and assumptions, and identify existing best practices and challenges during implementation. Likewise, the need to monitor and report global developments and trends in digital technologies used in health systems, public health and data science will advise us to depend on digital health research and innovation. The research and innovation agenda should align with the emerging needs to improve and disseminate evidence and information on the use of digital health at all levels. It should justify the return-on-investment of digital health and help the establishment and promotion of accountability mechanisms. The research and innovation agenda should also address the need for stimulating the development and testing of technologies, methods and infrastructures that overcome obstacles to the application of digital health and health priorities. This agenda should be closely linked with capacity-building of research teams.

Focus Areas

The overarching digital health research and innovation priorities for Ethiopia include implementation model effectiveness studies; feasibility studies; return-on-investment studies;

equity and rights analyses; Big Data Analyses; Predictive Models; Data Access versus confidentiality wrestlings; Artificial Intelligence; Business Analytics; Internet of Things, and the like.

Recommended interventions under the Digital Health Research and Innovation enablers are further unpacked in the “Digital Health Blueprint Enablers Plan” part of the Annex(Annex 2).

4.5. DIGITAL HEALTH WORKFORCE

The digital health workforce with appropriate education, skill mix, quality and adequate quantity at all public health offices and facilities is crucial to keep the digital health systems implemented and running to transform the overall health care services in the sector. The Workforce Enabler guides the design and implementation of the human resource roadmap (structure), appropriate curriculum (both for pre-service and in-service modalities) tailored to the digital health workforce and the health workforce at large emanating from the needs of the health system. There is an understanding that strengthening of the ICT health education and training programmes at post-secondary educational institutions such as universities, vocational training institutions and professional bodies by embedding Digital Health into their curricula and thereby increasing the number of skilled, nationally available digital health practitioners can enable the leapfrogging to the technological advancements used in health care delivery. Hence, systematic efforts should be made to create and foster an environment that encourages and supports digital health employees to remain employed. This can be done by maintaining strategies and practices in place in the bid to address their diverse needs. It is also equally important to create structure for the demand of digital health and assign appropriate workforce at all levels.

Focus Areas

The main focus of this Enabler is maintaining competent digital health workforce that can establish and maintain effective digital health systems with the aim of having resilient health systems and to realizing digital literacy among the entire health workforce. More specifically the Digital Health Workforce Enabler emphasizes on:

- Establishing and implementing digital health workforce standards and structures at all levels of the public health sectors;
- Developing curriculum of up to standards for in-service and pre-service trainings for post-secondary educational level digital health and other health workforce;
- Enhancing the capacity of the digital health workforce through development of tailored training programs for pre-service and in-service modalities to enable them capture, analyze and report using the digital health systems;
- Establishing digital health workforce retention mechanisms.

Recommended interventions under the Digital Health Workforce enabler are further unpacked in the “Digital Health Blueprint enablers Action Plan” part of the Annex(Annex 2).

4.6. GOVERNANCE AND LEADERSHIP

Digital Health governance and leadership is a mechanism by which decisions related to digital health planning, funding, implementation, monitoring, etc. are overseen augmented with proper digital health policies, legislation, compliance, and standards – with the aim of enabling the health system to use the digital technologies to maximize achievement of health care services. Availing strategic policy frameworks combined with effective oversight, coalition-building, regulation, and attention to system design and accountability is the key role of this Enabler. Likewise, it is also vital to enhance the leadership capacity to lead the overall execution of digital health strategic initiatives.

Focus Area

One of the major focus areas of the digital health leadership and governance is the creation and improvement of the functionality of the various digital health governance structures and framework at national and regional levels. This is done in light of the realization of inclusive and transparent digital health decision-making, consensus building and accountability with the intent of directing, implementing, enforcing, monitoring, and evaluating the digital health initiatives.

The other focus area is the realization of digital health via active engagement of multiple stakeholders with varied interests and priorities for the multi-stakeholder dialogues (MSDs),

facilitation of consensus building through collective identification of challenges, recognition of shared goals and interests, and creation of best considered solution pathways within this governance framework.

The third focus area is establishing appropriate digital health policies and legislations at national and regional levels and providing legal and policy framework for digital health implementation and operations. It is increasingly important to establish digital health related protocols, standards or SOPs and regulatory and formal compliance mechanisms to ensure the risk-tolerant digital health investment and funding.

Recommended interventions under the Digital Health Governance and Leadership Pillar are further unpacked in the “Digital Health Blueprint Enablers Action Plan” part of the Annex(Annex 2).

PART V: IMPLEMENTATION APPROACHES AND STRATEGIES

The blueprint will guide implementation of national as well as regional digital health solutions in a seamless way as an umbrella to guide the overall digital health investment and interventions. It shall give a high-level vision of what is to be implemented in the years ahead as part of a strategic roadmap. The planning process takes the needs and capabilities of the different stakeholders in realizing the vision. This entails the need for stakeholder analysis and mapping so that common understanding is created and each party knows its role and contribution. The implementation shall be done in a coordinated way by building on the lessons from the information revolution and other strategic initiatives underway. To be able to create a shared vision of what shall be done and to gain acceptance at levels, the blueprint shall be socialized and shared with all stakeholder during and after its development. The blueprint should be supported by additional roadmaps and other policy documents which shall be cascaded at all levels. It needs to be regularly updated periodically as part of fiscal planning. It should be able to accommodate change in the context, capabilities or capacity of the health system and the country at large.

5.1. IMPLEMENTATION APPROACHES

The following implementation approaches are proposed in order to harness the benefit of digital health implementations based on the pillars and enablers and priorities in the blueprint:

Use of Standards

Health data and other standards are crucial for creating resilient and interoperable systems. The standards are important for interoperability of the digital health systems, data exchange between sources, data storage and analysis, data security and confidentiality and data use for informed decision making. Health data exchanges should adhere to standards that address different transport, content and media types. Common data and data exchange standards such as ICD10, NCoD, SNOMED, LOINC, FHIR, and HL7, etc can be adopted as needed.

Integrated Approach

An integrated approach to stakeholder management and alignment of prior key initiatives shall be followed. Collaboration between stakeholders is a key criteria to implement digital solutions and services and achieve equitable health coverage. An integrated stakeholder management and engagement platform is necessary for digital technology projects to succeed and for the realization of the vision set out in the blueprint.

Community Approach

Creating a community of practice that can enhance capacity and mitigate the lack of skills for solution provision shall be done. The community approach is key in creating shared responsibility and creating sustainable solutions which are affordable. Successful implementation of digital health solutions and services require community engagement that takes the local context and situation into account. Understanding and integrating local issues into digital health design ensures that the right technological solution can be identified and social aspects that enable digital health technology to thrive are considered.

Government ownership

The blueprint can only be realized through appropriate leadership and governance. Higher bodies in the health ministry shall take the primary lead in following up its realization through creation of implementation road-maps and putting in place monitoring & evaluation mechanisms. The leadership and governance shall also be cascaded to lower level management to create a shared vision through socializing it via different engagement platforms. Though the primary governing body of this blueprint shall be the ministry of health.

Adopting Human Centred Design

Digital health solutions have to be developed following human centred design. This has to be adopted to ensure that users needs are well addressed and useful solutions are provided. Developing technology solutions that are user-focused, user-friendly and adjust to the local context: this strategy ensures digital health solutions and services should consider local context and focus on the end user. Designing and implementing digital health solutions are based on local needs and aspirations, takes work practices into account, aligns to local skill levels and builds in incentives for the individual to use the system.

Building Local capacity

Initiating capacity building strategies in collaboration with universities, research institutes and stakeholders helps in creating strong and sustainable local capacity. This strategy is aiming to establish collaboration and ensure sustainability of these initiatives engaging local universities for training, research and innovation. This strategy is also to establish strong coordination with research institutes and stakeholders for their steamed contribution, resource mobilization and overall support.

Implementation Research Oriented Approach

Implementation research is crucial in guiding the implementation of digital health initiatives based on local practices, experiences harmonized with scientific findings, and contextualization based on the reality on the ground. It is helpful to introduce practical solutions into the digital health system and facilitate full-scale implementations at national and regional levels. The intention of this approach is to provide solutions, identify challenges and best practices, to discover new solutions, to develop knowledge management and scale up best practices.

Competency/Incubation/innovation Centres

Establishing competency, incubation and innovation centers at national and regional levels which will foster the development of innovative digital health ideas to ensure the sustainability of the digital health initiatives. Such centers enable for collaboration among different stakeholders through creation, sharing, and testing of ideas. A lack of digital skills and technical abilities among health professionals are common cited roadblocks that impact implementation and acceptance of digital health solutions. It is factual that the competency centers will address skill and knowledge related issues by producing a pool of experts in digital health implementations. This approach focuses on creating a platform for different digital health innovators to share new ideas and experiences and dissemination of best practices.

Resource Synchronization

This strategy is to emphasize sustainable budget and resource allocation for the overall implementation of this strategy including local financing to achieve its goals and objectives.

Bringing resources from multiple sources and guiding it towards the realization of the blueprint avoids duplication effort and promotes efficient use of resources.

Contextualization

Solutions need to be contextualized to the local settings. Solutions shall not be designed in one size fits all mentality so that they accommodate local culture, operating environment, locale and the likes.

5.2 STAKEHOLDERS MAPPING

The Blueprint is nothing without the engagement and consistent collaboration of stakeholders. The following stakeholders are identified as major stakeholders that will directly take part in the realization of what is stated in the Blueprint.

No	Name	Description	Role	Responsibilities
1	Citizens/clients/patients	People who benefit from the digital system. They are the primary stakeholders as all the digital health development efforts are done to improve health outcomes	Beneficiary / users	Provide the necessary information in identifying needs, followup of development progress and quality of services
2	Healthcare providers	Service providers in the health sector e.g doctors, nurses, health extension workers, etc	Service providers / users	Involve in creation of the products and services following the human centered design principle
3	Higher Institution	Private and public universities and colleges	Capacity building	Creating local capacity. They shall be keen in understanding of current and emerging technologies and conducting research and development
4	Healthcare managers	Decision making entities in the health sector e.g Health Ministry, CEO, Medical directors, regional, zonal and departmental and sub-department heads	leadership	Endure leadership and management of digital health solution development and services provision. Monitor quality of service and bring customer satisfaction
5	Donors	Source of funding and technical support	Donation	Provide source of fund and follow-up and technical support in utilizing the fund
6	Implementing partners	Digital health solution developer and providers	implementer	Engage in product and service development, deployment, maintenance and support
7	Researchers	Academician who are involved in research and development	Researcher	Document lessons and propose recommendations for implementation
8	Communities	Communities of practice working on digital health	Contributor	Development of solutions, standards and identification of gaps and provision of best practices

5.3. THE BLUEPRINT ACTION PLAN

The major interventions, the core of the blueprint, are identified, streamlined and scheduled so as to ensure to guide other strategies and roadmaps to be crafted based on the blueprint. Enhancing computing infrastructure, network connectivity and service desk are the major initiatives as part of strengthening the ICT Infrastructure. In order to make the maximum benefit out of digital health services and solutions, implementation of remote health care services, mobile health care services, point of service applications, institution-based applications is of paramount importance. Being the end user of all the digital health interventions, the clients have stake in the outgrowing digital health technology, including access to digital health service promotion and information dissemination, and personal health records and use of health apps to track their health condition. Several interventions, including repositories, shared services, data warehouse initiatives, have been identified to maintain and utilize the data generated by the health sector. The enabling environments and initiatives, to ground the major digital health interventions, related to standards & Interoperability, system Security, research & Innovation, Workforce, Governance & Leadership are identified and properly scheduled. The detailed interventions with the respective action plan are indicated in the Annex 1 & 2 within this document.

5.4. MONITORING AND EVALUATING THE MATURITY LEVELS OF DIGITAL HEALTH INITIATIVES

Nowadays, the importance of assessing the maturity level of digital health using maturity model-based assessment tools have grown. These methods are powerful in describing the current maturity level of digital health systems in terms of human resources, business processes, technology, and organizational capabilities. The methods also facilitate users' ability to set goals for future levels of maturity and inform the development of improvement plans to realize the next maturity level toward a stronger digital health system for a country to meet its public health targets. The HIS maturity assessment gives due emphasis to the institutional maturity of the digital health in its entirety (based on the concept of HIS Stages of Continuous Improvement) as well as the maturity of individual digital health components and interoperability maturity of those systems. Based on the current maturity status of digital health and where we want to reach in the future, the assessment results will give information about the areas which need special attention by the different stakeholders.

MOH has conducted the digital health maturity assessment with the objective of establishing a systematic basis of measurement for describing the digital health maturity baseline (end of 2020), mid-term goals (2024 – the end of HSTP-II), and the ultimate goals (2030) through HIS Stages of Continuous Improvement (SOCI) and to set a roadmap toward resilient and interoperable systems, and prepare action plans for improvement.

5.5. HIS MATURITY ASSESSMENT FINDINGS AND FUTURE STATES (GOALS)

Using stages of continuous improvement (SOCI) tool, the current status and future states of the health digital health are unpacked in terms of five domains: Governance and Leadership, Management and Workforce, ICT Infrastructure, Standards and Interoperability, and, Data Quality and Use. The assessment findings have shown that among the five domain areas *ICT infrastructure and Leadership and Governance* are the areas that need more focus and attention in order to realize the objective of the digital health blueprint. Other domains also have areas to improve in order to meet the aspired maturity level in the coming one decade. The following matrix shows the current cumulative maturity scores (end of 2020), future maturity level for HSTP-II period, and ultimate aspired maturity for 2030. Selected pain-points also are highlighted to zoom-in to individual domains. Hence the ministry, agencies, regional bureaus, and relevant stakeholders need to give more focus and priority in order to minimize these gaps in these domain areas.

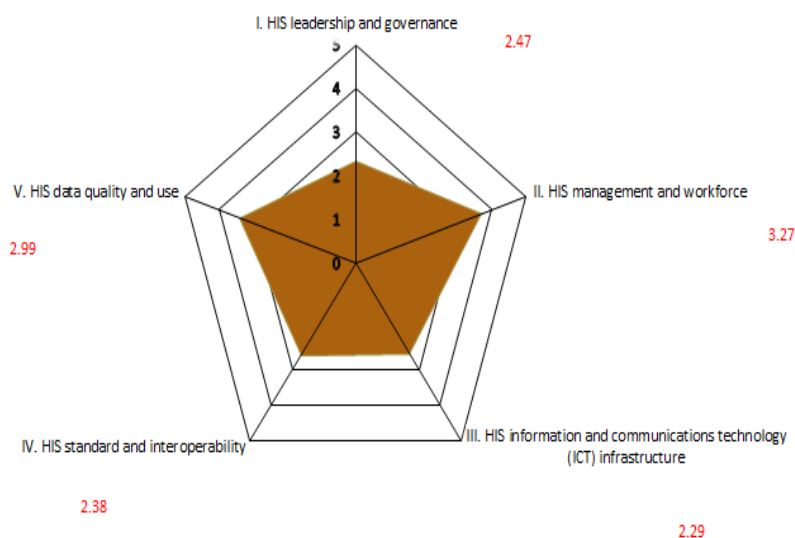


Fig. Digital health maturity status, current state (end of 2020)

Table. The current and Future Maturity States of digital health in Ethiopia

Domain Name	Current Cumulative Score (End of 2020)	Future Status (HSTP-II 2024)	Aspired Future Status (2030)	Pain points that need special attention ...
Leadership and Governance	2.47 (out of 5)	4.33 (out of 5)	4.99 (out of 5)	<ul style="list-style-type: none"> ● Endorsement and enforcement of policies and legislations; ● Structures, processes and specific mechanisms for enforcement of policies and legislations; ● Inclusive coordination mechanisms.
Management and Workforce	3.37 (out of 5)	4.67 (out of 5)	4.99 (out of 5)	<ul style="list-style-type: none"> ● Mainstreaming the Informatics concept; ● Clear HIT structure and incentive mechanisms; ● Tailored competency enhancement training and development programs; ● Assessing and deploying the digital health workforce to meet the growing demands.
ICT Infrastructure	2.29 (out of 5)	4 (out of 5)	4.99 (out of 5)	<ul style="list-style-type: none"> ● Business continuity plan – particularly sustainable power sources and connectivity infrastructure; ● Speeding up the pace of the HealthNet/VPN scale up and maintenance; Creating a strong collaboration with the service provider; ● Addressing the increasing hardware demands.

Domain Name	Current Cumulative Score (End of 2020)	Future Status (HSTP-II 2024)	Aspired Future Status (2030)	Pain points that need special attention ...
Standards and Interoperability	2.38 (out of 5)	4.11 (out of 5)	4.99 (out of 5)	<ul style="list-style-type: none"> ● Reviewing, endorsing and implementing the data exchange and messaging standards; ● Defining the minimum national clinical data sets based on international standards; ● Implementing and utilizing core registry services; ● Coordinating and working with agencies on unique person identification system; ● Ensuring security standards for data exchange and enforcement procedures.
Data quality and use	2.99 (out of 5)	4.72 (out of 5)	4.99 (out of 5)	<ul style="list-style-type: none"> ● Regular data reviews and audits - and automating the process; ● Dynamic data use strategy to meet the emerging decision support needs at all levels; ● Developing and managing data repositories and warehouse; ● Data use competency mechanisms; ● Standardizing the design, use and dissemination of information products; ● Developing and using guidelines on data use impact.

Based on the digital health maturity assessment results and the main findings depicted in the above table, the digital health blueprint implementation shall take into consideration the areas where there are strengths and those areas which need more attention by all stakeholders. Strategic initiatives and interventions shall also first be analysed with respect to the assessment results and the interventions shall happen accordingly. The maturity assessment will be carried

out periodically, and necessary adjustments in targets of the blueprint shall be considered based on the level of maturity of the domains at the times of assessment.

APPENDIX A: GLOSSARY OF TERMS

This section defines key terms that are crucial for understanding the digital health blueprint.

TERMS	DESCRIPTION
DIGITAL HEALTH	It is an umbrella term for a wide range of digital technologies that support in solving healthcare challenges. It is a field of knowledge and practice associated with the development and use of digital technologies to improve health.
DIGITAL HEALTH BLUEPRINT	It can act as a guide for managing complexity by directing use of various technologies to ensure that solutions are fit-for purpose in supporting current and emergent services and needs.
INFORMATION REVOLUTION ROADMAP	In the context of Ethiopian, information revolution is one of the four transformation agendas in the Health Sector Transformation Plan (HSTP). It refers to the phenomenal advancement in the methods and practice of collecting, analyzing, presenting, and disseminating information.
BIG DATA ANALYTICS	Refers to tools to accumulate, manage, analyze, and assimilate large volumes of disparate, structured, and unstructured data produced by current healthcare systems. Areas of application in health care include providing comprehensive knowledge discovery from the available huge amount of data.
FAIR DATA	FAIR is an acronym for Findability, Accessibility, Interoperability, and Reusability. It intends to make data machine-readable as well as human-readable. Machine readable is a term for data that can be found, accessed, interoperated, and reused by computational systems or algorithms with almost no human intervention.

TERMS	DESCRIPTION
BLOCKCHAIN	Blockchain is a distributed ledger technology for peer-to-peer (P2P) networks of digital data transactions that may be publicly or privately distributed to all users. It keeps a ledger of transactions that are interconnected, tamper proof and provides ways of tracking provenance. The potential of blockchain in healthcare is to overcome the challenges related to data security, privacy, sharing and storage.
INTERNET OF THINGS	The Internet of Things (IoT) is the network of dedicated physical objects (things) that contain embedded technology to sense or interact with their internal state or external environment. The Internet of Things (IoT) has been widely applied to interconnect available medical resources and provide reliable, effective and smart healthcare service to the elderly and patients with a chronic illness.
CLOUD COMPUTING	The cloud offers on-demand computing by using the latest technology to deploy, access, and use networked information, applications, and resources. It's often less costly than having multiple computers in various medical rooms each needing proper hardware, updated software, and network accessibility to upload, store, and retrieve patient or other medical data.

ANNEX 1: DIGITAL HEALTH BLUEPRINT PILLARS ACTION PLAN

Pillar I: ICT infrastructure

Intervention Category	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Enhancing Network Connectivity	<ul style="list-style-type: none"> Establish facility LAN connectivity Engage private institutions and small-scale enterprises in LAN installations Implement aggressive scale up of the HealthNet access across the health facilities and health offices 	<ul style="list-style-type: none"> Engage the private sector in the infrastructure establishment, maintenance and support Introduce new connectivity alternatives for remote and under resourced sites. 	<ul style="list-style-type: none"> Enhance network bandwidth at facilities Implement aggressive scale up of the Network connectivity access across the health facilities

Pillar I: ICT infrastructure

Intervention Category	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Enhancing Computing Infrastructure	<ul style="list-style-type: none"> Establish dynamic data centers at MOH, agencies and regions for data hosting demands – including the backup and disaster recovery sites. Identify systems and services for Cloud hosting, and implement as required. Explore, prioritize and engage the most secure, reliable and cost-effective Cloud options Equip the available data center infrastructure facilities with cooling facilities, fire extinguisher and Redundant Power Backup options 	<ul style="list-style-type: none"> Upgrade and expand existing data center and DR site infrastructure to the latest state of art technologies Strengthen multi-sectoral collaboration to explore and use in-country hosting alternatives, including domestic Clouds. Establish local cloud hosting centers 	<ul style="list-style-type: none"> Establish high standard local private cloud to serve the health sector and other domain hosting services Enhance the local cloud hosting centers
Establishing Service Desk	<ul style="list-style-type: none"> Establish Service Desks at national regional, zonal and woreda levels and strengthen with resources. Strengthen technical capacity building for service desk technicians engaged in technical support 	<ul style="list-style-type: none"> Strengthen logistics and service desk infrastructure at all level 	<ul style="list-style-type: none"> Enhance the service desk and implement integrated support for all initiatives.

Pillar II: Solutions and Services

	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Enhance remote health care services to improve access and equity	<ul style="list-style-type: none"> Enhance and scaleup Teleradiology service/program in public hospitals. Establish telehealth services such as telepathology, telepsychiatry, teledermatology, RPM etc. for remote medical consultation and health care rendering 	<ul style="list-style-type: none"> Enhance the fast scaleup of telehealth services in public hospitals Enhance Remote Patient Monitoring systems (RPM) at health facilities 	<ul style="list-style-type: none"> Develop Artificial Intelligence enabled telehealth programs at health facilities
Enhance mobile health care services to empower health worker's clinical decision-making capacity	<ul style="list-style-type: none"> Promote and facilitate the use of mobile and wireless technologies to support clinical decision making for health workers Enhance the development and implementation of mobile apps for health workers that enable patient health tracking, intercommunication, resources access and learning. 	<ul style="list-style-type: none"> Enhance the development and implementation of personal health record access apps for clients Enhance the development and implementation of mobile apps for clients' emergency management 	<ul style="list-style-type: none"> Improve mhealth services by incorporating cutting edge technologies through research
Enhance the development and	<ul style="list-style-type: none"> Establish clinical decision support systems and job aid tools like 	<ul style="list-style-type: none"> Enhance application features and functionalities in the 	<ul style="list-style-type: none"> Accelerate the implementation of

Pillar II: Solutions and Services

	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
implementation of point of service applications that aid health workers to deliver quality health service	<p>Electronic Health Record (EHR) and eCHIS at public health facilities</p> <ul style="list-style-type: none"> ● Establish Lab and Diagnostic Imaging Management Systems ● Establish Referral Coordinating Systems for managing point to point referrals, emergency responses and transports. ● Establish electronic Prescription and Medication Management Systems to generate and transmit a prescription order directly from a healthcare provider to a patient's pharmacy of choice ● Enhance eLearning and knowledge management (KM) systems for health care provider's capacity building 	<p>different digital health solutions based on gaps identified and feedback given from users.</p> <ul style="list-style-type: none"> ● Promote the effective use of e-learning systems by health workers and further improve the content administration and localization features. 	<p>comprehensive health record system by including more modules that exist separately as ancillary systems</p> <ul style="list-style-type: none"> ● Expand the implementation of an online e-prescription system in private pharmacies
Enhance the development and implementation of institution-based applications to enhance health system administration, planning, monitoring and regulation	<ul style="list-style-type: none"> ● Enhance electronic Health Commodity Management Systems ● Enhance the development and scaleup of electronic Health Workforce Management information systems to Plan, develop, Administer and Certify the workforce ● Enhance Evidence-based healthcare planning, monitoring and decision making by strengthening electronic health management information systems ● Develop and implement operations and assets management systems ● Enhance the implementation of electronic Health systems and services regulations at institutions and facilities ● Enhance the development and implementation of Health financing and insurance management systems ● Enhance the development and implementation of Public Health Emergency Management System (PHEM) 	<ul style="list-style-type: none"> ● Explore, accommodate and implement the need for further enhancement or change on the existing eHMIS platform. ● Enhance the fast scaleup of institution based digital health solutions at public health facilities 	<ul style="list-style-type: none"> ● Improve system features and functionalities based on user experiences and innovative ideas from technological advancements.

Pillar II: Solutions and Services

	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
	<ul style="list-style-type: none"> ● Enhance the development and implementation of Enterprise Resource Planning(ERP) system 		

Pillar III: Access & Delivery

	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Establish digital health service promotion and information dissemination systems to promote healthy behavior	<ul style="list-style-type: none"> ● Strengthen Social media presence and alternatives to communicate the efforts of the health sector. ● Assess the health information needs of different interest groups (communities) and develop Health Wikis and blogs platforms for knowledge and experience sharing. ● Promote use of corporate email communication system among the health workforce ● Strengthen Digital Health Call Centers and help desk systems for effective support of digital health systems, users and the general public (clients/ citizens) ● Ensure the availability of display boards at institutions and/or department levels 	<ul style="list-style-type: none"> ● Promote and enforce the development of patient portals accessed by clients. ● Promote, and enforce electronic systems for open data access 	<ul style="list-style-type: none"> ● Establish initiative specific development of multimedia contents for audiences
Establish client's access to personal health records and use of health apps to track their health condition	<ul style="list-style-type: none"> ● Promote, design and share contextualized wellness apps (mobile application programs that offer health-related services on smartphones, tablet PCs and other communication devices). ● Promote electronic access to shared medical records by the patients 	<ul style="list-style-type: none"> ● Promote, design and implement Wearable Sensors in order to help monitor health and/or provide clinically relevant data for care of priority diseases 	<ul style="list-style-type: none"> ●

Pillar IV: Data Hubs

	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Establish digital registries to provide shared health data services for digital health systems	<ul style="list-style-type: none"> Promote and support the development of Master Patient Index (MPI), Master Provider List (MPL), Master Facility Registry (MFR) that stores unique patient, suppliers and facility information respectively Enhance and use the National Health Data Dictionary (NHDD) with all priority health domains included 	<ul style="list-style-type: none"> Promote and update Terminology management system (TMS) as an integral part of interoperability solutions. 	<ul style="list-style-type: none"> Enhance the usage of MPI, MPL, MFR, and NHDD
Establish health data repositories for centralized data storage, archival and retrieval	<ul style="list-style-type: none"> Build and strengthen national and subnational data repository systems such as Shared Health Record (SHR) and other ancillary Health data repositories Collect, avail, update and use the GIS geodata files for geospatial analysis Enhance and implement the available picture archiving and communications system (PACS) 	<ul style="list-style-type: none"> Update and use the GIS geodata files for geospatial analysis 	<ul style="list-style-type: none"> promote the use of Picture archiving and communications system (PACS)
Enhance implementation of data warehouse, data analytics and business intelligence to support better decision support and research	<ul style="list-style-type: none"> Follow a Use-Case approach with priority health domains to ensure the comprehensive data warehouse progressively Build analytic platforms and execute at different levels 	<ul style="list-style-type: none"> Build data analytic capacities such as machine learning/artificial intelligence, big data analytics Promote data discovery and trend analysis with data from different sources 	<ul style="list-style-type: none"> Promote Cloud-based data services as necessary

ANNEX II: DIGITAL HEALTH BLUE PRINT

ENABLERS ACTION PLAN

Enablers: Standard & Interoperability, System Security, Research & Innovation, Workforce, Governance & Leadership			
	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
Enhance standard and system interoperability to accelerate health information exchange	<ul style="list-style-type: none"> ● Define and maintain data standards locally by giving due considerations to local policies, guidelines and legislation frameworks ● Adopt international data structure and messaging standards like LOINC, SNOMED, FHIR, etc. as applicable for different health domains ● Promote the customization and use of open-source digital health applications for easy integration among systems. ● Revisit the current eHA and upgrade it to come up with a resilient Digital Health Architecture Blueprint ● Implementing the Open Health Information Mediator (OpenHIM) as a middleware component designed to ease interoperability between disparate information systems. 	<ul style="list-style-type: none"> ● Establish local data standards ● Establish international data structure and messaging standards. ● Enhance the digital health architecture blueprint. ● Enhance the implementation of OpenHIM components for interoperability between disparate information systems. 	<ul style="list-style-type: none"> ● Enhance the digital health architecture blueprint. ● Maintain and update the interoperability and messaging standards.
Enhance system security to save guard digital health systems and patients data from unauthorized access and attacks.	<ul style="list-style-type: none"> ● Establish digital health data protection mechanisms by defining role-based access control for all digital health interventions ● Implement physical and logical cyber-security measures ● Establish secure Network Infrastructure and hardware (from end-device to Data Center equipment) ● Establish operational documentations for use on the network infrastructure and hardware security at all levels 	<ul style="list-style-type: none"> ● Establish security safeguarding mechanisms for all infrastructure and solutions ● upgrade security mechanisms and tools to the state of the art. ● update and implement security policies measures 	<ul style="list-style-type: none"> ● Enhance physical and logical cyber-security safeguard mechanisms at all levels ● update the digital health infrastructures and solutions documentation
Enhance digital health research and innovation for	<ul style="list-style-type: none"> ● Foster digital health researches to guide and support decision-making, policy, and practice 	<ul style="list-style-type: none"> ● Enhance the adoption of emerging digital technologies and establish 	<ul style="list-style-type: none"> ● Assess and adopt new and innovative cutting-edge digital

Enablers: Standard & Interoperability, System Security, Research & Innovation, Workforce, Governance & Leadership			
	Short Term (1-3 Years)	Medium Term (3-5 Years)	Long Term (5-10 Years)
better health care /service rendering	<ul style="list-style-type: none"> ● Enhance the adoption of emerging digital technologies and establish innovation centers at national level to promote digital health innovations in the health sector 	<p>innovation centers at subnational levels</p>	<p>health technologies (like AI, block chain, Big Data, wearables, Internet of Things, etc.) for use in the health sector</p>
Strengthen digital health workforce capacity on system use and technical support	<ul style="list-style-type: none"> ● Explore the existing ICT health workforce allocation and propose the required skilled professionals and structure supporting the digital health initiatives. ● Create/Revise the digital health workforce structure and deploy the required workforce at all levels. ● Design and implement digital health staff retention and motivation mechanisms. ● Revise/update the education and training curricula of the pre- and in-service training based on research or gap analysis findings ● Strengthen and mainstream the digital health education and training programs at post-secondary health educational institutions. 	<ul style="list-style-type: none"> ● Establish digital health workforce structure at all levels and deploy required workforce. ● Revise/update the digital health workforce curriculum for pre-service and in-service training ● Enhance the digital health education and training programs at all levels. 	<ul style="list-style-type: none"> ● Enhance the digital health workforce curriculum for pre-service and in-service training ● Enhance the digital health education and training programs at all levels.
Enhance digital health governance	<ul style="list-style-type: none"> ● Ensure bold representation of Digital Health in health proclamation and health policies. ● Prepare/update digital health domain specific policies/directives including data management and sharing policy (that enables data sharing to secondary users including online open access, external repository and managed access via applications), organization level ICT policy (roadmap for ICT implementation), social media policy (which advises the health sector on the use of social media), regulations, directives and guidelines(such as telehealth guideline), frameworks, and standard operating procedures (SOPs) 	<ul style="list-style-type: none"> ● Document/Model data standards on representation, format, definition, structuring, tagging, transmission, manipulation, use, and management of data, including data privacy and security standards. ● Establish digital health leadership and governance mechanisms. ● Maintain and establish investment and funding framework. 	<ul style="list-style-type: none"> ● Scaleup capacity building programs for leadership at all levels to enable define, direct, execute, enforce, monitor and evaluate the digital health ecosystem

Enablers: Standard & Interoperability, System Security, Research & Innovation, Workforce, Governance & Leadership			
Short Term (1-3 Years)		Medium Term (3-5 Years)	Long Term (5-10 Years)
	<ul style="list-style-type: none"> • Adopt or create a framework for the Digital Health Leadership and Governance including informal structures at all levels of the health sector. • Design capacity building programs for leadership to enable define, direct, execute, enforce, monitor and evaluate the digital health ecosystem • Device collaboration framework/platform at the national and regional levels, aligned with health goals and political support, and awareness and engagement from stakeholders • Prepare investment and funding framework to guide the digital health financing and ensure the digital health interventions are properly financed. 		