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MINISTRY OF HEALTH - ETHIOPIA
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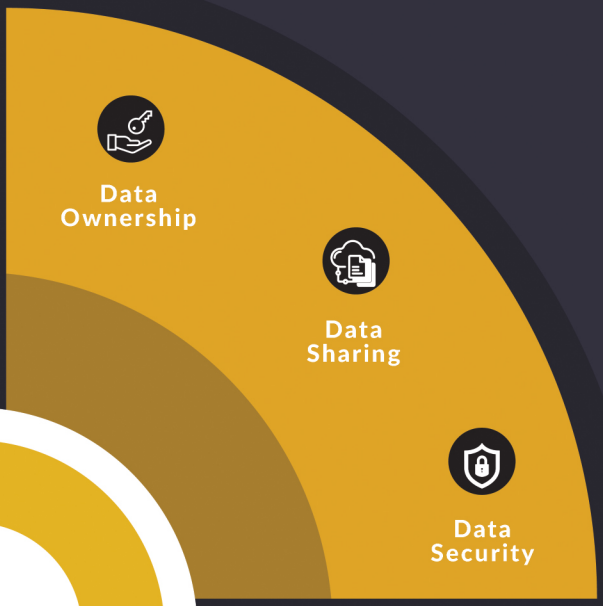

STANDARD FOR ELECTRONIC HEALTH RECORD SYSTEM (EHRs) IN ETHIOPIA

July 2021

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MESSAGE FROM THE MINISTER

The Ministry of Health has developed and started implementing the second Health sector transformation plan (HSTP-II) that spans from 2020/21-2024/25. To achieve the objectives of the strategic plan, key strategic directions and priorities such as provision of comprehensive equitable and quality health services, enhancing use of digital health technologies and information revolution are identified as key areas to be implemented in the strategic period. Availability and use of quality data is key to inform evidence based decision making at an individual and population levels. As a way to improve evidence-based decision-making in the health sector and improve quality of health services, development and implementation of electronic health record systems and solutions is crucial.

In the past decade, different electronic medical record systems have been developed and implemented by health facilities, in collaboration with different partner organizations. However, there was no national standard for the development and implementation of EMR systems. This has created non-interoperability among the different systems, poor information management, and created challenges to govern data security and related problems. To respond to these challenges and to strengthen the development and implementation of EMR systems in the country, the MOH has developed national standards for an Electronic Health Records (EHR) system in Ethiopia. The MOH believes that implementation of this standard improves the way health records are captured, stored, transmitted and used for decision making; which in turn improve quality service delivery and achieve improvement of the health status of the population.

This E H R standard is developed in consultation with different stakeholders that includes different MOH directorates, hospitals (public and private), partner organizations, academia and others. It is prepared for both the public and private health institutions. The standard should be followed by all facilities that plan to develop and implement any E H R system/solution. Facilities implementing an EHR System have to comply with this standard for any investments and efforts. They can refer to the minimum technical requirements for the selected E H R system, the security and safety considerations, the implementation requirements and the future scale up mechanisms.

Implementers, both public and private EHR implementers, have to conform to the minimum technical requirements depicted in this standard document to sustain the E H R solution in the sector. The Standard benefits all stakeholders that are involved in health-service improvement efforts. Complying with this standard, the MOH believes that we will have effective and efficient EHR solutions with multiple vendors but interoperable at all health facilities in the country.

Finally, I would like to acknowledge all those who have been involved in preparing this standard document and those who have participated in reviewing and providing comments and feedbacks. Looking forward towards implementation of E H R systems that conform with the minimum requirements as set by this national standard.

Lia Tadesse (MD, MHA)
Minister of Health,
Federal Democratic Republic of Ethiopia

MESSAGE FROM THE STATE MINISTER, PROGRAM WING

Digital health has been acknowledged by the World Health Organization as a key building block for universal health coverage and the health-related Sustainable Development Goals. In this respect many countries are implementing digital solutions such as electronic medical records, health management information system and electronic disease surveillance systems.

The federal ministry of health of Ethiopia together with the various stake holders in the sector, have been implementing different digital health initiatives in the country for long. One of such initiatives is electronic medical record system(EMR) which aims to digitally capture and process individual patient health data longitudinally. The Private health facilities have also been actively engaged in developing implementing their own EMR systems.

However due to lack of common and agreed standard on the development and implementation of EMR solutions in the country, it resulted in fragmented and siloed solutions which don't exchange health and health related data with one another and with other digital solutions. Data coming from EMR system both from the private and public health facilities is a main input for our nationally implemented health management information system and should automatically transferred from them. So far this is not possible due to the absence of EMR standards in the country.

This EMR/EHR standard document developed by the ministry along with relevant key stakeholders aims to resolve the aforementioned problems with respect to electronic medical records systems and lead to the availability of interoperable digital solutions as envisioned in the ministry's ehealth architecture(eHA) document.

I would like to take this opportunity to thank and express my deep appreciation all of you who have been involved in the development of this excellent piece of work and assure you that this will not be our last governance document and we will capitalize on the experience we have got in the development process of this standard document and produce many more to govern the digital health landscape in the sector.

Thank you all again!!

Dereje Duguma (MD, MPH)
State Minister, Program Wing

MESSAGE FROM THE STATE MINISTER, OPERATION WING

Ethiopia as a country put a clear road map on digital Ethiopia for the coming years in all aspects of social and economic dimensions. Enhancing digital health technology is one of the strategic objectives of the health sector transformation plan II. Digital technologies provide concrete opportunities to tackle health system challenges, and thereby offer the potential to enhance the coverage and quality of health practices and services.

Digitalization of data collection and management at all levels of health facilities through the Electronic Health Record (EHR) system is one of the major digital technologies that are being developed and implemented at all health facilities

It is known that patients and health facility customers are the ultimate owners of the data in the EHR. Therefore, all the EHR development and application efforts should be executed while keeping confidentiality and privacy of the patient data and implementing interoperability via recommended data exchange accepted protocols/standards.

MOH has prepared this 'Standard for Electronic Health Record System in Ethiopia' to set data and security standards to be followed for data exchange, to set minimum system functionalities, data sets to be captured and other implementation requirements to be considered for the successful development and implementation of EHR systems at the national level.

This standard document also sets data and security standards to be followed for data exchange, minimum system functionalities, data sets to be included and other implementation requirements such as ICT infrastructure, power supply, trained personnel, support & maintenance protocol, availability of budget for the sustainability of the systems...etc that should be considered for the successful development and national-level implementation of EHR systems.

I call upon all public and private health facilities, development partners, academia, regional health bureaus and all stakeholders to take responsibility and play their part for optimal implementation of this standard considering its vital role in ensuring quality and sustainable digitized health information system in health sector of our country.

Last but not least, I would like to pass my sincere gratitude to all who have technically and financially contributed to the preparation of this important standard document.

W/ro. Alemtsehay Paulos
State Minister, Operation Wing

MESSAGES FROM DIRECTORS

The EHR standard developed by the Ministry of Health enables all stakeholders to have a common standard and guideline for technology selection, adoption, development/customization and implementation at different health facilities. It also helps facilities and implementers to get an insight and common understanding regarding the requirements before, during and after EHR implementation.

The Ministry would materialize multiple vendor solutions satisfying the minimum criteria set in this standard. The standard also serves as a means to harmonize different EHR systems maintaining interoperability and hence easy patient and aggregate level data exchange at all levels.

I am grateful to all who have technically engaged and financially supported this crucial EHR standard.

MR. GEMECHIS MELKAMU
DIRECTOR, HEALTH INFORMATION TECHNOLOGY

Implementing an electronic health record to our health facilities has an immerse contribution for all clinicians supporting for better health care and service delivery.

One of the challenges in implementing electronic health record systems in Ethiopia was due to lack of a standard, that can guide various vendors on the way to develop, deploy and implement the systems. Cognizant of this fact, the Ministry endorsed the envisaged EHR standard which is believed to have an enormous impact in realizing EHR solutions at facilities. In doing so the standard will pave the way for better implementation of clinical decision support and job aid for health workers, while relying pertinent data and information for planners and decision makers.

I would like to thank all who have contributed.

MR. ABAS HASSEN
DIRECTOR, CLINICAL SERVICES

This standard document defined a baseline for all minimum core functionalities that needs to be incorporated for any EHR to be implemented at health facilities. The standard will have great contribution for improved availability and use of quality data for evidence based clinical and public health decisions. It will be instrumental to improve the quality of health services in the health sector.

All stakeholders involved in the selection, development and/or implementation of EHR should comply to all the minimum requirements set by this standard document. The ministry will develop guidelines and other required documents supporting the enforcement of the standard.

I would like to acknowledge all who have contribution for the successful completion of this standard.

MR. NAOD WENDRAD
DIRECTOR, POLICY PLANNING, MONITORING & EVALUATION

ACKNOWLEDGEMENT

This standard document is prepared by the active participation and involvement of all relevant stakeholders in the sector. Senior experts from different directorates of MoH, Universities, Agencies, Hospitals (public and private) and partner organizations have made significant contributions.

We sincerely acknowledge the highly professional contribution and sincere efforts of experts representing organizations:- St. Paulos Hospital Millennium Medical College, Ethiopian Food and Drug Administration, Ethiopian Pharmaceutical Supply Authority, Black Lion Specialized Hospital, Tirunesh Beijing General Hospital, Alert Hospital, Yekatit 12 Hospital, Mekelle University, ICAP in Ethiopia, JSI-DUP (Data Use Partnership), JSI-DHA (Digital Health Activity), United States Centers for Disease Control and Prevention (US-CDC), Clinton Health Access Initiative and Myung Sung Christian Medical Center (Korean Hospital).

We would like to appreciate the significant comments and feedback given by the MoH steering committee and HIS National Advisory Group. This document also bears the efforts of significant contributions through review and revision of it. We acknowledge the contribution in this regard by CDC in Ethiopia that facilitated the review of the entire document by a technical expert.

We also acknowledge the efforts made by ICAP at Columbia University Ethiopia, for the logistics arrangements and sponsorship during multiple rounds of technical team meetings in the EHR standard development and also for the quality graphics design and printing of this standard document with funding obtained from the President's Emergency Plan for AIDS Relief (PEPFAR) through US-CDC.

TABLE OF CONTENTS

ACRONYM

AI	Artificial Intelligence
API	Application Programming Interface
ASTM	American Society for Testing and Materials
BI	Business Intelligence
BMI	Body mass index
CCR	Continuity of care Record
CDA	Confidential Disclosure Agreement
CRVS	Civil registration and vital statistics
CRVS	Civil registration and vital statistics
DHIS	District Health Information System
DICOM	Digital Imaging and Communications in Medicine
eCHIS	Electronic community health information system
EDD	Expected date of delivery
eHA	eHealth Architecture
EHDAP	Ethiopia health data analytic platform
eHMIS	Electronic health management information system
EHR	Electronic Health Record
EHSTG	Ethiopian Hospital services transformation Guidelines
eLIS	Electronic laboratory information system
EMPI	Enterprise master patient index
EMR	Electronic Medical Record
EMR	Electronic medical record system
ePHEM	Electronic public health emergency
eRIS	Electronic regulatory information system
FHIR	Fast Healthcare Interoperability Resources
FSN	Fully Specified Name
GBD	Global burden of Disease
HGIS	health geographic information system
HL7	Health Level Seven International
HMIS	Health management Information System
HRIS	Human resource information system
HWF	Health WorkForce
HWR	Health workforce registry

ICD	International Classification of Diseases
ICD-O	International Classification of Diseases for Oncology
ICF	International Classification of Functioning, Disability & Health
ICHI	International Classification of Health Intervention
ICT	Information communication technology
IDSR	Integrated Disease Surveillance and Response (IDSR)
IDSR	Integrated disease surveillance and response system
IHTSDO	International Health Terminology Standard Development Organization
IPD	Inpatient department
IVR	Interactive voice recording
KPI	Key performance Indicator
LOINC	Logical Observation Identifiers Names and Codes
MDL	Master Drug List
MFR	Master Facility Registry
MOH	Ministry of Health
MPI	Master patient Index
MRN	Medical record number
NCoD	National Classification of Diseases
NHDD	National Health Data dictionary
NHS	National Health Service
OPD	Outpatient department
PACS	Picture Archiving and Communication system
PHR	Personal Health Record
SHR	Shared Health record
SNOMED	Systematized Nomenclature of Medicine
SNOMED CT	Systematized Nomenclature of Medicine — Clinical Terms
SNOMED GPS	Systematized Nomenclature of Medicine — Global Patient Set
SPA	Service provision assessment
TS	Technical Standard
UMDNS	Universal Medical Device Nomenclature System
WHO	World Health Organization
WHO-FIC	WHO Family of International Classifications

EXECUTIVE SUMMARY

MoH has been implementing Electronic Medical Record systems (EMRs) in the country using siloed stand-alone software applications. Hence, the development and implementation of the EMR system have never been guided by a set of standards and rules. This resulted in having a system that doesn't fulfill the requirements of various stakeholders, as well as the data generated from the system, which is not interoperable with systems in the sector and beyond. It is realized by the ministry that a comprehensive and longitudinally accessible individual/ patient-based health record which is an Electronic Health Record (EHR) system need to be developed and implemented at all health facilities. The aim of preparing this standard document is to set data and security standards to be followed for data exchange, minimum system functionalities and data sets to be included and other implementation requirements to be considered for the successful development and implementation of EHR systems nationally.

In order to implement a national EHR system, a robust EHR infostructure establishment is required. This is based on the national eHealth Architecture blueprint to define how facility-based EHR systems interact with shared services, repositories, and other health information systems. Predefined considerations are stipulated so that implementers and developers of EHR systems strictly follow every step of the infostructure to entertain interoperability. The infostructure is designed in such a way each component of the infrastructure could follow a predefined workflow to interact with other components.

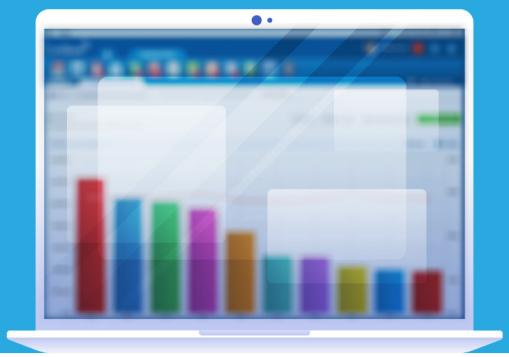
Taking into consideration that the EHR system should fulfill some minimum functionalities, the core system functionality is prepared to define the set of functionalities, modules, and minimum dataset for an EHR system. Eight core EHR functionality areas, ninety functionalities, and fifteen modules (subsystems) are described with a defined level of importance. Institute of Medicine (IOM) is used as a reference to select these key functionalities, and high priority is given to Safe, efficient, effective, and patient-centered medical practices and capabilities. The key functional areas define all critical aspects of an EHR system and facility levels.

EHR system design and development should consider data exchange and interoperability using known and accepted standards. Syntactic and Semantic interoperability standards and essential interoperability aspects of an EHR system are defined. The EHR interoperability standards specification considers implementation applicability in low resource settings. It also takes into mind that interoperability standards are dynamic and evolving. Strict enforcement of new and trending standards may not be feasible as legacy and proprietary EHR systems may exist. A comprehensive specification is outlined with minimum requirements of EHR to enable interoperability and data exchange. EHR developers and implementers are encouraged to consider EHR interoperability via recommended data exchange accepted protocols/standards in their EHR development and implementation efforts.

Data exchange and interoperability demand a solution for the issues of security and privacy of patient information. Implementation specifications and conformance tests should make sure participating systems consider the necessary privacy and security measures. Though the ultimate owner of the data is the patient, there are defined capabilities and possibilities to access, share, and control the data based on the national data access and sharing directives.

Successful implementation of EHR systems depends on the management, planning, roll-out, and ongoing operational activities. The implementation requirement specifies the pre-implementation requirements of EHR at a facility level, the ongoing operations, and the need for a central shared service ICT infrastructure requirement. Development of comprehensive implementation and management/ operation plan with all relevant stakeholders covering all phases of the EHR deployment at a facility. There should be a facility ready assessment for minimum requirements for optimal operations of an EHR system, like ICT infrastructure, power supply, trained personnel, support & maintenance protocol, availability of budget for the sustainability of the systems. The management and operation of the system need strong organizational arrangements like TWGs and continuous M&E of the system for its sustainability.

1 INTRODUCTION



INTRODUCTION

A well-functioning health information system is essential to improve health service delivery and health outcomes. Keeping an individual's medical records using paper-based systems has been long practiced globally. In the advent of Information Communication Technology, the health system in general and medical recording system in particular have been leveraging electronic based systems. In Ethiopia, the data collected from different wings of the electronic medical recording systems were not standardized and data cross referencing about past medical history, diagnosis and treatment were poorly handled and the data exchange between and among different systems was hard to achieve. It has also been uncommon to see duplication of medical records which led to poor patient satisfaction and efficient provision of care

So far, the MOH, in collaboration with a partner, tried to implement an EMR system in some public health facilities some starting from ten years back but couldn't go far because of different behavioral, technical, and organizational factors. Most of the EHR software developed and implemented in the public health facilities were not based on EHR standards so that couldn't meet the functional and nonfunctional requirements of health facilities. In addition, the usability and friendliness of the user interface were not up to the need of end users (care providers). Most of the software lacks capabilities to ensure continuity of care, delivery of efficient health services and minimize medical errors. Most of them have no or little capacity to produce reports for patient and program monitoring. Data exchange among the different electronic health recording systems was barely possible. Since there is no implementation guide, maintenance and change management has been very difficult. Regarding, behavioural aspect, most care providers don't prefer to use electronic health record systems over the usual pen-paper practice of medical recording. Most facilities do not provide adequate training and motivational incentives to improve the skill and willingness of the end users. The management and leadership are also keen to have an EHR system. However, their level of commitments for the creation of a sustainable paperless environment is not as encouraging as it has been reflected on allocating an inadequate budget and no interest to hire the appropriate IT personnel for support. The private experience of EHR system implementation seems a bit different from the public health facilities as most associated the physicians and other care providers' payments is very much dependent

on what is recorded in the electronic health recording system, leading to relatively better status EMR implementations. However, the focus on collecting adequate structured and unstructured data about a patient during each encounter is very much limited to certain parameters.

The major challenges of the existing EMR application used in the country have lots of challenges. Most of the applications weren't developed following standards like data, messaging, security and implementation standards. Secondly, since most of the applications are not governed by the ministry, it resulted in siloed application, duplication of efforts and resource wastage. Thirdly, some applications were designed for specific requirements of individual facilities which hinders scaleup to other facilities. It is also observed that most of the applications are using proprietary technologies that hinders the sustainability and ownership of the systems.

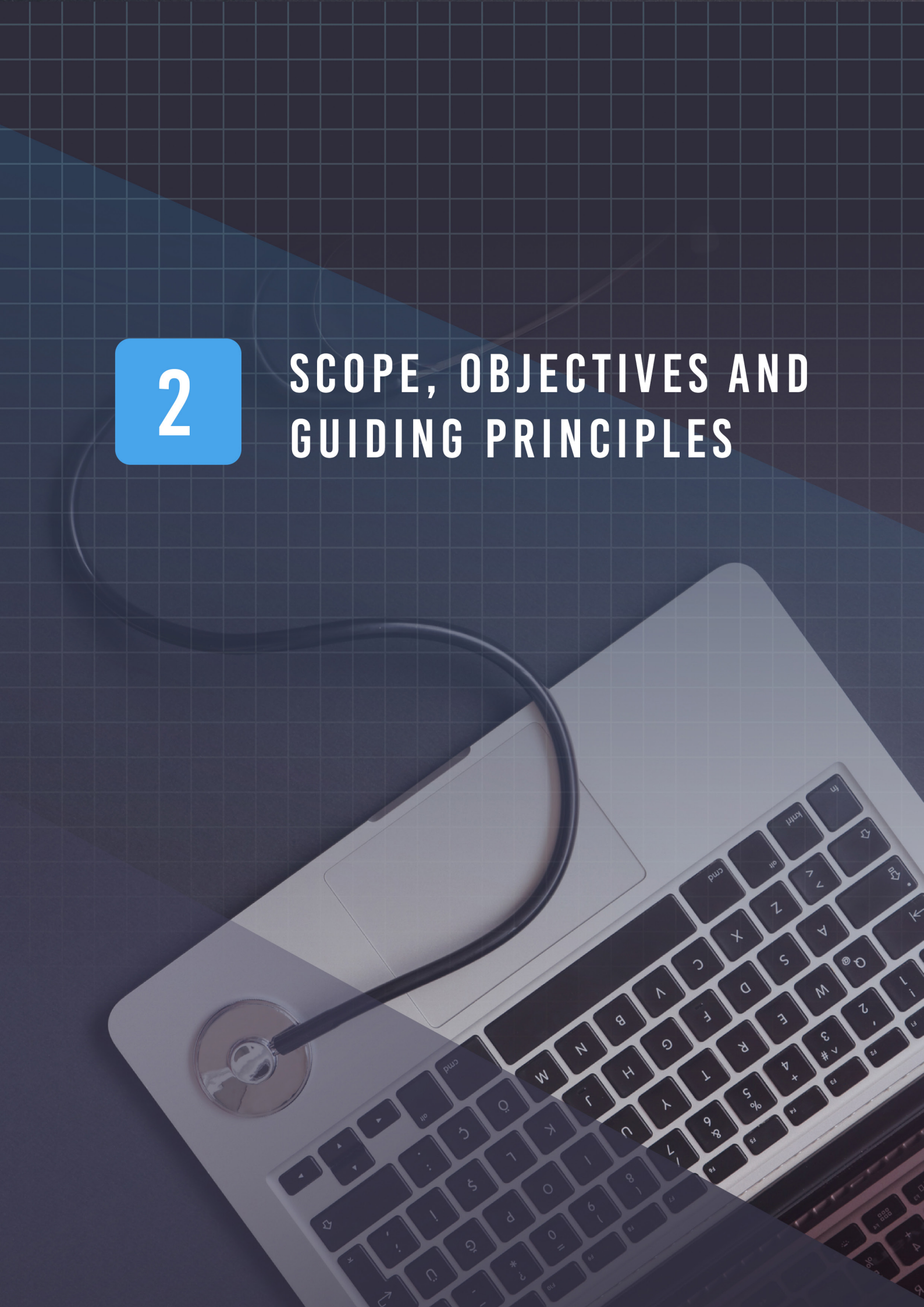
Building national individual-level longitudinal health records is only possible through the implementation of interoperable EHR systems that comply with nationally defined functional terminology, data exchange and security standards, and implementation requirements. In this regard, the ministry of health didn't have a mechanism to guide and lead the development/customization of EHR systems and coordinate investments towards establishing responsive and interoperable EHR systems. Therefore, aligning with the national digital health blueprint and strategy, MOH produced a national standard for EHR system development and implementation to shape the future EHR ecosystem in the country.

The national EHR standard is developed with extensive stakeholders' participatory process. A series of consultative workshops were undertaken between the Ministry of Health, Agencies, health facilities, partner organizations, academia, and other stakeholders. Senior experts with extensive experience in developing and implementing electronic health information systems at different levels of the health system participated during the development of this EHR standards document

This document comprises 7 chapters. The first chapter is an introduction that states about background, rationale information and the standard document development process. Chapter 2 is about the scope, objectives and guiding principles. Chapter 3

deals with EHR infostructure. Chapter 4 is about core functionality of the EHR, which describes the minimum core functionalities that any EHR system is expected to include as a standard. Chapter 5 describes EHR data standards and interoperability, describing the different terminology and messaging standards to be used in EHR systems for system interoperability. Chapter 6 describes data ownership, sharing, privacy, and security in EHR systems. The last chapter describes the requirements for the implementation of EHR systems both in pre-implementation and during operation.

2 SCOPE, OBJECTIVES AND GUIDING PRINCIPLES



SCOPE, OBJECTIVES AND GUIDING PRINCIPLES

In this chapter, the EHR system scope, objectives and guiding principles are described as follows in consecutive sessions

2.1 Scope

The scope of this document is to prepare standards for the development and implementation (inhouse developed or customized or off-the-shelf) of the EHR system at health facilities in the Country. This standard governs all health facilities/ care providers dealing with individual patient health recording (public, private, other government & non-government health facilities), EHR software developers/ vendors and implementers, EHR system regulators/ evaluators in Ethiopia.

This document does not include legal frameworks for abiding the rules/ standards set by it. It also doesn't include rules on patient data sharing agreements between health facilities. It won't overpass existing policies/ legislation frameworks on patient health recording and sharing. Only the core functionality of the EHR system is specified here, hence the functional and non-functional requirements of an EHR system are beyond the scope of this document. The functional and non functional requirements that system developers specify/set should not contradict the standards set in this document and are subordinates to it.

Health Information Systems (HIS) governance is one of the pillars of the Ethiopian Health information systems. Accordingly, the Ministry of Health (MOH) of Ethiopia has developed, approved and implemented different governance structures and mechanisms for the different national health information systems. Governance of E H R development and implementation will be based on the existing national HIS governance systems that are developed and approved by the MOH of Ethiopia. A separate E H R governance mechanism for E H R implementation is therefore not in the scope of this document and it is not included in this document.

2.2 Objectives

The general objective of this document is to set standards for the development and implementation of an EHR system in the country that will streamline the standardized health data collection, transmission, analysis and use for clinical and public health decision making. Hence It aims at developing and implementing a standard document which enables various electronic systems, across all health facilities in the government and private structure, to support seamless data exchange for longitudinal continuum of care.

The specific objectives of this standard document are :

- To identify core system functionality areas, general system functionalities, modules, modules functionalities and their minimum data sets that any EHR systems should have/should meet.
- To define terminology and messaging standards for the EHR system interoperability.
- To define EHR system data ownership, sharing, privacy and security standards and measures.
- To set minimum implementation requirements and or guides for EHR system in both pre-implementation and operation phases

2.3 Guiding principles

The MOH formulated the following guiding principles to be used as a guide by different stakeholders during the selection, development/customization and implementation of an EHR software/system. This guides to establish a robust, dynamic, standardized, interoperable and secured EHR system to support the health systems ensuring continuity of care, quality health service delivery, and equitable distribution of health resources.

- Engage the User: EHR solution developers should partner with multiple system users throughout the EHR solution development lifecycle. Co-creating the EHR solution, and continuously gathering and incorporating users' feedback must be followed to better address the specific context, culture, behaviors and expectations (improving current processes, saving time, using fewer resources and improving quality) of the people who will directly interact with the EHR solution.

- Understand the Existing Ecosystem: Dedicating time and resources by solution developers and implementers to analyze and understand the EHR ecosystem, or context is important. Doing this is helpful to ensure that the selected EHR solution will be relevant and sustainable and will not duplicate existing efforts. Activities include engaging with target users and stakeholders, consulting existing research, reviewing legal and regulatory policies and monitoring the ecosystem for changes throughout.

- Design for scale: EHR solution designers should plan and design for scale from the initial stage. It means thinking beyond the pilot and making choices that will enable widespread adoption later, as well as determining what will be affordable and usable by larger health facilities, rather than by a few pilot sites. This can be best expressed by the idea of "thinking big, starting small and scaling fast". Attention should be given to the simplicity, flexibility and modularity of the solution to adapt to other contexts. Don't attempt to scale without fully validating that the initiative is appropriate in a new context and addresses a priority need.

- Build for sustainability: EHR system design and implementation should consider the sustainability of the system in the long term. This requires proper design and deployment of ICT infrastructure to ensure system availability and reliability, capacitation of staff for real time system support, change management planning, and awareness creation and engagement of all stakeholders for the benefit aspired from it. Establishing interdisciplinary implementation groups consisting of developers, members of IT departments, management and system users to ensure the success of EHR implementation is also needed.

- Ensure Privacy and Security: Organizations must take measures to protect confidential information and identities of individuals represented in data sets from unauthorized access and manipulation by third parties. Confidentiality and security of personal data of clients should be maintained with an aim to preserve the dignity and security of the individuals represented.

- Comprehensiveness and Interoperability: An EHR solution developed and implemented by health facilities should be comprehensive enough to register and store individual patient records for each visit of a care provider from birth to death. Moreover, the patient's record should be longitudinally accessible from any other health facilities by health workers. In aiming to develop a comprehensive and interoperable system, all service outlets of the health facility should be considered, the system should be scalable and extensible to accommodate growth in number of users and data size, and additional system features and functionalities. It should not be a siloed EMR system and should exchange data with other systems through interoperability.

- Use Open Standards, Open Data, Open Source, and Open Innovation: An open approach to digital development is prioritized and promoted to increase collaboration in the digital development community and avoid duplicating work that has already been done. Programs can maximize their resources — and ultimately their impact — through open standards, open data, open-source technologies and open innovation. Adopt and expand on existing open standards: specifications developed by, agreed to, adopted by and maintained by a community and that enable sharing of data across tools and systems. Use existing open platforms and global public goods where possible to help to automate data sharing, connect the EHR system with others and add flexibility to adapt to future needs.

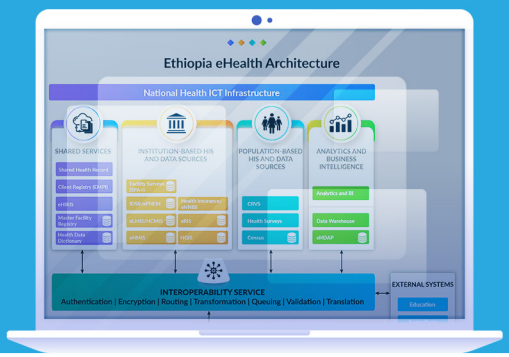
- Reuse and Continuously Improve: EHR solution development and its implementation should consider adapting and enhancing existing products, resources and approaches instead of reinventing the wheel. Developers and implementers should focus on assessing what resources are currently available and using them as they are to meet program goals and modifying existing solutions, products and resources to improve their overall quality, applicability and impact.

- Be Collaborative: EHR system development and implementation needs collaboration of different groups for the sake of sharing information, insights, strategies and resources across projects, organizations and sectors, leading to increased efficiency and impact.

- Compliance to HIS Governance : The development or customization and implementation of an EHR system needs strong governance structure and leadership. Therefore, complying to national and subnational health information system governance structures,policies and rules; coordination of efforts; and engagement of the leadership is critical for successful EHR system implementation in health facilities.

- Existing Systems Compliance to EHR Standards: The realization of well functioning and interoperable EHR systems with central shared health records in the country requires adoption and implementation of nationally defined data exchange EHR standards. Therefore, all vendors or system owners, financiers and implementing bodies need to updates their existing EMR or EHR systems' core functionalities, data elements, data exchange standards, system security controls, privacy, access and data sharing protocols, implementation and maintenance practices in line with specifications described in different sections of this document. To be nationally certified and reach upto the level required, an existing EMR system should go through evaluation by the national appropriate governance body. A criteria (from the standard document) may be tailored to fit different types of facilities in the three -tiers Ethiopian health service delivery system.

3 THE EHR SYSTEM INFO-STRUCTURE



THE EHR SYSTEM INFO-STRUCTURE

Availing longitudinal individual health data records at national level can be achieved either by establishing a single EHR system that runs in all health facilities, standalone diagnostic centers and dispensing pharmacies or by allowing multiple independent but interoperable EHR systems to be developed and deployed by health facilities. Both approaches have their own pros and cons. The former goes with the motto of MOH, which is one plan, one report and one budget, to bring uniformity of health data by promoting a unitary system. Such an approach may be useful for low income countries like our country, Ethiopia as it highly reduces the cost associated with the development/customization of the right software, dealing with interoperability issues and adoption of international data exchange standards. It also demands less sophisticated technical skills to manage data exchange with other external systems and also requires huge initial investment and may leave the country dependent on limited software vendors and technology platforms.

On the other hand, allowing multiple systems to operate in a country, the second approach, allows many stakeholders to involve software development using different technology platforms and scale-up activities. This approach supports one of the basic principles of Ethiopian health system which is democratization and decentralization of the health system in the eyes of digitization. Since such approaches bring a wider range of semantic and syntactic variations of health data collected by different EHR software, achieving good quality of data exchange among health facilities and bringing uniformity of data at national level is not an easy task. In fact , such an approach without strict monitoring and evaluation mechanisms in place is extremely dangerous.

Therefore, with due consideration of the costly business of managing interoperability issues and limited resources, the MOH developed EHR systems standards and implementation requirements to support establishment of a single source of truth for individual health records at national level by allowing those EHR systems that fulfill the requirements to participate in the digital health ecosystem. A proper infostructure to accommodate the implementation of multiple EHR systems at facilities yet interchanging data with the nationally/ centrally built SHR need to be identified and established. This is based on the existing national eHA framework and lays down a platform for the implementation of the EHR system nationally.

3.1 The National eHealth Architecture

Ethiopia has a National eHealth Architecture (eHA); A blueprint (figure 1) which depicts a conceptual framework for how the different eHealth system components interact and defines how interaction among these systems can be made possible through interoperability services. In light of the national EHR system to be built, the eHA gives guidance on how the facility based EHRs (described as point of service EMR in eHA) can interact with a centrally managed SHR repository system. To materialize this, the eHA defines shared health service registries such as eMPI, MFR, HWR and NHDD.

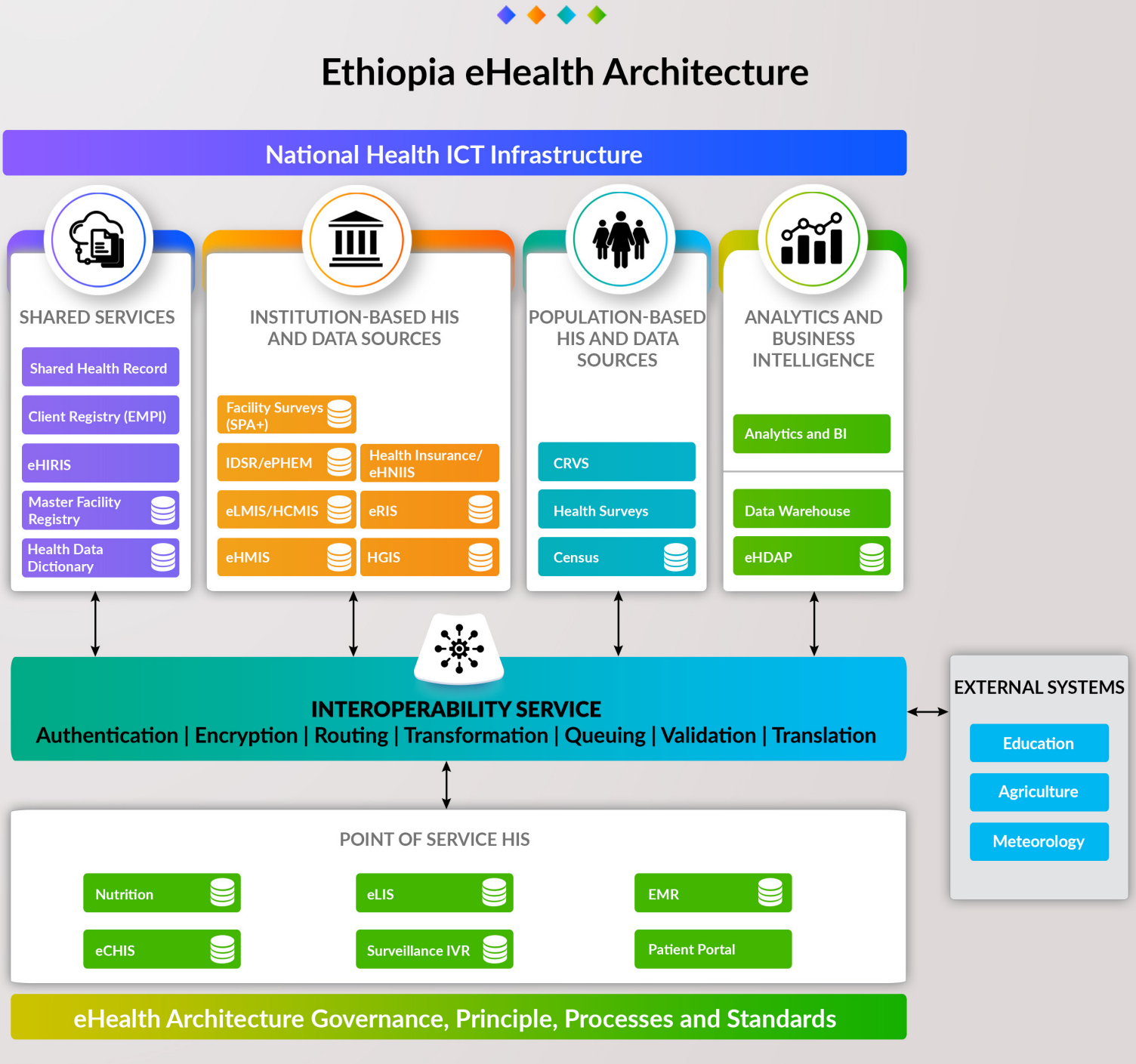


Fig 1: Ethiopia eHealth Architecture

3.2 The EHR Infostructure

EHR, leveraging the concept of architecture, stipulates different registries, repositories, and point of service solutions as components of a predefined infostructure with aligned workflows and business processes. A given point of service application that deals with individual records must consider interacting and communicating among and between different components of the infostructure with the defined process and workflows. Fig 2. illustrates the relationship and communication among and between different EHR components. The EHR refers to the below listed components: -

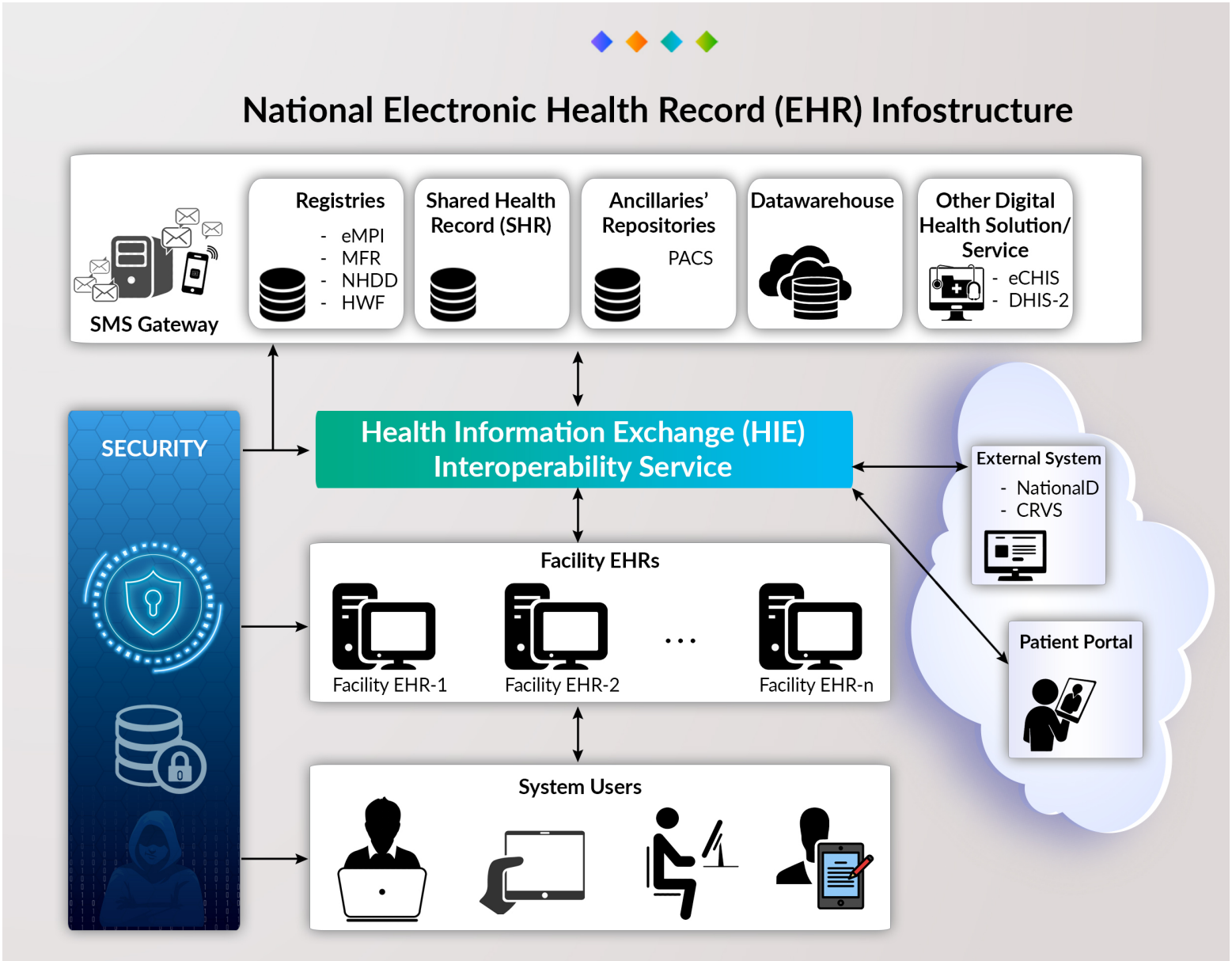


Fig 2: EHR infostructure blueprint

Facility EHRs: A facility EHR is an EHR ready system, passing through the interoperability layer, interacts with central registries, repositories and data warehouses to record access to client data so that the longitudinal continuum of care could be achieved.

Interoperability Service: Ans interoperability layer which facilitates the process of health information exchange enforcing privacy and security measures to provide a single point of control and transaction monitoring.

Registries: Shared services designed to serve as a single source of truth for patient, facility, Health workforce and data dictionary data.

- eMPI(client registry): A shared registry that holds personal and demographic information of a patient who received healthcare service across multiple facilities.
- MFR: A master facility registry is a complete listing of health facilities in a country which identifies each facility and consists of a set of administrative information.
- NHDD: National Health data dictionary is a central registry which provides health data terminologies codes and classifications such as national classification of disease, national drug and LAB lists.
- HWF registry: Health workforce registry is a shared registry that holds health professionals minimum data set. In a national context an electronic health workforce registry can be considered the single authoritative source of health workforce information. Though it is not an exact match, eHRIS/ iHRIS can be considered here.

Repositories: Central repositories designed to capture shared health records, ancillary repositories and data warehouses.

- SHR: Shared health record is a collection and storage of electronic health information about individual patients in a centralized repository, which is capable of being shared across different healthcare settings and electronic health record systems.
- Ancillary Repositories: A repository system with a dedicated support to a specific health information system at a national level.
- Data Warehouses: a central managed large health data collected from different healthcare settings and information systems.

Patient Portal: A secure platform which helps patients access their data. In the context of eHA and EHR infostructure the privilege provided to the patient is the role of access only. Though the ultimate owner of the data is the patient, the role to edit and delete patient data are prohibited in the patient portals.

Other digital health solutions and services: Refers to other institution based and population-based health information systems participating under the umbrella of eHA. This may, for example, include DHIS2, eRIS etc.

External Systems: Application systems from other sectors which are in need of health data from the EHR infostructure.

ICT Infrastructures: The information communication technology infrastructures and Device management systems that are established to foster the communication and integration of the EHR components. Initiatives such as HealthNet, national data center establishment are the backbones for the realization of the infostructure.

Security: A cross cutting concept which aligns privacy, security and other risk managements in the perspective of business, information or data, Application and Technology or infrastructure of the infostructure.

General points to be considered:

The development of national EHR system and its associated implementation guidelines and governance model is based on the following Points:

- An optimal and dedicated national ICT infrastructure should exist to enable inter facility connectivity and resource sharing.
- A shared health record repository should be built at a national level and maintained centrally and provide the following services.
    - Enable longitudinal record access made possible as one point of data sharing for the facility EHRs.
    - Generation of national healthcare metrics, which are defined in the national indicator dataset
    - Source of data for the implementation of a national data warehouse.
    - Interface ancillary repository systems for two way data sharing e.g PACS systems
    - Interface with external systems such as CRVS systems that manage vital events (birth and death notifications for registration)
    - Interface with other digital health solutions, including community based EHR systems such as eCHIS, routine electronic HMIS and surveillance systems, for aggregate data exchange.

  - Interface with a patient portal system enabling patients to view results and follow their appointments.
  - Interface with SMS gateway systems to send notifications to patients.

- Facility EHRs should be developed/ customized based on the standards set in this standard document and implemented and functional at the point of service addressing all implementation requirements
- Exchange of patient-based transactional data and/ or patient health summary between the facility based EHR systems and the national SHR.
- Data exchange between facility EHRs is done through the SHR using the middleware and not through a direct point-to-point interoperability mechanism.
- Building a comprehensive EHR system that incorporates all the modules (where applicable) stated under the EHR core functionalities chapter of this document is prioritized. Facility based ancillary systems that implement individual module(s) as part of some program initiatives shall be integrated into the facility based EHR system through point-to-point interoperability mechanism.
- The MPI is a single source of information on patient demographics for identification, hence establishing and maintaining eMPI is mandatory. The MPI interfaces with facility based EHRs, the SHR and external systems such as national identification.
- Timely synchronization between different systems should be made possible
  - SHR and Facility EHRs
  - National PACS repository with Facility based PACS systems
  - Facility EHRs and facility based ancillary systems.

Mapping between EHR infostructure and eHA: The EHR infostructure is aligned with the eHA conceptual framework It is in fact subordinate to the national eHA and defines the EHR conceptual framework by zooming in on the components linked with EMR. Below table, table 3.2-1 summarizes the mapping/ linkage between EHR infostructure and eHA.

No	Component/ Concept in EHR Infostructure	Component/ Concept in eHA
1	Facility EHRs	Point of service EMR
2	Repositories (SHR, Datawarehouse, Ancillaries)	Shared Services (SHR), Analytics and Business Intelligence (Datawarehouse)
3	Registries (eMPI, MFR, NHDD, HWR)	Shared Services(Client Registry-eMPI, MFR, NHDD, eHRIS)
4	Other Digital Health Solutions(eCHIS, DHIS2)	Institutional Data Sources (eHMIS) & Point of service HIS (eCHIS)
5	External Systems (National ID, CRVS)	Population based HIS (CRVS)
6	Patient Portal	Point of Service (Patient Portal)
7	Health Information Exchange (HIE)	Interoperability Service
8	Security (Entire Ecosystem)	Interoperability Service (Authentication, Encryption), eHA governance (Standards)
9	ICT Infrastructure (VPN-HealthNet, Internet, Computing Infrastructure (Severs, PCs, PDAs, Tablets.))	National Health ICT Infrastructure
10	System Users	Health Workforce

Table 3.2-1: EHR Infostructure linkage with eHealth Architecture

4 EHR SYSTEMS CORE FUNCTIONALITIES

EHR SYSTEMS CORE FUNCTIONALITIES

Since the past few years, different EHR systems have been developed or customized by Non-Governmental Organizations (NGOs), private vendors and health facilities with different capabilities tailored to the individual health facility's needs. However, due to the growing need for individual health data at national level and the complex nature of health facility's information system, most implemented electronic medical recording systems functionalities are limited to automating certain aspects of health facilities and not yet capable of exchanging patient data among other e-health systems. Moreover, data collected from such systems lacks uniformity as there is no mechanism in place at national level to enforce EHR systems complying with the minimum data elements defined by MoH. Therefore, with due consideration of the national HIS strategies and the digital health blueprint, it is important to define the core set of functionalities, modules and minimum dataset for an EHR system in order to support all service delivery outlets and bring its desired benefits to the individual, health facility and higher level. In this chapter, eight EHR core functionality areas, 102 functionalities and fifteen modules (sub systems) are described with a defined level of importance. The eight functional areas are based on IOM standards. The key functional areas shall define all critical aspects of an EHR system. These are:- Basic demographic and clinical information, Order and referral management, Result Management, Decision Support, Administrative processes, Data management, use and Reporting, Exchange of Electronic Information and Patient Support.

These functionalities and modules serve as a base for reviewing and evaluating an EHR system to be deployed or running in health facilities.

Standards referenced

The functional requirements of an EHR system are mostly referenced from the HL7-electronic health record system functional model. In addition, the Ethiopian hospital service transformation guideline is used as a reference to determine the modules or sub systems that need to be included in EHR systems customized or developed to the Ethiopian context. Other national and international references are also used. The following are the major standards referenced:

- HL7 - Electronic Health Record System Functional Model, Release 2.0.1

- Standards and Guidelines for Electronic Medical Record Systems in Kenya, 2010
- ISO/TS 18303: Health informatics
- Ethiopian Hospital Services Transformation Guideline (EHSTG) Volume 1 and 2, MOH, 2016
- National HMIS Recording and reporting procedures manual, MOH, 2018
- National HMIS indicator reference guideline, MOH, 2021
- Hospital Performance Monitoring and Improvement Manual, MOH, 2016
- Health Services Transformation in Quality (HSTQ), MOH, 2018

4.1. EHR Core functional areas

The electronic health recording systems to be customized or developed shall have minimum functionalities and data set to support all activities directly or indirectly related to provision of health services to individual patients/clients. Capabilities that support identification of an individual uniquely and capturing demographic and health information during the time of each encounter is one of the groups of functionality an EHR system is expected to meet. This definitely adds value to the quality of health service delivery by ensuring continuity of care. The second category of EHR functionalities enable care providers to set any kind of clinical orders to investigate a patient's health problems or treat conditions or refer/consult/transfer cases for the betterment of services. The third group of EHR functionality supports easy management of previous and current results, enhancing efficiency. Capabilities that support clinical and administrative decisions such as access to current knowledge sources, reminders and alerts in the process of care are categorized as decision support functionalities. These capabilities are expected to reduce potential medical errors and enable care providers to provide effective services. The fifth group is about those functionalities that support health facility administrative processes such as queue management, patient scheduling for services, billing and bed management. These functionalities help hospitals to have better control on available resources and provide equitable and efficient services towards improving patient satisfaction. The individual level data, nationally defined aggregate service and disease reports, custom report, data visualization and analysis using built in analytic tools is an ever- growing demand in the health system. Thus, the sixth group of capabilities serve data management, use and reporting needs health facilities. To support provision of health services regardless of where the individual is located, and to facilitate team work among care providers, an EHR system shall support exchange of quality individual and aggregate data among different systems. The last but not the least group of EHR

functionalities focuses on capabilities that enable patients to access their own health records, receive tailored educational material and transmit data from remotely located patient monitoring devices.

4.1.1. Demographic and Health information

This refers to individual patient or client related information regarding their demographic and health information generated and captured during health facility encounters or visits. Complete demographic and health information enables health care providers to diagnose and treat illness and injuries. An EHR system is required to capture and render:

- Demographic data of an individual including but not limited to: Unique identifier, Biometric data, First name, Middle Name, Last name, Gender, Date of Birth, Physical address -Region, Zone/Sub-city, Woreda, Kebele, House Number; Phone number, Education level, Occupation, Marital status, and Contact address.
- Clinical data such as chief complaint, history of present illness, past medical, social and family histories, vital signs, findings of physical examination, investigation request and results, problem list, procedures, immunization information, Medication list, progress note or follow up, nursing diagnosis and care given, diagnostic images, referral information, consent notes and discharge summary.
- The system shall capture demographic and clinical data using structured formats and free texts
- The system shall capture chief complaints, problem lists (including diagnoses), medication, lab test, procedures and immunization data using selected & adopted terminology standards.
- The system shall render a list of time tagged interaction summary for each encounter and service unit level interaction with capability of selecting and expanding a particular interaction.

4.1.2. Order and referral management

Care providers using an EHR system shall be able to order clinical investigations, procedures, cares, medications and other services within or to other health facilities electronically. As a result, one can ensure effective and safer practice of health services to individual patients. In addition, electronic communication of patient's referral information can facilitate collaborative work of health facilities towards providing the right health service to the right individual by the right care provider at the right time. Therefore, critical EHR systems developed or adopted and run in

the Ethiopian health facilities shall support electronic referral and ordering clinical services. Orders and referral services include but not limited to:

- Laboratory tests
- Diagnostic tests and imaging
- Prescriptions
- Procedures
- Nursing care
- Follow up care
- Diet/ dietary service
- Intra/inter/referral or linkage between departments/units
- Transfer in and out
- Consultations
- Others

4.1.3. Decision support

One of the key benefits of having an EHR system in a health facility setting is minimizing potential medical errors, improving safer and effective practice of Medicine by care providers during each encounter. Thus, it is also essential for an EHR system implemented in our setting to have functionalities that support the clinical decision making process. This include but not limited to:

- Availing clinical guidelines
- Allow access to current clinical knowledge sources
- Alert, remind, prompt for erroneous drug prescription
- Alert for drug- drug interactions
- Alert of out of range values
- Reminders for Service Appointments and chronic care services
- Alert for allergies
- Decision support tools such as expert system (suggesting diagnosis based on clinical data and algorithms)

4.1.4. Data management, use and reporting

Collecting individual level data for health facilities in electronic format makes the quality and management of data, analysis, use and reporting easy. Availability of shared health records at national level also provides a unique opportunity to access individual level health data for other health facility consumption, to generate national reports, perform big data analysis and carry out research. Therefore, an EHR running in a health facility shall have capability to:

- Generate and send routine reports and facility KPI reports; and clinical data report
- Produce Custom reports
- Display dashboards for KPIs
- Support data entry validation
- Export data set with recommended format

4.1.5. Result management

All investigation results from laboratory, Diagnostic test and imaging, Pathology units from a facility and other standalone diagnostic centers should be electronically collected and integrated with the patient chart. Care providers should be able to find and review previous results to monitor the patient status and support his/her clinical decisions on diagnosis and treatment of the patient. This improves efficiency of service provision by minimizing time and reducing the cost for repeat investigations. An EHR system shall have capabilities to:

- Receive and send lab, diagnostic test and imaging results
- Display previous results
- Display charts for trends of test results

4.1.6. Administrative processes

To facilitate efficient management of health facility resources, improve patient satisfaction and attain better control of financial flow, an EHR system shall be integrated with or have the following capabilities.

- Billing system
- Bed management system
- Queue management system
- Appointments management system
- User management

4.1.7. Exchange of electronic information

The practice of medicine demands exchange of data among care providers and health facilities, diagnostic centers and other service providing settings where the individual patient/client receives health services. To facilitate the data sharing activities, there is a need to build shared health records at national level along with other services such as client registry, facility registry, HR system and PACS (picture archival computerized system). This to happen, an EHR system should be capable

of supporting individual level data exchange within nationally defined EHR eco systems and recommended standards. Therefore, the developed or customized EHR shall be capable of interfacing with:

- Patient monitoring Devices
- Laboratory machines and equipment
- Client registry for MPI service
- Shared health records
- Master facility registry
- Health workforce registry (HRIS)
- Other ancillary systems such as PACS, Radiology information system, Laboratory information system, Supply chain management system...etc.

4.1.8. Patient support

Patient centered approach for health service delivery is one of the quality dimensions MoH is promoting in the country. Based on the national information act and data access and sharing policy, an EHR should support patient data access; and able to capture health data from remote medical devices used by individual patients. It may also be capable of sending tailored educational instructions to patients.

4.2. EHR core system functionalities

Based on the core EHR system functional areas described above, the national EH R standard specifies 102 functionalities that shall, should, or may be supported by an EHR system in order to be accepted and run in the Ethiopian healthcare settings. 'Shall' stands for functionalities that must be included in an EHR system; "Should" represents a functionality that an EHR system is required to have; and" May" indicates a functionality of an EHR system is good to have. The incorporation of these 102 functionalities depends on the type of health facility and EHR evaluation criteria.

Priority orders

- High (H): Functionalities an EHR system must support
- Medium (M): Functionalities an EHR system required to have or support
- Low (L): Functionalities an EHR system good to have or support

	Functional Specification for E H R	Priority
	A. Cross Functional	
1.	The system shall support all services defined by MOH for each respective health facility	H
2.	The system shall capture all data elements required for individual patient management and program monitoring and evaluation	H
3.	The system shall support paperless function and electronic patient data exchange across all service delivery outlets and other facilities	H
4.	The system shall associate unique identifier information (e.g., system ID, medical record number) with each patient medical record	H
5.	The system shall support access to medical information to all health care providers involved in care provision	H
6.	The system shall support displaying summary of services provided to patients by date, type of service, diagnosis or other criteria	H
7.	The system shall support auto-capturing date and time for all transactions or events of each encounter	H
8.	The system shall support send and receive shared health records from other EHRsources per pre-defined data set	H
9.	System shall support security controls on medical records to ensure that data cannot be viewed, deleted or altered except within the current session and/or by an authorized user	H
10.	The system shall support maintaining audit logs. The audit log should have dates and time stamps for all entries	H
11.	The system shall have data entry validation capabilities across all data entry forms	H
12.	The system shall have the capability to capture dates and timestamps for all entries	H
13.	The system shall have the capability to manage care providers information involved in care provision	H
14.	The system shall provide the capability to manage free text comments associated with all demographic and clinical data entry	H
15.	The system may have the capability to capture and render historical paper based data using different technologies such as scanning	L
16.	The system shall provide the ability to manage a record for a patient when the identity of the patient is unknown	H
17.	The system shall provide the ability to manage patient charts as obsolete, inactivated or nullified in accordance with local policies and procedures, as well as applicable laws and regulation	H
18.	The system should have a feature that support displaying an indicator that the health record of the patient/client is incomplete (for selected data elements)	M
19.	The system shall support capability of setting price of services	H
20.	The system shall support deactivation of the file of deceased patient records	
	B. Basic Demographic and Health Information	
	B.1. Basic Demographic /Identification	
21.	The system should have a feature that support MPI service using the national client registry supporting multiple unique identifiers	M
22.	The system shall generate a unique individual identifier for new clients (MRN)	H

	Functional Specification for E H R	Priority
23.	The system shall support resolving duplicate patient records	H
24.	The system shall support display of key demographic data at each interaction point	H
25.	The system shall support updating demographic characteristics as necessary	H
	B.2. Clinical Information	
	Vital Signs	
26.	The system shall support capturing and displaying vital signs such as blood pressure, respiratory rate, pulse rate, Oxygen saturation, temperature, pain score, weight, height and random blood sugar	H
27.	The system should auto calculate nutritional status of individuals (Such as body mass index-BMI, Weight for age-WFA, Weight for Height-WFH)	M
28.	The system should alert out of range values for vital signs	M
29.	The system shall support generating reminders to take vital signs at intervals ordered by treating physician	H
30.	The system shall support display of main vital signs and trends over time	H
	Patient History and physical examination	
31.	The system shall be capable of capturing chief complaint with its duration	H
32.	The system shall support capturing clinical data based on standard formats and protocols (Example: ART intake forms, ART follow up forms, Integrated RH card etc...)	H
33.	The system shall allow data entry for history of present illness, personal/social history, family history, NCD risk assessment, history of allergy and adverse drug reactions	H
34.	The System shall have capability of capturing past patient history as relates to medical, surgical, obstetrics/gynecology, pediatric and other care provided	H
35.	The system shall capture immunization history and status based on selected terminology standard for vaccines	H
36.	The system shall provide the ability to create and maintain a client-specific immunization schedule.	H
37.	The system shall capture family planning, pregnancy care, childbirth and postnatal care data based on the national formats (capable of capturing data for each visit)	H
38.	The system shall support capturing physical examination findings as structured and free text form	H
	Problem List	
39.	The system shall have capability to capture, maintain, display and report all active problems associated with the patient, based on the selected terminology standard	H
40.	The system shall capture all diagnosis of the patient, and condition of the patient (Severity, chronicity...) based on nationally selected diagnosis standard	H
41.	The system should support capturing reasons for any diagnosis change in the course of patient treatment	M
42.	The system shall be capable of mapping diagnosis to the national classification of diseases	H

	Functional Specification for E H R	Priority
43.	The system shall be capable of capturing diagnosis as new or repeat; and as primary/main and other diagnosis	H
44.	The system should be able to capture and track diagnosis status as presumptive and confirmed	M
45.	The system shall provide the ability to manage the status of each problem identified (e.g., active, inactive, resolved)	H
46.	The system shall provide the ability to display active problems	H
47.	The system should be able to sort problems as required by the care provider such as by severity, time of occurrence or other factors	M
	Progress note and treatment plan	
48.	The system shall capture and display progress note and treatment plan based on the national standard format	H
49.	The system shall display previous medication and investigation results	H
50.	The system should support capabilities of recording and rendering procedures and surgeries performed information with a description	M
51.	The system shall provide the ability to manage adverse effects following medications	H
	C. Order and referral management	
52.	The system shall support ordering laboratory tests coded with nationally selected terminology standard	H
53.	The system shall support managing orders status (such as completed, on progress, cancelled…)	H
54.	The system shall support managing blood and blood products order	H
55.	The system shall support ordering diagnostic and imaging requests, based on selected diagnostic and imaging standard	H
56.	The system shall support prescribing pharmaceuticals based on selected pharmacy standards including e-prescription	H
57.	The system shall have the capability to manage prescription order including editing, cancelling prescriptions when a medication is prescribed by mistake	H
58.	The system shall support ordering follow up care, nursing care based on selected nursing standard	H
59.	The system shall support capabilities to manage consent order	H
60.	The system shall support managing consultations and referrals information	H
61.	The system may support display of the status of consultations and referrals (as completed, pending, cancelled…)	L
62.	The system shall support capturing and rendering other orders such as dietary order, physiotherapy… etc.	H
63.	The system shall display available medicines, laboratory tests, diagnostics and imaging services in the specific facility	H
64.	The system shall support the ability to manage and render urgency status of orders	H
65.	The system shall support transmitting orders to other systems	H

	Functional Specification for E H R	Priority
	D. Result Management	
66.	The system shall have the capability to receive, display and maintain current and previous laboratory test results with reference values	H
67.	The system shall support capability of displaying alert message for out of range result values	H
68.	The system should have the capability to access laboratory results from other laboratory Information Systems	M
69.	The system shall have the capability to receive, display and maintain availability, safety and compatibility of blood and blood products	H
70.	The system shall have the capability to receive, display and maintain current and previous diagnostic and imaging results (images) with description of the findings and impressions	H
71.	The system should have the capability to send and receive diagnostic and imaging results from/to radiologic information system, PACS (Picture Archiving Computerized System)	M
72.	The system shall have the capability to receive, display and maintain current and previous prescribed drugs dispensed to the client/patient	H
	E. Decision Support	
73.	The system shall have the capability of accessing clinical guidelines and current clinical practices knowledge sources	H
74.	The system shall have the capability of displaying alerts and reminders to all care providers, when there is an abnormal value or when there are events to be attended based on certain clinical protocol specific to certain services	H
75.	The system shall have the capability to display reminders/alerts for abnormal lab results, drug-drug interactions, allergies etc....	H
76.	The system should support the ability to render a notification to the care providers when specific order or doses are due	M
77.	The system shall have a reminder for immunization due date, Antenatal care visits, compute gestational age, expected date of delivery (EDD) and other similar clinical decisions	H
78.	System shall automatically trigger an alert upon documentation of a diagnosis or an event required to be reportable to MOH and/or EPHI	H
	F. Administrative processes	
79.	The system shall have the capability to capture and manage billing information and claim management for all transactions	H
80.	The system shall have the capability to capture and manage bed information such as number and availability of beds, rooms, wards etc...	H
81.	The system shall support the ability to manage re-location of patients	H
82.	The system shall have the capability to manage patient appointments	H
83.	The system shall support queue management for all services	H
84.	The system shall have the capability to manage and display waiting lists for different services	H
85.	The system shall have the capability to manage and issue medical certificates	H
86.	The system shall have the capability to manage different system users with different roles and privileges	H

	Functional Specification for E H R	Priority
	G. Data management, Use and Reporting	
87.	The system shall have the capability of generating aggregate HMIS reports required by MOH, such as disease report (morbidity and mortality report), service report	H
88.	The system shall have the capability to electronically transmit aggregate national reports to national HIS systems such as DHIS2	H
89.	The system shall have the capability to generate ad hoc custom reports	H
90.	The system shall have data analytics features such as data visualizer, dashboards... etc.	H
91.	The system shall create and maintain patient-specific summary views and reports that include, at minimum: problem list, medication list, treatment interruptions and restart dates, adverse drug reactions, care history, and missed appointments	H
	H. Exchange of Electronic Information	
92.	The system shall support the exchange of data using nationally selected messaging standard and protocols with other systems	H
93.	The system shall have Communication/messaging capabilities to exchange patient information among care providers (feedback mechanism)	H
94.	The system may provide the ability to receive and render structured demographic and clinical information from registries	L
95.	The system should provide the ability to harmonize system information with registry information	M
96.	The system may support data capturing and rendering from laboratory equipment and patient monitoring medical devices	L
97.	The system should provide the ability to exchange clinical information with pharmacies using messaging or service standards	M
	I. Patient support	
98.	The system may have a patient portal that supports patients to access their own medical record, but cannot alter data, based on the recommended data confidentiality protocol	L
99.	The system may have educational materials for patients	L
100.	The system may support capturing and rendering patient information from patient sources such as remote monitoring devices	L
101.	The system may send alert messages to patients/clients for their appointments, treatment instructions, follow ups...etc.	L
102.	The system may provide the ability to render and annotate instructions pertinent to the patient as selected by the provider	L

4.3. EHR System Modules, Functionalities and Minimum data set

This EHR standard specifies fifteen modules/ sub systems to support the entire health facility activities so that a paperless environment can be created, and an EHR system can support provision of safe, effective and efficient health services to individual patients/clients. The EHR system to be deployed in a health facility should have the following modules. A queue functionality should also be an integral part of the EHR system. The inclusion of the modules depends on the type of health facility and EHR evaluation criteria.

1. Triage and Registration module
2. Liaison Module (including bed management service)
3. Outpatient Module
4. Emergency Module
5. Inpatient Module (including nursing care services)
6. Maternal, Neonatal and Child health Module
7. Non-Communicable Diseases Management Module (Diabetes Mellitus, Hypertension, Cardiac Diseases, Asthma, Epilepsy, etc)
8. HIV chronic care management module
9. Tuberculosis management module
10. Laboratory Module
11. Diagnostic and Imaging Module
12. Pharmacy Module
13. Rehabilitative and palliative care module
14. Billing Module
15. Reporting module

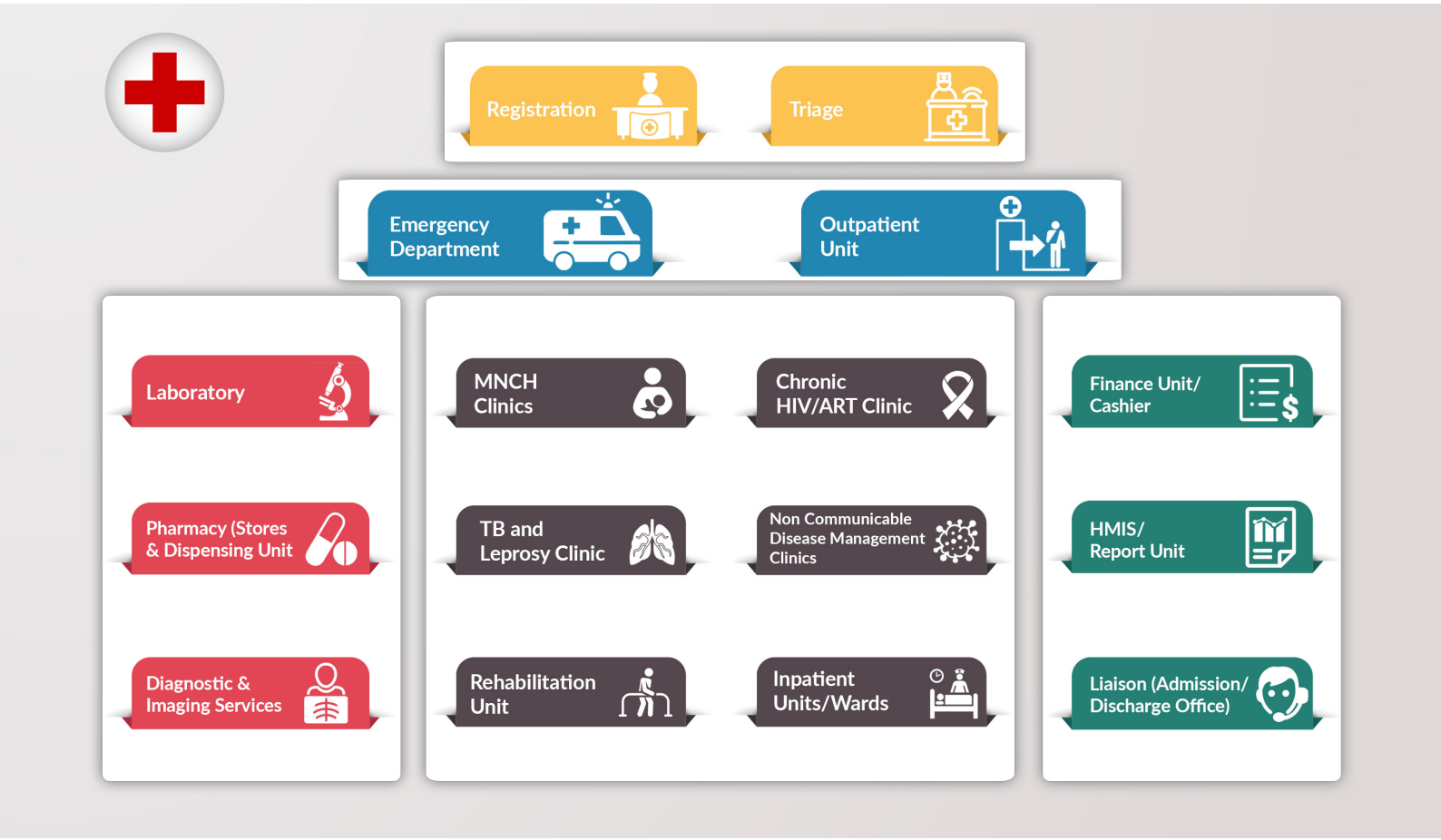


Figure 3. Module's interrelationship in an EHR system

Module Functionality and Minimum Data Set Requirements

This document describes the functional and minimum data set requirements each module shall support in addition to those relevant capabilities listed under the eight core functionality areas. Under this section, module description, its capabilities and the minimum data elements are described for each module.

4.3.1. Triage and Registration Module

Description: This module supports registration of patient triage and registration related services such as sorting patients, prioritization of patients, registration of patient/client demographic data, interacting with other patient registries such as electronic MPI services.

Functionalities:

- Capable of capturing and displaying patient triage information included in the standard triage format
- Capable of capturing basic demographic information such as full name, age, sex, adress, based on a standard medical record format (Demographic section of an individual medical record)

- Capable of labelling patients/clients based on the type and severity of case
- Capable of assigning patients to different departments/units
- Capable of assigning Medical Record Number (MRN) automatically for new clients/patients
- Capable of capturing scanned documents such as referrals and other documents
- Capable of displaying inactive medical records
- Capable of displaying summary demographic information about patients/clients
- Capable of displaying the status of service provision to patients/clients so that re-assignment is possible
- Capable of interfacing with client registry (MPI)
- Capable of displaying clients/patients with appointments
- Capable of displaying and printing service ID and appointment cards
- Capable of displaying payment method and status of payment
- Capable of generating standard and custom reports
- Capable of capturing and identifying biometrics data

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of triage and registration service includes the following data sets. It includes: type of patient (New/repeat), full name, unique ID number, biometrics data, date of birth, address, contact information, patient educational and marital status, occupation, unit where the patient is assigned, payment type and payment status. For details, see annex 1.1 section.

4.3.2. Liaison Module

Description: This module supports registration of liaison services such as referral in and referral out, bed management, admission and discharge management, provides information about admitted patients and captures information about social services provided. The functionalities and the minimum data set a liaison module of an EHR should meet are described below.

Functionalities:

- Capable of capturing and displaying number of beds in the facility (free, occupied) by department, ward and sex
- Capable of managing wards, rooms and beds
- Capable of displaying "admission request lists" by admission diagnosis, date, time, admitting physician, department and ward
- Capable of assigning patients to the appropriate ward, room and bed
- Capable of managing patient appointment schedules including priority setting (Displaying waiting list, priority patients,
- Capable of scheduling patients for post discharge follow up (to referral clinics/units)
- Capable of managing referral-ins and referral-outs (capable of capturing detail referral information)
- Capability to receive and send referral feedbacks
- Capability to display services received and financial information/ payment status about the patient
- Capable to display discharge summary, including post-mortem care
- Capable of capturing and displaying clearance form
- Capable of capturing and displaying death certificate based on a standard form
- Capable of displaying the status of the patients/clients by progress status and final decision, date and time, final outcome
- Capable of capturing and displaying social services provided to patients
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of liaison service includes the following data sets: Bed information, bed management, ward information, information about admitted and discharged patients, referral in and referral out information, social services information. For details, see annex 1.2 section.

4.3.3. Outpatient Module

Description: This module supports all health services provided in outpatient departments of a health facility including regular, referral and special clinics. It is inclusive of all the processes a patient may go through while receiving care or services as an outpatient case. This module of an EHR system shall have the following capabilities and minimum data set.

Functionalities:

- Capable of identifying, sorting and selecting list of patients assigned to the specific outpatient service unit
- Capable of displaying status of OPD patients as waiting, on progress, complete during the encounter
- Support summarizing and displaying patients' previous interactions and sorting by date, diagnosis, and service unit
- Capable of displaying specific previous patient interaction to view the information in detail
- Support capturing and displaying scanned documents such as referrals
- Capable of capturing and displaying vital signs
- Capability of capturing and displaying patient history such as chief complaint with duration, history of present illness, past medical/surgical/gynecological history, social/family history, allergy history as a structured and as free text form
- Capable of capturing and displaying problem list/diagnosis in a structured form based on the selected national terminology standard
- Capable of capturing and displaying Non-Communicable Diseases (NCD) risk factors, screening information based on standard format
- Capable of capturing physical examination findings by system (organ system), in a structured form-based on selected clinical terminology standard, and free text
- Capable of providing diagnosis menu by specialty such as Surgery, Gyn.Obs, Dental, ENT, Pediatrics, Dermatology, Ophthalmology, IMNCI...etc. for ease of searching a specific diagnosis
- Support capturing and displaying diagnosis as main and other diagnoses, new and repeat; and status as presumptive and confirmed diagnosis
- Capable of displaying updated available list of laboratory tests, diagnostic and imaging studies, and pathology tests with price
- Capabilities to order laboratory tests, diagnostic and imaging investigations, and pathology tests

- Support electronic receiving and rendering laboratory, diagnostic and imaging, pathologic test results
- Capable of capturing and displaying Provider Initiated Testing and Counseling (PITC) information
- Capable of capturing and displaying treatment plan
- Capable of displaying medicines' stock status by dispensing units and stores
- Support prescribing medicines electronically
- Support transferring patients to other outpatient units
- Capable of managing patient referral such as referring patient, displaying referral status of patients, receive and send referral feedbacks
- Support care provider communications among others within the health facility and external staff for consultation and other patient matters
- Support electronic patient admission and Capable of displaying facility's bed information such as beds occupied, free beds, ward type, bed number, bed transfer history...etc.
- Capabilities to manage patient appointments
- Capable of displaying a list of services provided in the facility, its cost, type of payment (cash, credit, free, insurance...), and cash balance
- Capable of managing medical certificate, consent
- Capable of generating OPD specific standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of outpatient service provision includes the following data sets: Clinical information such as chief complaint, history of present illness, past medical history, systemic review, physical examination, vital signs, lab investigation, list of problems, medications, procedures, diagnosis and treatment plan. For details, see annex 1.3 section.

4.3.4. Inpatient Module

Description: This module supports all the inpatient activities or workflows provided to any admitted cases ranging from reviewing newly admitted patient information to discharging or referring patients to other units or higher level. The functionalities and the minimum data set an inpatient module of an EHR should meet are described below.

Functionalities:

- Display summarized previous key patient information (summarized demographic information allergy, chronic illnesses, current status and diagnosis…)
- Capable of displaying newly admitted patients' list by date and time, specific unit and admission diagnosis
- Capable of sorting, selecting specific admitted patient and display detailed admission information
- Capable of adding new admission note writing page
- Capable of capturing and displaying structured and free text while using admission note (chief complaint, HPI, vital sign, P/E, assessment and plan)
- Capable of ordering laboratory requests, including urgency status
- Capable of ordering procedures, diagnostic and imaging requests and pathology request
- Capable of ordering follow-up care as per standard inpatient monitoring charts
- Capable of managing nursing care
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of capturing and displaying PITC information
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of providing diagnosis menu by specialty
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions
- Capable of displaying medicines' stock status by dispensing units, stores etc…
- Capable of transferring patients to other departments
- Capable of referring patients to other health facilities
- Capable of communicating and consulting with other experts in the facility
- Capable of capturing and displaying clinical pharmacist notes
- Capable of capturing and displaying progress note with structured and free text forms
- Capable of managing medication administration (by nurses)

- Capable of managing pre-operative, operation and post-operative notes (as per the standard)
- Capable of scheduling for surgeries/procedures
- Capable of capturing and displaying anesthesia evaluation note (pre, intra and post operation)
- May have the capability of capturing and displaying data from medical monitoring devices (mechanical ventilator etc)
- Capable of viewing scanned documents such as referrals
- Capable of capturing and displaying discharge, death summary
- Capable of referring patient electronically
- Capable to receive and send referral feedbacks
- Capable of managing medical certificates, consent based on standard forms
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance…), cash balance
- Capable of automatically deducting the cost of each procedure or service provided
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of inpatient service provision includes the following data sets. It includes, clinical information such as chief complaint, history of present illness, past medical history, systemic review, physical examination, vital signs, admission information, lab investigation, list of problems, medications, procedures, diagnosis, treatment plan, progress notes, anesthesia notes, pre-operative, operation and post-operation notes, discharge information, referral information, etc. For details, see annex 1 section.

4.3.5. Emergency Module

Description: This module supports all emergency services provided in the emergency department of a health facility. It is inclusive of all the processes an emergency patient may go through while receiving care or services as an emergency case. This module of an EHR system shall have the following capabilities and minimum data sets.

Functionalities:

- Capable of identifying, sorting and selecting list of patients assigned to emergency unit
- Capable of displaying status of emergency patients, by category (Red, yellow, green….)
- Capable of adding new patient form
- Capable of summarizing and displaying patient previous interactions (by date, diagnosis, service unit, …)
- Capable of displaying specific previous patient interaction to view patient information
- Display summarized previous key patient information (summarized demographic information allergy, chronic illnesses…)
- Capable of viewing scanned documents such as referrals
- Capable to record and display vital signs
- Capable of capturing and displaying patient history: Chief complaint with duration, history of present illness, past medical/surgical/gynecological history, social/family history, allergy history as a structured and as free text form
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of capturing physical examination findings by system (organ system), in a structured form and free text
- Capable of indicating diagnosis as new and repeat; as main and other diagnosis; presumptive and confirmed diagnosis
- Capable of ordering laboratory requests, by urgency status
- Capable of ordering diagnostic and imaging requests
- Capable of ordering pathology request
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of capturing and displaying PITC information
- Capable of providing diagnosis menu by specialty
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions

- Capable of displaying medicines' stock status by dispensing units, stores etc...
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of admitting patients for an inpatient care
- Capable of making appointments
- Capable of displaying list of patients with appointment by date
- Capable of displaying available beds
- capable of managing medical certificates, consent
- Capable of capturing and displaying progress note with structured and free text forms
- Capable of transferring to other units or facilities
- Capable of documenting patient outcome /discharge status
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance...), cash balance
- Display and track list of medicines and supplies in the emergency unit
- Capable of displaying and assigning patients to the appropriate category of beds
- Capable of managing medication administration (by nurses)
- Capable of capturing and displaying procedures performed
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of emergency service provision includes the following data sets: Clinical information such as severity status, chief complaint, history of present illness, past medical history, systemic review, physical examination, vital signs, lab investigation, list of problems, medications, procedures, diagnosis and treatment plan. For details, see annex 1 section.

4.3.6. Maternal, neonatal and child health module

Description: This module supports recording of data related to maternal, neonatal and child health services. It includes information on services such as Family Planning, Antenatal care, Delivery, Postnatal care, abortion care, neonatal care, immunization and other child health services provided at the health facility. It should include all the required functionalities and data elements based on the standard formats developed for these services. The minimum functionalities and data elements of the module are described below.

Functionalities:

- Capable of identifying, sorting and selecting list of patients assigned to respective service units
- Capable of displaying status of patients/clients (as waiting, on progress, complete…)
- Capable of adding new patient/client standard service specific formats
- Capable of displaying list of summarized patient's/client's previous interactions (by date, parity, gravidity, abortion, gestational age, diagnosis, service unit, demographic information, allergy, chronic illnesses…)
- Capable of displaying specific previous patient's/client's interaction to view detailed information
- Capable of capturing and viewing scanned documents such as referrals
- Capable to record and display vital signs
- Capable of capturing and displaying family planning service information based on standard format (including list of methods, counselling, side effect, etc..)
- Capable of managing sexual and reproductive health services
- Capable of managing adolescent and youth health services
- Capable of capturing and displaying comprehensive abortion care service based on standard formats
- Capable of capturing and displaying ANC service information based on standard formats
- Capable of capturing and displaying labor and delivery (including partograph,…) related information based on standard format
- Capable of capturing and displaying postnatal service information based on standard format
- Capable of managing immunization and growth monitoring service information based on standard format

- Capable of managing IMNCI service information based on standard format
- Capable of managing nutrition services
- Capable of capturing and displaying patient history: Chief complaint with duration, history of present pregnancy, past medical/surgical/gynaecological history, social/family history, allergy history as a structured and as free text form
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of capturing physical examination findings by system (organ system), in a structured form and free text
- Capable of indicating diagnosis as new and repeat; as main and other diagnosis; presumptive and confirmed diagnosis
- Capable of ordering laboratory requests
- Capable of ordering diagnostic and imaging requests
- Capable of ordering pathology request
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions
- Capable of displaying medicines' stock status by dispensing units, stores etc...
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of admitting patients for inpatient care (high risk maternal ward, NICU,)
- Capable of making appointments
- Capable of displaying list of patients/clients with appointment by date
- Capable of displaying available beds
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance...), cash balance

- capable of managing medical certificates, birth certificate, consent
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of maternal, neonatal and child health service should be recorded in this module. It includes data elements that relates to sexual and reproductive health, adolescent and youth health, Family Planning, Abortion Care, Antenatal Care, labor and Delivery, Postnatal Care, immunization, growth monitoring and promotion, nutrition, IMNCI and other maternal and child health services. For details, see annex 1 section.

4.3.7. Non-Communicable Diseases (NCD) Module

Description: This module supports recording of data related to services for non-communicable diseases. It includes information on screening, diagnosis and management of diabetes mellitus, hypertension, cardiovascular diseases, asthma, cancers including cervical cancer screening, management, and other NCDs. It should include all the required functionalities and data elements based on the standard formats developed for these services. The minimum functionalities and data elements of the module are described below.

Functionalities:

- Capable of identifying, sorting and selecting list of patients assigned to the unit
- Capable of displaying the status of NCD patients (waiting, on progress, complete...)
- Capable of summarizing and displaying patient previous interactions (by date, diagnosis, service unit, ...)
- Capable of adding new patient form
- Capable of displaying specific previous patient interaction to view patient information
- Display summarized previous key patient information (summarized demographic information allergy, chronic illnesses, status of the NCD, investigation results, other relevant information...)
- Capable of viewing scanned documents such as referrals
- Capable to record and display vital signs

- Capable of capturing and displaying patient history: Chief complaint with duration, history of present illness, past medical/surgical/gynecological history, social/family history, allergy history as a structured and as free text form
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of capturing physical examination findings by system (organ system), in a structured form and free text
- Capable of capturing and displaying NCD information as per a specific NCD format
- Capable of capturing and displaying cervical cancer screening and treatment services based on standard formats
- Capable of capturing and displaying Diabetes Mellitus, hypertension, asthma, CVD and other NCDs screening and treatment services based on standard formats
- Capable of indicating diagnosis as new and repeat; as main and other diagnosis; presumptive and confirmed diagnosis
- Capable of ordering laboratory requests
- Capable of ordering diagnostic and imaging requests
- Capable of ordering pathology request
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of capturing and displaying PITC information
- Capable of providing diagnosis menu by specialty
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions
- Capable of displaying medicines' stock status by dispensing units, stores etc...
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of admitting patients for an inpatient care

- Capable of making appointments
- Capable of displaying list of patients with appointment by date
- Capable of displaying available beds
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance…), cash balance
- capable of managing medical certificates, consent
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of NCD services should be recorded in this module. It includes data elements that relates to screening, diagnosis, treatment and follow up of clients/patients with Non-Communicable Diseases. It includes Cervical cancer screening and treatment, Hypertension, DM< CVD, Asthma, Cancer and other NCDs. For details, see annex 1 section.

4.3.8 Chronic HIV Care /ART Module

Description: HIV Care/ART follow up module is a module that has the functionality of recording and capturing data related to patients who are on chronic HIV care. It also includes information about clients who receive HIV testing services. The module should include all required functionalities and data elements based on the standard "ART patient monitoring guideline" and other national HIV prevention and treatment protocols. The minimum functionalities and data elements of the module are described below.

Functionalities:

- Capable of summarizing and displaying patient information/ dashboard (basic demographic information, Address, MRN, unique ART number, type of test, other relevant information…)
- Capable of capturing and generating unique ART number
- Capable of managing HIV test information by different modalities (VCT, index testing etc…) based on a standard format
- Capable of capturing and displaying ART intake forms
- Capable of capturing and displaying ART follow up form
- Capable for capturing and displaying TB screening information for registered HIV patients
- Capable of generating reminders to care providers whenever there are missed appointments, lost, lost to follow up (LTFU) pts, drop

- Capable of displaying list of patients who are eligible for viral load test
- Capable of capturing and displaying patients who are on DSD (Differentiated service delivery model)
- Capable of capturing and displaying enhanced adherence counselling form
- Capable of capturing and displaying PMTCT information (both for the mother and HIV exposed infants)
- Capable of ordering and receiving viral load tests and its result
- Capable of adding new patient form
- Capable of managing transfer-in and transfer-out patients
- Capable of managing pre-exposure and post-exposure prophylaxis based on a standard form
- Capable of identifying, sorting and selecting list of ART patients assigned to different ART units
- Capable of displaying status of ART patients (waiting, on progress, complete…)
- Capable of displaying specific previous patient interaction to view patient information
- Display summarized previous key patient information (summarized demographic information allergy, chronic illnesses…)
- Capable of viewing scanned documents such as referrals
- Capable to record and display vital signs
- Capable of capturing and displaying patient history: Chief complaint with duration, history of present illness, past medical/surgical/gynaecological history, social/family history, allergy history as a structured and as free text form
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of displaying risk factors for NCDs
- Capable of capturing and displaying NCD screening and its result based on standard format
- Capable of capturing physical examination findings by system (organ system), in a structured form and free text
- Capable of indicating diagnosis as new and repeat; as main and other diagnosis; presumptive and confirmed diagnosis
- Capable of capturing and displaying PMTCT service information based on standard format

- Capable of managing HIV exposed infant follow up and monitoring
- Capable of managing patient's viral load test and its result
- Capable of ordering laboratory requests
- Capable of ordering diagnostic and imaging requests
- Capable of ordering pathology request
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of providing diagnosis menu by speciality
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions
- Capable of displaying medicines' stock status by dispensing units, stores etc...
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of admitting patients for an inpatient care
- Capable of making appointments
- Capable of displaying list of patients with appointment by date
- Capable of displaying available beds
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance...), cash balance
- capable of managing medical certificates, consent
- Capable of generating standard and custom reports
- Capable of generating cohort report

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of chronic HIV care services should be recorded in this module. It includes data elements based on standard formats such as HIV intake forms A and B, chronic HIV care follow up form, HIV testing forms and other standard HIV related formats. For details, see annex 1 section.

4.3.9 Tuberculosis and leprosy Module

Description: This module supports recording of data related to services for tuberculosis and leprosy. It includes information on screening, diagnosis and treatment of drug sensitive tuberculosis, drug resistant tuberculosis and leprosy diseases. It should support a longitudinal record and follow up of patients on TB and leprosy patients until they finish their treatment. It should include all the required functionalities and data elements based on the standard formats developed for these services. The minimum functionalities and data elements of the module are described below.

Functionalities:

- Capable of summarizing and displaying patient information/ dashboard (basic demographic information, Address, MRN, Diagnosis, type of TB, other relevant information)
- Capable of capturing and generating unique TB and leprosy number
- Capable of capturing and displaying TB diagnosed patients on standard drug sensitive and DR TB treatment registration forms
- Capable of capturing and displaying standard TB follow up forms (drug sensitive and DR TB Rx follow up forms)
- Capable of capturing, sending and receiving TB and leprosy related laboratory investigations such as DST, smear and culture tests based on standard forms
- Capable of ordering and capturing TB and leprosy treatment drugs based on the national treatment protocol
- Capable of generating reminders to care providers whenever patients miss their appointments, lost to follow up (LTFU) from treatment etc
- Capable of referring and receiving TB and leprosy patients to other units or other facilities such as Treatment follow up sites (TFCs) for DR TB patients
- Capable of admitting TB patients to TB ward
- Capable of capturing and displaying TB patient follow up information from TB wards
- Capable of capturing and tracking TB and leprosy contacts information
- Capable of capturing and displaying patient appointment information
- Capable of prescribing TB and leprosy drugs as per the national TB treatment standard and patient type
- Capable of capturing and displaying TB treatment adherence support information based on the standard format

- Capable for capturing and displaying HIV test information for registered TB patients
- Capable of adding new patient form
- Capable of managing transfer-in and transfer-out patients
- Capable of identifying, sorting and selecting list of TB patients
- Capable of displaying status of TB patients (waiting, on progress, complete…)
- Capable of managing leprosy patients (screening, treatment, follow up, disability status, treatment outcome and related data)
- Capable of displaying specific previous patient interaction to view patient information
- Capable of viewing scanned documents such as referrals
- Capable to record and display vital signs
- Capable of capturing and displaying patient history: Chief complaint with duration, history of present illness, past medical/surgical/gynecological history, social/family history, allergy history as a structured and as free text form
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of displaying risk factors for NCDs
- Capable of capturing and displaying NCD screening and its result based on standard format
- Capable of capturing physical examination findings by system (organ system), in a structured form and free text
- Capable of indicating diagnosis as new and repeat; as main and other diagnosis; presumptive and confirmed diagnosis
- Capable of ordering laboratory requests
- Capable of ordering diagnostic and imaging requests
- Capable of ordering pathology request
- Capable of displaying available laboratory tests, diagnostic and imaging studies, pathology tests
- Capable of receiving and displaying laboratory, diagnostic and imaging, pathologic results
- Capable of providing diagnosis menu by specialty
- Capable of capturing and displaying treatment plan
- Capable of ordering prescriptions

- Capable of displaying medicines' stock status by dispensing units, stores etc...
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of admitting patients for an inpatient care
- Capable of making appointments
- Capable of displaying list of patients with appointment by date
- Capable of displaying available beds
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance...), cash balance
- capable of managing medical certificates, consent
- Capable of generating standard and custom reports
- Capable of generating TB cohort report

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of tuberculosis and leprosy treatment services should be recorded in this module. It includes data elements based on standard formats prepared for drug sensitive TB, drug resistant TB and leprosy programs. At a minimum, it should include data elements related to screening, diagnosis, treatment and follow up of TB and leprosy patients. For details, see annex 1 section.

4.3.10. Laboratory Module

Description: This module describes standard laboratory information that will be included in EMR for the purpose of information exchange between healthcare professionals. It focuses on bidirectional exchange of test requests and test results between health care providers, laboratories and patients. It includes data capturing on pre-analytical, analytical and post analytical phases of the laboratory process. It also includes data on blood, blood products and blood services.

Functionalities:

- Capable of displaying summary demographic data of patients/clients and diagnosis by different searching methods
- Capable of displaying laboratory requests from different units, by date and time (All requests and individual detail request information)
- Display laboratory requests by urgency status
- Capable of listing and sorting requested laboratory tests
- Capable of managing pathology services (tests, requests and results)
- Capable of capturing and displaying list of laboratory tests, define its price and reference values
- Capable of capturing and displaying sample information using standard formats
- Capable of generating barcodes
- Capable of capturing and displaying specimen transaction logs, occurrence management logs
- Capable of capturing and displaying blood requests and services based on a standard format
- Capable of receiving lab requests from other facilities and interfacing with reference laboratory
- Capable of interfacing with laboratory machines and equipment
- Capable of managing laboratory reagents, chemicals and supplies
- Capable of capturing and displaying internal quality control data as per the national standard
- Capable of capturing laboratory results
- Capable of managing result validation
- Capable of notifying requesting care providers/phlebotomists about rejected/discarded samples
- Capable of displaying laboratory service payment status
- Capable of sending laboratory results
- Capable of alerting out of range laboratory values
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of laboratory, pathology and blood services. It should include the following data sets:

List of laboratory and pathology tests, requested lab tests, laboratory result, interpretation of result, lab references, sample type, clinical information, time of sample collection, turn-around time, price of lab tests, test related internal quality control, blood service information. For details, see annex 1 section.

4.3.11. Diagnostic and imaging Module

Description: This module supports recording data related to diagnostic and imaging services. It includes functions related to ordering, receiving and replying diagnostic and imaging services such as endoscopy, X-ray, MRI, CT scan, Ultrasound, Echocardiography etc... services.

Functionalities:

- Capable of displaying summary demographic, diagnosis, pregnancy, allergy, metal implants, known chronic diseases, date and time, etc... by different searching methods
- Support capturing and displaying patient demographic data and requests from other facilities
- Capable of assigning and register unique identifier for diagnostic and imaging service
- Capable of capturing and displaying list of diagnostic and imaging tests, also defining the price
- Capable of displaying diagnostic and imaging service payment status
- Capable of displaying diagnostic and imaging requests from different units, by date and time (all requests and individual detail request information), , ordering physician with qualification, reason for the order
- Capable of listing and sorting requested diagnostic and imaging studies by date and time, modality, status....
- Capable of managing appointment and tracking patients as deemed necessary
- Capable of capturing and displaying pre-procedure 'advice' notes
- Capable of ordering pharmaceutical related to the procedure
- Capable of ordering laboratory tests
- Capable of capturing and reporting adverse drug reactions
- Capable of adding consent form
- Capable of capturing and displaying diagnostic and imaging result

- Capable of interfacing with diagnostic and imaging equipment
- Capable of interfacing PACS server (including supporting telemedicine services)
- Capable of interfacing RIS, if available
- Capable of managing diagnostic and imaging pharmaceuticals stored at the unit
- Capable of capturing and displaying procedure note
- Capable of forwarding the captured image to other facilities
- Capability of managing available diagnostic and imaging tests
- Capable of generating standard and custom reports

Minimum Data Set

The minimum data elements for which data should be captured as structured or free text during provision of diagnostic and imaging services include the following data sets: type of diagnostic and imaging service ordered, order ID, reason for order, date and time ordered, ordered by, result/interpretation, diagnostic modality, known chronic diseases, pregnancy status, reactions, image, date and type of result released, pre-procedure checklist, advice note, TAT and internal quality control related information. For details, see annex section.

4.3.12. Pharmacy Module

Description: This module supports pharmaceuticals transactions such as receiving pharmaceuticals from suppliers, storing and issuing to dispensing units, requesting pharmaceuticals, inventories, stoke management, bin and scorecard management, dispensing, prescribing, data on medicine compounding and related services and clinical pharmacy services.

Functionalities:

- Capable of receiving and listing prescriptions as per the standard prescription formats (Normal, Narcotics and psycho-tropics prescriptions)
- Capable of displaying prescription orders for individual patients/ clients
- Capable of displaying summary demographic, allergy history and diagnosis of patients
- Capable of capturing drug therapy commentary to the prescriber, if there is an identified issue
- Capable of displaying list of available pharmaceuticals along with full drug information in the dispensing unit and in the store

- Capable of handling medicines that require compounding
- Capable of capturing prescription information for patients from other health facilities/over the counter medicines
- Capable of deducting cost of pharmaceuticals dispensed
- Capable to display payment type (credit, exempted, insurance, paying) of patients/clients
- Capable of displaying payment status and receipt number for paying patients;
- Capable to capture and display type of dispensing counselling provided with a standard format
- Capable of displaying and printing pharmaceuticals counselling information
- Capable of sending and receiving e-prescriptions to and from institutions
- Capable of displaying and printing undispensed medicines
- Capable of forecasting and supply planning of pharmaceuticals
- Capable of capturing list of pharmaceuticals/formularies based on a selected standard
- Capable of producing requests from service delivery units (internal facility request and re-supply (IFRR) to facility warehouse
- Capable of producing requests from (RRF) facility warehouse to EPSA or private suppliers
- Capable of receiving pharmaceuticals from facility store to service units
- Capable of receiving pharmaceuticals from EPSA or other sources to facility store
- Capable of issuing pharmaceuticals from facility to facility
- Capable of managing inventory and stock management including loss/adjustment
- Capability to display list of expired/unusable stock at service delivery point
- Capability to manage drug information service
- Capable of generating standard and custom reports
- Capable of sending alert or reminder for medicines out of stock or with near expiry date
- Clinical pharmacy service

Minimum data set

The minimum data elements for which data should be captured as structured or free text during provision of pharmacy services should be recorded in pharmacy module. It includes the following data elements: List of pharmaceuticals (with its strength, formulation and dosage), storage data, bin card management data, pharmaceutical issuing and receiving, expiry information, inventory and stock status, type of pharmaceutical by source (program, budget, RDF), clinical pharmacy related information such as drug-drug interaction, side effects, dose appropriateness, consultations, dispensing counselling. For details, see annex 1 section.

4.3.13 Rehabilitation care module

Description: This module supports recording of data related to rehabilitative and palliative health services provided at health facilities. It should support recording data based on standard formats developed for rehabilitative and palliative care services. The minimum functionalities and data elements of the module are described below.

Functionalities:

- Capable of identifying, sorting and selecting list of patients assigned to the rehabilitative care units
- Capable of displaying the status of rehabilitative care patients (waiting, on progress, complete)
- Capable of adding service specific form for new patient
- Capable of displaying summary of patient's previous interactions (by date, diagnosis, service unit, ...)
- Capable of displaying specific previous patient interaction to view patient information
- Display summarized previous key patient information (summarized demographic information allergy, chronic illnesses, prosthetics, orthotics and surgical interventions...)
- Capable of viewing scanned documents such as referrals
- Capable to display vital signs
- Capable of capturing and displaying rehabilitation care information as per standard format
- Capable to record and display problem list/diagnosis in a structured form based on the selected national standard
- Capable of capturing and displaying diagnosis

- Capable of ordering diagnostic and imaging requests
- Capable of displaying available diagnostic and imaging studies
- Capable of receiving and displaying diagnostic and imaging results
- Capable of capturing and displaying treatment plan
- Capable of ordering physiotherapy procedures and prosthetics
- Capable of transferring patients to other units
- Capable of referring patients to other health facilities
- Capable of displaying referral status of patients
- May have the capability to receive and send referral feedbacks
- Capable of communicating with other experts in the facility
- Capable of making appointments
- Capable of displaying list of patients with appointment by date
- Capable of displaying a list of services provided and its cost, type of payment (cash, credit, free, insurance…), cash balance
- Capable of managing medical certificates, consent
- Capable of generating standard and custom reports

Minimum Data set

The minimum data elements for which data should be captured as structured or free text during provision of rehabilitative and palliative services should be recorded in this module. It includes data elements based on standard formats prepared for rehabilitative and palliative care services. For details, see annex 1 section.

4.3.14. Billing Module

Description: This module supports recording of financial transactions in the health facility, for all types of payment modalities. It should have the capability to capture data elements related to setting price for services, deduction, balance, insurer/payer information and preparing billing reports..

Functionalities:

- Capable of setting billing or payment type (credit, free, insurance, self-sponsored)
- Capable of managing insurance and credit services

- Capable of managing service price
- Capable of displaying customers' demographic data, payment and service type
- Capable of computing total price, balance,....
- Capable of generating invoice including serial number, reason for payment
- Capable of generating billing reports
- Capable of handling transactions (invalid or voidable transactions....)

Minimum Data Set

The minimum data elements for which data should be captured in the billing module include price for services, financial deduction, balance, insurer/payer information and preparing billing reports. For details, see annex 1 section.

4.3.15 Reporting Module

Description:

This module supports the generation of reports based on the national standard reporting formats. It should generate routine health management information system (HMIS) service report on a monthly, quarterly and/or annual basis. It should also generate KPI report and HSTQ reports. It should also generate morbidity and mortality report based on the national classification of diseases, disaggregated by age, sex and other attributes as per the national format. In addition, this module should be able to generate case based and custom reports as needed. The minimum functionalities and data elements of the module are described below.

Functionalities:

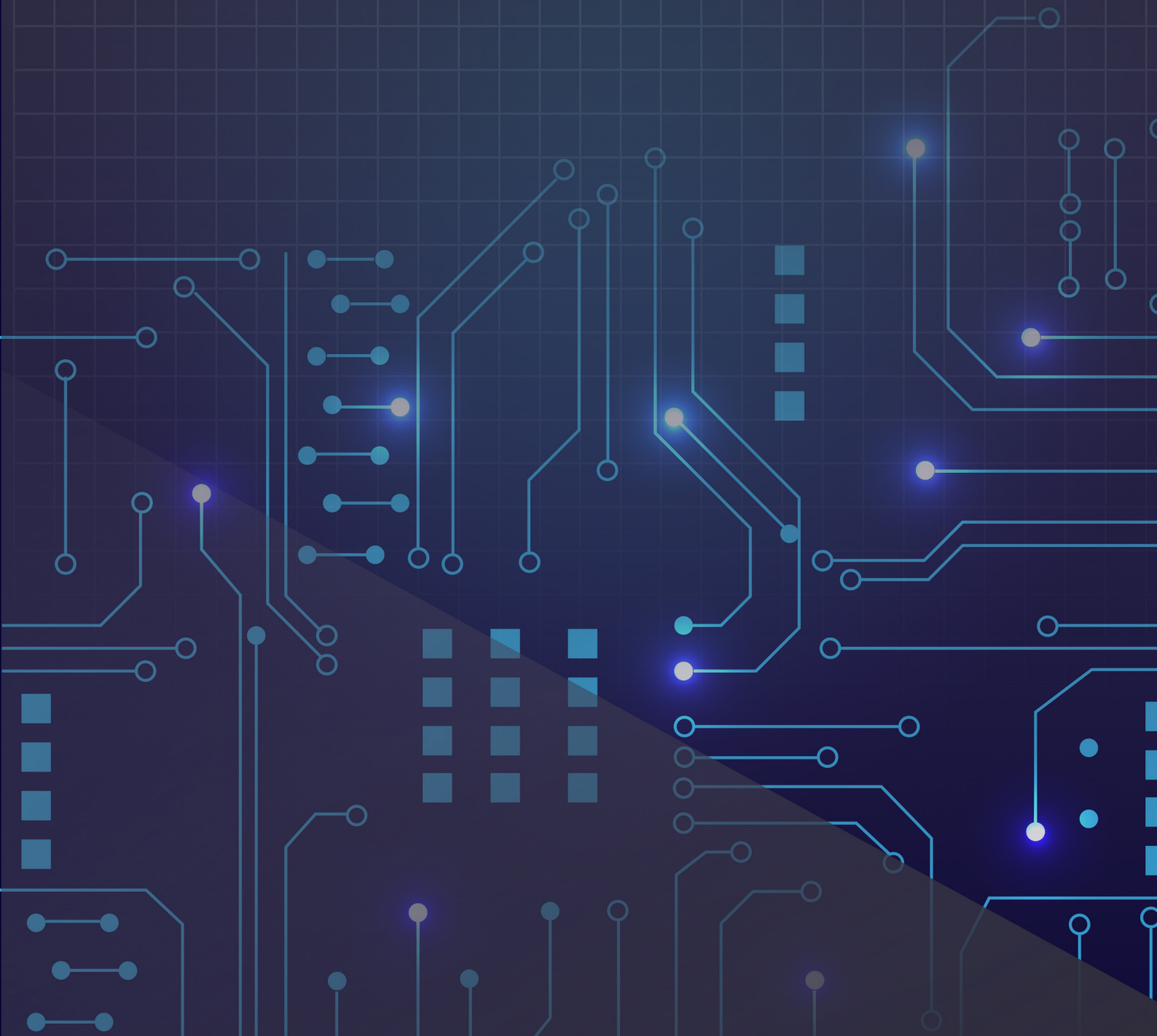
- Capable of generating standard monthly, quarterly and annual HMIS service report
- Capable of generating disease (morbidity and mortality) report based on national classification of diseases
- Capable of generating case based / surveillance reports
- Capable of generating custom reports based on need
- Capable of generating registers for each program area
- Capable of sending report to a national selected eHIS system (DHIS2) and other systems

- Capable of generating charts/visualizing performance with interactive dashboard
- Capable of exporting reports in different formats (Word, Excel, CSV, JSON, XML, PDF)
- Capable of displaying flagging performance level of health facilities
- Capable of sending and receiving clinical information with CDA (Clinical document Architecture) format

Minimum Data Set

The minimum data elements of this module are all the reportable data elements that are set in the standard HMIS reporting formats for each level of the health system (HMIS service reportable data elements and disease reports). The minimum data elements may be changed depending on the revision of the HMIS reporting formats at different periods.

5 EHR DATA STANDARDS AND INTEROPERABILITY



EHR DATA STANDARDS AND INTEROPERABILITY

Interoperability helps health solutions to exchange meaningful information via the accepted standards. Interoperability is essential to facilitate decision-making and reduce waste by minimizing or even eliminating duplication of efforts while improving safety and reducing errors at the same time. Furthermore, it encourages successful data exchange so that patients can stop ferrying their medical records from treatment to treatment by enabling the technology, interoperability standards, and clinical workflows to be better and ultimately provide better care to patients. As a result of these deficiencies, there is a clear and pressing need to develop a coherent and integrated approach to health information, based on standards and international best practices. A robust health information environment will allow all stakeholders, the general public, patients and service users, health professionals, and policymakers to make choices or decisions based on the best available information. Hence EHR implementations should consider data exchange and interoperability using known and accepted standards. This section explains syntactic and semantic interoperability standards and suggests essential interoperability aspects of an EHR system.

EHR interoperability standards specification and use within EHR is developed in consideration of applicability in low resource settings. The health sectors existing infrastructure brings its own challenge and assumptions should be taken to work in such environments. It also takes into mind that interoperability standards are dynamic and evolving over time. Strict enforcement to use recent standards may not be feasible as legacy and proprietary EHR systems may exist. A comprehensive specification is outlined with minimum requirements of EHR to enable interoperability and data exchange. EHR developers and implementers are encouraged to consider EHR interoperability via recommended data exchange accepted protocols/standards in their EHR development and implementation efforts. Standards referenced by the selected standard will also be considered as recommended in the EHR standard.

References and Standards

In order to encourage harmonization and effective use of data and the information that can be inferred from EHR data, this standard document has identified well-known and accepted standards. And provided recommended and candidate standards that apply in different domains and modules of an EHR. In making use of the recommended standards, consider the following items:

- Implementers are expected to comply with the license agreement of the standards they use.
- The EHR development and data exchange specifications are developed to mature the national eHA, EHR development efforts should align their objectives accordingly.
- In adaptation with national efforts, make sure to follow the latest developments techniques.
- Make sure the latest updates of standards are reflected in your adoption.

No	Type	Standard Name	Scope/ Intended Purpose	Remark
1	Terminology	NCoD/ESV-ICD11	Diagnosis or Conditions as cause of morbidity and mortality-Reporting	Latest classification will be used
		ICD	Diagnosis or Conditions as cause of morbidity and mortality-Recording	Latest version adopted by the country
		ICD-PCS	Procedures (Surgical, Investigation or Therapeutic)	Latest version
		LOINC	Laboratory Tests, measurement, observations	
		RxNorm	Pharmaceuticals	
		SNOMED-CT	Clinical signs,symptoms and other terms (not represented by the above standards)	

No	Type	Standard Name	Scope/ Intended Purpose	Remark
2	Messaging/ Data Exchange	• **HL7 FHIR** Latest Version: v4.0.1: R4 Organization: HL7 • **HL7v3** Latest Version: v3.x Organization: HL7 • **HL7v2.4** Latest Version: v2.x Organization: HL7	Represent and share information	Even though it is possible to use three of them, It is highly recommend developers use the latest FHIR standard
		• **CDA** Latest version: 2.0; 2005 Organization: HL7 • **CCD**: Latest version: 1.0 Organization: HL7 ASTM	To define the structure of medical records such as medical history,physical findings, investigations, medications given, discharge summaries and progress notes, for data exchange of clinical care.	
		• **DICOM** Latest Version: DICOM Organization: NEMA	Radiologic and other imaging data communication	
		• **CCR** Latest Version: CCR		

5.1. Terminology Standards

With the complex nature of the health system, collecting bulky data about the diagnosis, clinical orders, and procedures makes the AS-IS transfer of systems resources more complex. So globally, structured codes and terms have been prepared to define the semantics of information using consistent and computable mechanisms to be ingested by the consumers.

Semantic interoperability is the main essence behind the development and adoption of different terminology standards. Countries have been into the preparation and localizing of different terminology standards at the national and sub-national levels. Organizations govern the use of terminology standards in a local setting by mapping the resources and concepts across different terminology standards.

Based on purpose and value; terminology standards can be classified as:-

1. Reference terminology standard
2. Aggregation terminology standard

Reference or clinical terminology standards defines all terms and codes of clinical procedures and interventions of a client at a given point of health service. On the other hand, Aggregation terminology focuses on concepts and resource classification for the compilation of routinely collected secondary data for analysis and interpretation.

Referenced Terminologies

Referenced terminology is “a collection of concepts and relationships that provide a common reference point for comparisons and aggregation of data about the entire health care process, recorded by multiple different individuals, systems or institutions.” The commonly used and globally known reference terminology standards such as SNOMED CT, LOINC and RxNorm are widely used in clinical coding.

Aggregate Terminologies

In this section aggregate terminology and coding standards that are to be used in clinical practices, testing & diagnostics, classifications of diseases etc. will be defined. This considers local initiatives currently being used at the health sector as well as adoption and mapping of globally available terminologies and coding systems that enhances interoperability between EHR systems, ancillary systems and other healthcare systems that interact with EHR.

Aggregated terminologies are used to classify, record and aggregate related health and medical concepts together. WHO FIC codes are one the most widely used classification systems internationally.

WHO Classification Codes: WHO Family of International Classifications (WHO-FIC)

- WHO ICD-10: International Classification of Diseases (ICD) and its derivative classifications
- WHO ICF: International Classification of Functioning, Disability and Health (ICF)
- International Classification of Health Interventions (ICHI)
- International Classification of Diseases for Oncology (ICD-O)

As part of HMIS reform a Local initiative was started and developed the National classification of disease(NCoD) the main target being revising the classification of disease morbidity and mortality to focus on diseases that are relevant for epidemiological surveillance, planning, and management purposes.

Adopted Terminology Standards

Though the development and implementation of terminology standards have been in practice in a different context and setting across national and global spaces, there have to be pre-defined selection criteria to select a suitable standard amongst the many existing ones. A selected terminology standard should fit for the purpose of eHealth Architecture roadmap. The governance criteria related to licensing and intellectual property should also be considered while selection. Failing to do so could lead the implementer and the country at large to cost and adoption implications.

Terminology standards discussed here, as the candidate standards, should be the priority in implementation as they address the best possible answers to the aforementioned selection criteria. Though implementers are encouraged to act and follow the direction given here, there is a window space to use other known standards with the possibility of mapping to the selected ones. So implementers should follow implementation guides and contextualized and localized national and sub national standards, if any, in harmony with the discussed standards here.

a. Reference terminology: SNOMED CT

SNOMED CT is a comprehensive, clinically validated, semantically rich, healthcare terminology vocabulary in the world. A multilingual system, SNOMED CT covers many aspects of healthcare, including patient histories, details of procedures, and the spread of epidemic disease. This standard is developed by the International Health Terminology Standard Development Organization (IHTSDO). It is a resource that facilitates evolutionary growth in expressivity to meet emerging requirements representation with validated clinical content. It does not attempt to standardize the whole of the medical language nor does it intend that all clinicians should use the same terms. Instead, SNOMED CT attempts to provide the language to adequately reflect the meaning and use of medical concepts.

The integration of a clinical terminology such as SNOMED CT into computer-based patient records provides a comprehensive and functional terminology for clinical care. SNOMED CT can be utilized to index, store and retrieve patient information for clinical purposes. SNOMED CT helps ensure comparability of data records between multiple practitioners, across diverse platforms and computer systems. This standard is currently used in more than eighty countries and has the possibility of mapping it to other international standards.

IMPLEMENTATION STRATEGY: Clinical Terminology

- Implementers shall use SNOMED CT for clinical health record systems.
- Implementers shall use SNOMED GPS as SNOMED CT reference set.
- Mapping between SNOMED and other referenced and aggregated candidate standards shall be prepared.

b. Reference terminology: LOINC

LOINC (Logical Observation Identifiers Names and Codes) provides a set of universal names and ID codes for identifying laboratory and clinical test results. LOINC facilitates the exchange and pooling of results, such as blood hemoglobin, serum potassium, or vital signs, for clinical care, outcomes management, and research. Considering the laboratory production code as an identification code for the test result causes interpretation issues between different medical information producers. So, Regenstrief institute developed LOINC to rescue the issue of test and medical data exchange problems.

LOINC (Logical Observation Identifiers Names and Codes)

- Provides standard identifiers, names, and codes for representing clinical observations and laboratory test results.
- Includes medical and laboratory code names, nursing diagnosis, nursing interventions, outcomes classification, and patient care data set.
- LOINC codes are classified as Laboratory and Clinical. Under each of these main categories, codes are distributed into specific categories. LOINC code covers clinical observations and laboratory test results.

IMPLEMENTATION STRATEGY: Lab and Observation

- LOINC coding shall be used for processing Laboratory results and reports.
- In case of implementation of the national LAB list there should be a mapping between LOINC.

c. Referenced Terminology: RxNorm

RxNorm is a normalized naming system for drugs and a tool provides normalized names for clinical drugs and links its names to many of the drug vocabularies commonly used in pharmacy management and drug interaction systems. Because these systems use many different sets of drug names, it can be difficult for one system to communicate with another. To address this challenge, RxNorm provides normalized names and unique identifiers for medicines and drugs. The goal of RxNorm is to allow computer systems to communicate drug-related information efficiently and unambiguously.

IMPLEMENTATION STRATEGY: RxNorm

- RxNorm coding shall be used for processing pharmaceutical data in drug stores, dispensaries and prescriber side.
- Incase of implementation of the national drug list there should be a mapping between RxNorm.

d. Aggregation terminology: ICD

Of the WHO-FIC classification the most widely used system is the ICD classification system. The International Classification of Disease (ICD) is a global health information standard for diagnosis, procedure, billing and other clinical and health aggregation, prepared by WHO. ICD is used in different epidemiological conditions such as defining disease, disease patterns, managing health care, and monitoring the outcome. ICD classification system is in continuous improvement, it ensures that the code set will gradually cover more codes to meet the future needs of medical practitioners internationally. The coding terminology provides a comprehensive set of alphanumeric codes for identified diseases and symptoms. WHO has been releasing versions of ICD at different times. Currently there is a new ICD11 introduced to the system. The reason to revise are many but to mention some: -

1. Identifying new diseases and conditions
2. Disease and condition disaggregation [from 14,400 to 55,000]
3. Removing conditions that are no longer considered as disorders.

IMPLEMENTATION STRATEGY: Classification Codes

- NCoD shall be used as a standard national disease classification.
- There shall be a mapping capability between NCoD to ICD10/11.
- Where a need arises for the use of procedural classification, it is recommended to use the ICD-10-PCS.
- ICD 11 is released and efforts should be made to adopt ICD 11 if possible and Mapping of ICD 10 to ICD 11 should be considered.

5.2. Messaging Standards

Messaging standards outline the structure, content and data requirements of electronic messages to enable the effective and accurate sharing of information. The term 'message' refers to a unit of information that is sent from one system to another. Messaging standards specify the technical aspects of sending messages so that one health information system application can interact with another and have a common understanding. The message will have its own syntactic structure to follow so that the sender and receiver communicate smoothly.

Most terminology standards cannot stand alone but need a messaging format or standard to accompany them to accommodate extra information about a patient, clinician, or other resource and deal with the transfer mechanism from sender to receiver. Within the health setting, EHR Systems coexist with several other systems such as Laboratory Information systems, Pharmacy Information systems, the Health management Information systems and Demographic Surveillance systems. Exchange of information between systems is important for several reasons, including increased efficiency through decreased entry of duplicate data, decreased errors in medical information through the same mechanism, and increased availability of health information promoting better clinical decision making and improved continuity of patient care.

The most known messaging standards are HL7 V2, V3, FHIR are the chronologically ordered releases of HL7. Besides these there is HL7 CDA to represent a clinical document and DICOM to handle medical imaging. Each release has got its own cornerstone in the long-lasting messaging standard development.

5.2.1 Adopted Messaging standards

The five candidate standards identified as potential messaging standards are:-

1. Health Level 7 version 2.x
2. Health Level 7 version 3
3. Health Level 7 Clinical Document Architecture (CDA)

4. Health Level 7 Fast Healthcare Interoperability Resources (FHIR) and
5. Digital Imaging and Communications in Medicine Committee (DICOM).

An overview of each standard is described below.

1.1 Health Level 7 version 2.x

The HL7 v2.x standard provides specifications for messages to support the sharing of information on admission to and transfer within and between healthcare facilities. It provides messages to support many scenarios, including the ordering of laboratory investigations, radiology tests and medications for patients and sending the results of the tests ordered to the ordering clinicians. It can support transmission of referrals and discharge summaries between clinicians and sharing of appointment scheduling information.

In order to define messages for different contexts, the standard specifies a set of building blocks for messages known as message segments which may be reused when constructing messages. Each segment consists of multiple fields which are constructed using pre-defined data types.

1.2 Health Level 7 version 3

The HL7 v3 messaging standard was created to support large scale health information systems and attempts to support all healthcare workflows. Benefits include reduced ambiguity, maximum reuse and increased consistency in HL7 messages. The HL7 v3 standard is published as a large web-based document that contains specific subject areas, also known as domains, such as laboratory, pharmacy, medications and patient administration.

The v3 messaging standard uses the Reference Information Model (RIM) and a formal methodology called the HL7 Development Framework (HDF) to increase the detail, clarity and precision of message specifications. HL7 v3 messaging combines a formal methodology with established models and value sets needed to express the full range of specifications for eHealth interoperability, including specifications for prescribing, referrals, and discharge summaries.

1.3 Health Level 7 Clinical Document Architecture

In addition to creating messaging standards, HL7 also develops standards for representing clinical documents, such as referrals and discharge summaries, known as the Clinical Document Architecture (CDA) standard. CDA is a good option

for countries who have limited resources as they can adopt simple CDA-based architectures. CDA is regarded as a standard that is easier to implement than the v3 standard. The normative version of the CDA, release two, was published in 2005. CDA has the benefit of being based on a common information model known as the Reference Information Model (RIM). An information model provides a framework for organizing data so that it can be delivered and re-used in a variety of different ways. CDA ultimately allows for shared information at the point of care and promotes reusability across a sufficiently wide range of documents.

The development of CDA was driven by the need for clinical information to be interpreted by both human readers and computer systems. CDA supports a combination of free text for human readability and adds structure and coding to the document to enable machine processing. CDA provides for different levels of conformance to the standard. The different levels enable implementers to develop simple documents, known as level 1, that are displayed and presented to clinicians in a readable format or more complex documents that are coded for machine processing, known as level 2 and 3.

1.4 Health Level 7 Fast Healthcare Interoperability Resources

FHIR is the most recent standard created by the HL7 organization. FHIR is a standard that enables the secure electronic sharing of health information and the real-time exchange of information using web technologies. FHIR is suitable for use in a wide variety of contexts, including data sharing between electronic health records, mobile phone applications, cloud communications and server communication in large institutional healthcare providers.

FHIR was first proposed in July 2011. There are two distinctive features that the FHIR standard has focused on compared to other HL7 standards — security and the use of resources. FHIR is considered more secure than previous standards as all health data exchanged using FHIR is required to be transmitted using secure protocols.

The basic building blocks in FHIR are called resources. There are various types of resources defined in the standard, including clinical, identification, workflow, administrative, infrastructure, conformance and financial resources. The philosophy behind FHIR is to build a base set of resources that, either by themselves or when combined, satisfy the majority of common information exchange scenarios in healthcare. FHIR also supports resource profiles. Profiles describe the information handled by the system on a per use case. They define a series of variations on the same set of resources for different scenarios.

The primary objective of FHIR is to ensure that it is easy to implement and that it provides a rigorous mechanism for exchanging data between healthcare applications.

FHIR takes advantage of and has a strong foundation in web services. Web-based technologies are well understood and widely supported by the implementation community. Examples of technologies endorsed by FHIR include HTML and Cascading Style Sheets for user interface integration, either JSON or XML for data representation and OAuth for authorization.

1.5 Digital Imaging and Communications in Medicine Committee (DICOM)

DICOM is a standard for handling, storing, printing, and transmitting information in medical imaging. It includes a file format definition and a network communications protocol. The communication protocol is an application protocol that uses TCP/IP to communicate between systems. DICOM files can be exchanged between two systems that are capable of receiving image and patient data in DICOM format. The National Electrical Manufacturers Association (NEMA) holds the copyright to this standard. It was developed by the DICOM Standards Committee, whose members are also partly members of NEMA. DICOM enables the integration of scanners, servers, workstations, printers, and network hardware from multiple manufacturers into a picture archiving and communication system (PACS). DICOM is known as NEMA standard PS3, and also as ISO standard 12052:2006, Health informatics – Digital Imaging and Communication in Medicine (DICOM) and includes workflow and data management standards.

IMPLEMENTATION STRATEGY: Classification Codes

- The FHIR standard should be considered for new initiatives on a use case by use case basis when it becomes a normative standard and is mature enough for implementation.
- The HL7 v2.4 messaging standard should continue to be supported.
- The CDA standard should be used for exchange of documents.
- DICOM standard for laboratory data and imaging should be implemented.

MoH will continue to work with the health informatics community to analyze use cases, select the most appropriate standard to use and develop specifications based on project requirements. Culture of electronic data exchange and interoperability among and between systems comes after the adoption and implementation of terminology standards. So far, efforts have been into introduction of data dictionaries for different reference and aggregated terminology needs. As a result of the introduction of these terminology standards different data exchanges are demonstrated. But, the national profiling process of messaging standards is demanded.

6 DATA OWNERSHIP, ACCESS, SHARING, PRIVACY AND SECURITY

DATA OWNERSHIP, ACCESS, SHARING, PRIVACY AND SECURITY

The legal act of giving the right and complete control of health data and the acquisition, distribution and use of the data by other actors and stakeholders of the EHR system should be given a priority in implementing EHR systems. Besides the ownership, access and sharing issues, privacy and security concerns to safeguard the EHR data should also get an emphasis in implementation.

References and standards

The following standards, in whole or in part, are normatively referenced in this document and are indispensable for its application. An E H R system should comply with the following standards to ensure optimum level of security, privacy, data access, integrity and sharing for safer and secured practice of medicine in the health system.

No	Type	Standard Name	Intended Purpose
1.	Data access mechanism and control	• ISO/TS 14441:2013 Health informatics — Security and privacy requirements of EHR systems for use in conformity assessment. • ISO 22600:2014 Health informatics - Privilege Management and Access Control (Part 1 through 3)	• Implementer's security and privacy Conformity test and certification test. • Defines principles and specifies services needed for managing privileges and access control to data and/or functions.
2.	Integrity	• ISO 27799:2016 Health informatics Information security management in health using ISO/IE • ISO 13606:2019 Health informatics Electronic health record communication	• The threats to the privacy, confidentiality, integrity and availability. • Syntactic and semantic capabilities (through a dual model approach) as well as terminology, security and interface considerations for the standardized exchange of EHR.

No	Type	Standard Name	Intended Purpose
3.	Encryption/ Digital Certificate	• ISO 22857:2013 Health informatics — Guidelines on data protection to facilitate trans-border flows of personal health data and • ISO/TS 21547:2010 Health informatics — Security requirements for archiving of electronic health records — Principles • ISO/TR 21548:2010Health informatics — Security requirements for archiving of electronic health records — Guidelines • ISO 17090 Health informatics - Public Key infrastructure • Ethiopian National PKI Technical Standards Guideline INSA version 1.02012 E.C	• The encryption key, certification, and management • provides guidance on data protection requirements to facilitate the transfer of personal health data across national or jurisdiction (normative for international data access) • define the basic principle needed to securely preserve health records in any format for the long term. • ISO/TR 21548:2010 is an implementation guide for ISO/TS 21547. ISO/TR 21548:2010 will provide a methodology that will facilitate the implementation of ISO/TS 21547 in all organizations that have the responsibility to securely archive electronic health records for the long term.
	Audit logs	• ISO/TS 18308 defines legal re quirements purely from a security perspective, including authentication, audit log, nonrepudiation, and so on. • ISO 27789:2013(en) Health informatics — Audit trails for electronic health records • Active Standard ASTM E2147. Standard Specification for Audit and Disclosure Logs for Use in Health Information Systems. • 45 CFR 170.210 - Standards for health information technology to protect electronic health information created, maintained, and exchanged.	records (EHR), in terms of audit trigger events and audit data, to keep the complete set of personal health information auditable across information systems and domains.

When point of service EHR applications connect with other systems and registers in the Enterprise architecture, a defined infrastructure has to be inplace to address the needed business process and workflow. Data exchange and interoperability between participating systems or components demands a solution for the issues

of security and privacy patient information. special implementation specification and conformance testing should be followed to make sure participating systems have the necessary privacy and security measures.

6.1. EHR data Ownership

The increasing health data captured, processed, stored through the EHR system needs to be properly managed, on the other hand, interactive actors' legal ownership, rights, obligations, expectations, roles, trust, and the need to improve existing health data protection and privacy should be maintained. The data owners are actors who claim the possession, copyrights, and complete control over a single piece or set of data to ensure their control and ability to take legal action if their ownership is illegitimately breached by an internal or external entity. According to the draft national data access and sharing policy, health act, and health information proclamation those different actors are expected to have different privileges, roles, and levels of trust. The data owner has a role to Amend/ Add and Audit trail/ Limit time, trust on the level of access/ Consent.

IMPLEMENTATION STRATEGY: Data ownership

- The ultimate ownership of the health data resides with the client.

6.2. Data Access and Sharing

The availability, accessibility, quality, and use of health information for decision-making processes, through the appropriate use of information communication technology to ultimately impact the access, quality, and equity of healthcare delivery at all levels is important. EHR systems must have a secured built in application programming interface (API) or synchronization tool which can be built or added on to an existing EHR or ancillary application to support synchronizing health data with each other and the central system to allow them to communicate access and share data. The API and synchronization tool should have different security layers of authentication and authorization mechanisms in place to prevent the health data from unauthorized access. Intra and cross EHR data sharing policy concerns and issues should be addressed in different policy directives implementation guidelines and operating procedures. Implementers shall follow those documents and implement accordingly.

Based on the HIPPA personally identifiable information, directly or indirectly identifiable individuals' information upon whom clinical service is performed should be preserved. Those personal identifiable information (PII) are identifiers such as: -

Direct Identifiers

1. Name
2. Address
3. Medical Record Number or other identifying number or code
4. telephone number
5. email address
6. Biometrics

Indirect identifiers

A combination of the information below listed data elements

1. Gender
2. Ethnicity
3. Date of birth and other similar descriptions
4. Relatives, next of kin personal information

The below table explains the role and responsibility of each and every participant or actor of the EHR system. In the time of data access and sharing and other privacy and security measures actors are only expected to follow the given rights.

NO	Roles	Descriptions	Responsibilities
1	Care provider	An individual or group, a physician, nurse, specialized treatment center who provides health care service to a client.	• View, create, edit, delete contents in the system • Share trust among the system and other shared providers
2	Institution/ Facility	A facility or administrative office where clients and Care provider meet or health data is generated or used	• Store, provide access to and/or from, and provide physical data storage area and communication mediums
3	Implementer	An individual or groups or organizations or companies who develop and/or supply the EHR solution to the institution.	• Can define, create, edit, configure/set-up, delete, access the EHR system • Monitor/Adjust the care provider collaboration to the system and/or system to system interaction • Grant/deny unauthorized access/privilege and ensure the healthiness of the system
4	Clients	A person who visits the institution/facility for at least one service and is the source of data.	• Can view/read the information or give data to the system • Can give consent for the data provided
5	System	Software or hardware that interacts with the EHR System in the institution	• Can read, write or delete and share the data from the EHR system

IMPLEMENTATION STRATEGY: Data access and sharing

- Data to be shared shall be anonymized, available, and made accessible for data users to use, wherever it is found legal, ethical and ensures the confidentiality of information provided by respondents is respected.
- Data to be shared shall follow the national data access and sharing directive and protocol.

4.1.1 Health data grant conditions

Access to health data is a cornerstone for producing timely and objective research which builds a transdisciplinary evidence base that helps inform efforts to improve health, well-being, equity, privacy, and security. All health data grants are subject to special terms and conditions provided by health sector services and must ensure compliance with all relevant legislation and government regulation relating to interacting actors, including any subsequent amendments introduced while work is in progress. Grants must notify the intended actor of any change in its status, that might affect the security, ownership, privacy aspects and shall have adequate business continuity plans in place to ensure that operational interruptions to the research are minimized.

IMPLEMENTATION STRATEGY: Data grant conditions

- Health data grant shall follow necessary legal procedure. Guaranteed shall inform any changes of the data to the owner.
- Grant and access of client data for medicolegal reasons shall follow necessary legal procedures.

4.1.2 Health Data retention process

Activating and deactivating health data permanently or temporarily should be easily identified by the date flagged against the database or catalogs which indicate the future culling date. Health records should be retained from the system on a scheduled time frame basis and the system must thoroughly notify records to ensure that they are ready for subsequent actions. Deactivation date must be recorded in the system against the individual record, and the Inventory of records must be updated to reflect the batch of records deactivated in the cull and must be confidentially kept and notified for confirmation

IMPLEMENTATION STRATEGY: Data culling process

- There shall not be permanent deletion of client data. Role and timestamp based data deactivation should be implemented so that actors of the EHR follow accordingly

6.3 Privacy and Security

Leveraging data access could lead to Evidence-based medicine but exposing data among different actors of the system leads to security breaches and counterfeits. EHR adoption depends on different adoption preconditions and criteria. One of the determinant adoption criteria shifting the adoption curve from paper-based to electronic health records is the security and privacy standard. Complying to a given modality of data saving and sharing matters to worry most about how individuals' data is going to be treated following standardized privacy and security standards. This has an advantage in encouraging privileged data demand and information use among stakeholders.EHR as a concept and workflow is expected to have a security and privacy functionality and standard operating procedure following global and national standards, policies, and directives. Though technology selection is up to the implementers, the issue of data access, sharing, privacy, and security should act according to agreed, and contextualized security standards. Privacy and Security standard adoption criteria should be described and discussed from the perspective of an EHR implementation plan.

Privacy and Security safeguard thematic areas are adopted here from the privacy and security rules of the Health Insurance Portability and Accountability Act(HIPAA). Organizational or administrative safeguard, physical safeguard, and technical safeguard should be taken into consideration while ensuring;-

- Identity management, enterprise security, disclosure, and trust among actors of the health data owner.
- Prepare business continuity plan aiming at security breaches and hazardous natural and environmental occasions counterfeiting protected personal information
- Socializing and enforcing privacy and security policies and directives to enrich the human element towards following certain procedures as a cultural practice and habits.
- Timely notification of a privacy or security breach to all authorized personnel

EHR Security Safeguard Standards

During EHR implementation, security technical standards must consider the privacy and security aspects and emphasize electronic personal information controlling and access. The EHR as a solution and business process, in general, should possess and consider the following standards. Standards for privacy and security standards alongside technical safeguard characteristics are listed below: The EHR should satisfy and comply with referenced standards by the national EHR document to address cybersecurity and data ownership issues.

Privacy and Security Technical characteristics

An EHR system provides an integrated view of healthcare records by enabling interoperable module applications. The EHR system plays a significant role in advancing the healthcare service delivery to make sure individuals' data is kept safe and accessed with shared responsibility. Technical specifications of the participating systems shall include the implementation specification concerning privacy and security. EHR solutions are expected to address standard specifications and guidelines discussed in this section.

Data access mechanism and control

IMPLEMENTATION STRATEGY: Data access mechanism and control

- Notwithstanding the type of access, whether local within the system or in a time of exchange between solutions, Actors claiming access to the EHR solution shall pass-through multifactor authentication and authorization measures using a password and access token.
- Role-based Access control for authentication and authorization shall be the minimum requirement. But, If possible, Attribute-based access control is preferable.
- Implementers shall depose the use of strong authentication and data protection policies and operating procedures. Sharing of individual user's credentials and or use of common credentials is prohibited.
- Data access procedure shall consider a change in its access space to entertain different emergency exceptions. Authorized and unauthorized access plus planned and unplanned exceptions shall define the need for an emergency authentication process.
- Data access operations must be through access rights verification, and all access information should be logged.
- An Institution or a provider representing the institution should define, assign and maintain access roles.

- The ultimate owner of the data is the client. But Actors shall have data access grant, trust, and delegation procedures based upon an agreed consented process. The focus of this document here is given to EHR solutions than PHR. Patient portals, to access EHR records to support consumer health informatics, are encouraged but clients' privilege to update and edit individual records are not allowed.
- The system shall record a login session and report a user account after a maximum of three consecutive invalid login attempts.
- Token based authentication mechanisms shall be inplace at the time of data exchange between other systems.
- User name and a password with at least eight characters (a mixture of uppercase, lowercase special characters and numbers) shall be used.
- The system should enforce and alert users to change passwords in a three month interval.
- The system session shall timeout and lock itself if it remains idle for five minutes.

Integrity

IMPLEMENTATION STRATEGY: Integrity

- There should be a possibility to exchange partial or complete records while maintaining integrity.
- The EHR solution shall maintain the integrity of the data at rest and data in motion.
- The system shall have a data validation and verification mechanisms at the time of data capturing

Encryption

IMPLEMENTATION STRATEGY: Encryption

- The system shall have a builtin encryption technique for data management in motion and at rest.
- EHR solution should leverage a Public Key Infrastructure(PKI). And shall confirm the legitimacy of users and systems by enabling stronger, certificate-based security and identity services and management tools to maximize network efficiency and security.

Audit Logs

IMPLEMENTATION STRATEGY: Audit Logs

- EHR solutions shall record audit information on all patient record transactions. The solutions shall provide auditable resources, activities, services, and events when needed.
- The system should provide services for logging and storing events, such as creating, updating, transmitting, receiving, and maintaining contents. These could be contents such as user name and id, event time and status.
- The logs should be Immutable, Time-stamped, Auditable, Pseudonymised.
- The audit trails should be accessible and understandable to the client. The EHR solution should create a secure audit log package with versioning, identification, and provision for describing functional roles for role-based access each time a user accesses, creates, updates, or archives personal health information.
- EHR solution Shall have an indelibility requirement that no permanent deletion of any Health record should be allowed.

EHR Administrative Standards

The organization must place a legal hold and preserve audit log information from an EHR system to prevent unauthorized access and use of the system for deliberate destruction, loss, and alteration of individual health records. And the EHR system shall use the administrative data security safeguarding mechanisms and the organization shall prepare business continuity, disaster recovery, contingency, risk analysis, and process management plans for technical, administrative, and other security holes and incident management on EHR towards ensuring the security of EHR system and clients' data, additionally the organization must implement the backup procedures, standard operating procedures, and the security safeguarding mechanism in place with supporting tools detailing the privilege and authorization level for actors. And shall enforce security measures against abnormal use of client's data in EHR to socialize and build trust to all actors.

IMPLEMENTATION STRATEGY: Administrative safeguard

- The institution should implement standard operating procedure on the security management process referring to national security guidelines and policies.
- The standard operating procedure shall discuss risk analysis and management to reduce risk and vulnerabilities for EHR business continuity.
- The institution shall manage role based EHR service grant and sanction when violations happen.
- The institution shall assign a security official responsible for the development and implementation of policies and procedures regarding privacy and security.

EHR physical Standards

EHR Physical safeguard standards emphasize the protection of workstations, network devices, and buildings, amongst many others. Physical standards mentioned here shall give support to the technical standards stated above. Security and Privacy officers shall follow equivalence and conformance procedures and guidelines to harmonize the whole process in one pipeline.

IMPLEMENTATION STRATEGY: Physical safeguard

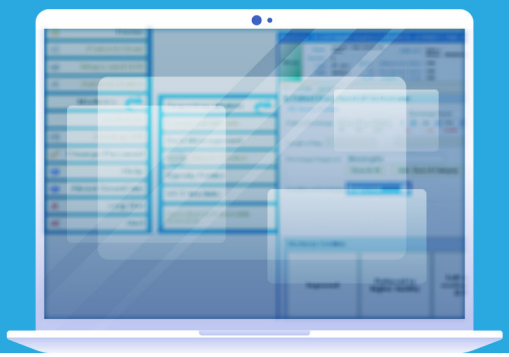
- Facility access control and devices usage and security control mechanisms shall be defined.
- Data backup and restore procedures shall be defined.
- Physical access controls shall be defined and entry control mechanisms shall be in place. Entry and exit logs should be tracked so that every user's operation remains identified.
- Operational standards shall consider Radio Frequency Identification (RFID) in user access, equipment inventory inspections, and tracking.
- Sanitize or destroy information system media containing sensitive information before disposal or reuse.

Recommendation

The increased growing demand to demonstrate result brings Leadership and governance in frontline towards building a robust secured, transparent health system, which ensures that strategic policy frameworks exist and are combined with effective oversight, coalition-building, regulation, national policies attention to system administration, security, privacy, and accountability, which is an intrinsic aspect of governance that concerns the management of relationships between various interacting actors, stakeholders, including devices, systems, individuals, firms, health systems, and other entities towards strengthening the security, privacy, transparency and ownership through financing, monitoring, delivering and use the provided health services.

The health sector should create a coordinating body for safeguarding, governing the data ownership, access, sharing, privacy, security, accountability for/at all levels of the health sector actors, and system functionality to oversee preparedness for and responses to any threats related to data access, sharing, ownership, privacy, and other health data-related security threats. The coordinating body should have a budget, logistics, and the authority necessary to coordinate and govern all activities across the system, data, and the health sectors.

7 IMPLEMENTATION REQUIREMENTS



IMPLEMENTATION REQUIREMENTS

Implementing electronic health records at any facility requires minimum requirements which are needed for the smooth running and sustainability of the system. The implementation of a shared health record and facility EHRs requires standard ICT infrastructure, skilled workforce, finance, leadership and governance etc. This implementation requirement will specify the pre implementation requirements of EHR at a facility level and also the need for a central shared service ICT infrastructure requirement. These requirements serve for all kinds of health facilities at all levels of the health hierarchy. The quantity and specification of the proposed items could vary from facility to facility depending on the type and size of the facility but at least this document serves as a check least to see if all the necessary ICT infrastructure is in place at a facility before EHR implementation.

The Implementation requirement is concerned with the minimum pre and during implementation requirements both at facility level and at the central shared service level. Health facilities at all levels of the health hierarchy and government, private and all other types of health facilities are considered in the minimum implementation requirement. This Implementation scope addresses the minimum implementation requirements of electronic health records at facility level and central level where the shared record of clients' information is kept. It also describes ICT infrastructure within facilities and the central level.

The main focus areas of this implementation requirements are Readiness Assessment, Hardware requirements, Software requirements, Workforce requirements, network and connectivity requirements, Asset management, Change management, Training, Finance/budget, Implementation, Monitoring and Evaluation, Power supply and Mini data centers

Citations and References

No	Type	Standard Name	Intended Purpose	Remark
1	Standard	Electronic health records in India	To recommend adopting standards, implementation specifications, and to enhance the interoperability, functionality, utility, and security of Health information technology	
2	Handbook	Handbook for Electronic Health records implementation	The EHR implementation handbook is a milestone in our understanding of the challenges that arise in planning and executing an EHR Implementation and impact of such an implementation on healthcare processes and organizations.	
3	Manual	Electronic Health Records: Manual for Developing Countries	Designed to serve as a basic reference when exploring the development and implementation of Electronic Health Record (EHR) systems.	
4	Standard	Standards and Guidelines for Electronic Medical Record Systems in Kenya	Provides guidance for EHR system developers and implementers, as well as health facilities in Kenya that are contemplating or currently using EHR systems to manage patient data	

7.1. Pre-Implementation Minimum Requirements for facilities

Implementing electronic health records (EHR) requires a wide range of prerequisites which have to be in place for the effective and sustainable use of the system. To implement an electronic health record system, a facility needs to fulfill the following minimum requirements as a prerequisite

7.1.1. Readiness Assessment

Every health facility intending to use an EHR system must first be assessed to determine its level of readiness for implementation which enables it to evaluate the readiness of a site, and if necessary, to take action to ensure that all requirements are met for successful EHR system implementation. The assessment should include organizational culture, management and leadership, operational readiness and technical readiness (the checklist is annexed as in annex 2)

7.1.2. Hardware requirements

Health facilities are expected to meet the necessary hardware requirements for EHR implementation. The required number and type of hardware devices might vary from facility to facility but needed to meet the expected minimum specifications

for the type of facility intended to be used. Based on the number of service units and users of the system , the number and performance capacity of each hardware type varies.

The hardware devices should support both a stationary and mobility needs of services at a facility. Some services at a facility could be served using fixed devices and others like inpatient and emergency departments require mobile devices like tablets.

Hardware requirements include Personal computers, Server computers, mobile devices, printers, barcode printer, barcode reader, Scanner, UPS, Biometrics devices and the likes.

Facilities need to have sufficient numbers of personal computers at each service unit. The computers have to be connected to LAN, a central server and external systems. Since patient data is to be stored in a central location every facility needs to have server computers/computers which are capable of storing patient data the facility serves and can serve the concurrent access of all the end users.

The Ethiopian EHR implementation follows electronic first modality which requires patient data to be captured electronically first and a summary of that data to be printed and put in the patient folder. For this purpose, every facility is expected to have enough printers at suitable locations to print patient summary data.

Health workers at a facility are usually work by doing rounds at different wards and for this purpose there should be enough number of mobile devices which can access patient record in the EHR (see Annex 3)

7.1.3. Operating system & utility software requirements

In order for an EHR system to run properly in a facility and not to be targeted by malicious attacks, there should be antivirus software installed at every personal and server computers. The antivirus software should be regularly updated and needed to be licensed.

Besides, facilities need to have either windows or Linux based operating systems for the computers to be used to run the EHR application. The minimum version of the operating systems for Server should be under active support by the vendor and reviewed overtime.

Mobile devices like tablets should support the latest android or IOS operating system.

7.1.4. Workforce requirements

For successful implementation and sustainability of the EHR system at any health facility, skilled manpower with IT/HIT background and an end user well-trained on ICT usage is essential. In addition to that an appropriate organizational structure designed for the IT unit is expected at all facilities. The implementation team or workforce includes skilled manpower with the necessary expertise or skill mix. There should be a help desk at a facility at all times to ensure the availability of the system.

The EHR system to be deployed at any facility should take into consideration the skill level of end users and organizational culture and there should be a mechanism to train and capacitate the end user to fully utilize the application for better service delivery.

7.1.5. Connectivity requirements

Implementation of the EHR system requires local area network interconnecting facility service units and also facility to facility.

- Service units should be interconnected with Local Area Network(LAN) to efficiently transact patient data.
- There should be a wide area network (WAN) connecting every facility either by virtual private network(VPN), like HealthNet, or through the internet to connect central shared health records.
- The band width of the connection should be strong enough for patient data transmission at a facility level and data exchange with other facilities via the shared services.
- There should be Wireless connectivity at each facility that supports mobility of physicians. The strength of the wireless connectivity and the wireless access points specification depends on the type of the facility.
- The Security of the LAN and Wireless connectivity of the facility should fulfill end-to-end encryption, access control tools (like wireless key or Password) and physical security to secure patient data transfer within a facility and central data center.

7.1.6. Power supply requirements

For Successful implementation of EHR systems it requires a reliable power supply system. A variety of electric power sources may be available for different facilities, including the main power grid, solar power, generator power or wind power. For continuous availability of an EHR system at a facility it is required to have an alternative power supply which can fully take over the main supply in case of interruptions.

The following Power supply requirements should be fulfilled: -

- Servers, Switches and workstations must be powered by an Uninterruptible Power Supply (UPS) sufficient to power the system for long enough to ensure safe shutdown, and to prevent corruption of databases.
- Testing and maintenance of power backup units must be done to ensure their reliability.
- Surge protection and voltage stabilization should be provided to protect all computer equipment within EHR installations against power surge damage.
- All batteries, whether those in laptops or in UPS units, should be tested with sufficient frequency to detect any loss in capacity below the threshold for useful operation.
- Regular documentation of power testing should be maintained.
- Every facility needs to implement a maintenance schedule for power systems such as generators and UPSs

7.1.7. Local Data center

The EHR system implementation at specific facilities must have a locally established Mini data center equipped with all the necessary Servers, Networking equipment, UPS and cooling systems and security mechanisms. Depending on the type and size of facility the data center equipment might vary from facility to facility but must have the minimum basic functionalities required for EHR implementation.

7.1.8. Change management

Facilities need to have a change management strategy which enables them to smoothly transit to the new system. The change management strategy should be part of the facilities strategic document and clearly depicts how new systems like EHR are to be adopted and sustained. There should also be a mechanism on how champions are selected, incentivized and set a clear strategy on how to migrate previous data.

The data generated from the EHR system should be used at local level for decision making and should also be indicated on the facility strategy document.

In order to ensure an effective response to any support request on the EHR system, facilities should make it in their priority business process and assign required resources. It is also important to have a service level agreement (SLA) with telecom service providers to ensure accessibility of longitudinal patient health records.

The overarching purpose of change management is to accelerate the speed at which health facilities move successfully through the change process so that anticipated benefits of an EHR are achieved faster.

Facilities should establish a Change management Team, TWG and steering committee in the facility.

Some of the major activities expected are:

- Responsibility enabling and championing digital transformation throughout the facility.
- The change management team should have a scheduled regular meeting.
- They must have adequate time, be committed, skilled or trained to fulfil their important roles
- They should track the minor and major issues on the EHR system and plan the mitigation strategy
- They should have a mechanism to ensure usage of data generated by the system for decision making and planning.
- They should prepare a change management strategy and implementation plan.
- The team should design a business continuity plan for sustainability and smoothness of service delivery in the facility.
- There should be a disaster management and recovery plan to ensure there is no or minimum disruption of services.
- There should be a clear change request workflow and feedback mechanism that is visible for all.
- ICT team also has to document all change requests and corresponding mitigations.
- To manage requests for major and minor change request, the change management team should prepare tools like change request form, change management log, etc
- Every change should have passed the following steps: Generate change request, Log Change request status, Evaluate Change request, Authorize and Implement.

7.1.9. Training

Health facilities implementing EHR systems need to have clear strategies on user training. The strategy should indicate mechanisms for new employees joining the facility to start using the system. Facilities also should avail training resources and space for EHR capacity building purposes. Facilities should also put in place a Mentorship program for a specific period of time to enable end users to properly use the system.

7.1.10. Finance

For the sustainability of an EHR implementation, a facility needs to set aside a budget for the procurement of computers, spare parts, consumables like papers & inks, generator fuel and various recurrent expenditures. The budget should be clearly indicated in the facility annual budget plan.

7.1.11 EHR Software selection criteria

While considering to implement the EHR system, all facilities either purchase or develop the software, they should include the following points as a selection criterion.

- Software module capability
- Software vendor reputation (quality of product, service, support)
- Software interoperability capability (interfaces or integrates with other systems)
- Licensing /ownership model (per user, per location, enterprise).
- Scalability (can grow as we grow).
- Hardware and infrastructure requirements and compatibility (implementation model, cost to implement, and impact on existing resources/investments
- End-user needs /requirements meet (patient, provider, business, partners).
- Future state capabilities (software roadmap has future features of interest).
- Feedback and recommendations from current customers

7.2. Managing and supporting EHR System Operation

In this section, target requirements expected during the operation of the EHR system within facilities are explained as follows.

7. 2.1 Monitoring and Evaluation

During the operation of the EHR system, there should be a monitoring and evaluation plan to guide implementation and evaluate the successes and challenges.

The implementation team should identify and document key process milestones that will be used to monitor the EHR installations, define key questions and outcome indicators for periodic evaluation of the EHR systems. The established change management team, TWG and Steering committees should evaluate the progress based on the overall objectives and expectations. Hence the result of this process should answer the following questions like: Does the EHR improve patient care? Does the EHR improve record keeping? Does the EHR improve reporting?

7.2.2 Data Backup

Backup of patient information is fundamental to the reliability and recoverability of EHR systems at a facility. A documented backup plan which ensures the backup should be complete, timely and must exist which defines the backup routines. The patient data backup plan should indicate the type of backup media, frequency, type(full/incremental), responsible persons, location where backup data is stored and back up data restoration procedures.

7.2.3. System Support

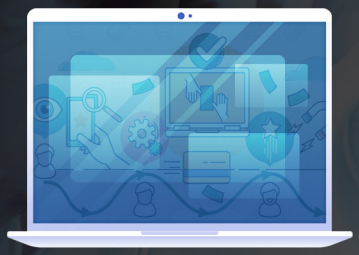
EHR systems will need regular maintenance and support for the hardware and software. The quality of the system support will ultimately determine the success or failure of an EHR system. Every facility or institution using an EHR system will identify its source of support, which may be sourced either internally or externally through a service level agreement. The source of support and how to access it shall be known to the management and to all users within the facility.

7.3. Implementation Considerations

EHR system implementation entails proper planning and mobilizing resources. It is also required to properly install ICT infrastructure and train staff for smooth deployment of the system. Some of the basic things that must be taken into account before and during the EHR System are:

- It is advisable to implement the EHR system parallel to the Manual (Paper based) option until the digital one matured enough
- The Change management should prepare the implementation plan and mitigation strategies
- Depending on the existing situation of the facility, it is advisable to implement EHR in phase-based approach
- Health Facilities should make sure that the data generated by the EHR system is used for local decision making and planning

- The initial step of EHR implementation is to come up with a detailed strategic plan for the activities ahead. Assign duties and responsibilities for the team members, identify the physician champions, and create a space for mutual support and dependence, follow implementation plans and correct any issue at the initial stage.
- Facilities should benchmark those facilities from already implemented the EHR system and take lessons from their practical experience
- Backup of EHR data should be automated within the system wherever possible to ensure consistency.
- Facilities should migrate patient data which has been captured previously either on paper or digitally. The data should at least contain the previous three years patient health record
- Facilities should make sure that A secure physical environment is provided for computer equipment
- Computers used for handling and storing health information should be dedicated to that function and not used for other purposes such as personal document processing, audio and video file downloads, Internet browsing, or other unrelated functions.
- All computer systems must have virus detection software installed and updated regularly.



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ANNEXES

Annex 1: Minimum Data sets

1.1. Triage and Registration Module Minimum Data Sets

SN	Data Element /Field	Data type/ Format	Form (Data Source)
1	Patient Type (New, exiting)	Text	
2	New Patient ID	Numeric	
3	Biometric data	Image/text	
4	First Name	Text	
5	Middle Name	Text	
6	Last Name	Text	
7	Sex	Text	
8	Birth date	Date: dd/mm/yyyy	
9	Region	Text	
10	Zone	Text	
11	Woreda	Text	
12	Kebele	numeric	
13	House Number	Alphanumeric	
14	Educational status	Text	
15	Marital status	Text	
16	Occupation	Text	
17	Contact name and address	Text	
18	Mobile number	Alphanumeric	
19	Direct Telephone	Alphanumeric	
20	Patient Condition (Severity)	Text	
21	Assigned to clinic	Text	
22	Referral document	BLOB	
23	Appointment date	Date	
24	Payment Type	Text	
25	Registration Fee	Numeric	
26	Payment status	Text	

1.2. Liaison Module Minimum Data Sets

SN	Data Element /Field	Data type/Format	Form (Data Source)
1	Ward Number	Numeric	Liaison form
2	Ward Name	Text	Liaison form
3	Room Number	Numeric	Liaison form
4	Floor Number	Numeric	Liaison form
4	Bed Number `	Numeric	Liaison form
5	Medical Record Number	Numeric	Liaison form
6	Patient Full Name	Text	Liaison form
7	Date of Admission	Date	Liaison form
8	admitting physician	Text	Liaison form
9	Admitting department	Text	Liaison form
10	Appointment date	Date	Liaison form
11	Referred to	Text	Liaison form
12	Referred from	Date	Liaison form
14	Referred Date	Date	Liaison form
15	Service type given	Text	Liaison form
16	Price for the service	Numeric	Liaison form
17	Discharge date	Date	Liaison form
18	Discharge reason	Text	Liaison form
19	Social services provided	Text	Liaison form

1.3. Outpatient Module Minimum Data Sets

SN	Data Element /Field	Data type/ Format	Form (data source)
1	Chief complaint	text	patient form
2	Duration of chief complaint (time)	Numeric	patient form
3	Onset of chief complaint	Text	patient form
4	Location of chief complaint	Text	patient form
5	history of present illness	Free text	patient form
6	Past Medical History	free text	past history
7	Surgical History	free text	patient form
8	Gynecologic history	free text	patient form
9	Family and social history	free text	patient form
10	Surgical interventions	free text	patient form
11	BMI (Kg/M^2)	numeric in range	Patient form
12	Weight	Numeric	Patient form
13	Height/length	Numeric	Patient form
14	Head circumference (cm)	numeric	Patient form
15	MUAC	numeric	Patient form
16	General appearance	text	Patient form

SN	Data Element /Field	Data type/ Format	Form (data source)
17	Blood Pressure: Systolic	Numeric	Patient form /Vital sign chart
18	Blood Pressure: Diastolic	Numeric	Patient form /Vital sign chart
19	Temperature (0c)	Numeric	Patient form /Vital sign chart
20	Pulse pressure	Numeric	Patient form /Vital sign chart
21	Respiratory rate	Numeric	Patient form /Vital sign chart
22	Oxygen saturation	Numeric	Patient form /Vital sign chart
23	Pain score	Numeric	Patient form /Vital sign chart
24	HEENT	Text	Patient form
25	Glands	Text	Patient form
26	Chest	Text	Patient form
27	Cardiovascular	Text	Patient form
28	Respiratory	Text	Patient form
29	GI	Text	Patient form
30	Renal	Text	Patient form
31	Integumentary	Text	Patient form
32	Musculoskeletal	Text	Patient form
33	Other	Text	Lab request and result form
34	Lab tests	Text	Lab request and result form
35	Lab Results	Alphanumeric	Lab request and result form
36	Medications Prescribed	Text	Prescription form
37	other investigations requested	Text	Investigation form
38	Investigation results	Text	Investigation form
39	Diagnosis, problem list, procedures	Text	Lab request and result form
40	Treatment plan	Text	Patient form

1.4. Emergency Module Minimum Data Sets

S.No	Data Element /Field	Data type/ Format	Form (data source)
1	Severity status, by category	Text	patient form
2	Means of arrival (Ambulance or not)	Text	Patient form
3	Chief complaint	text	patient form
4	Duration of chief complaint (time)	Numeric	patient form
5	Onset of chief complaint	Text	patient form
6	Location of chief complaint	Text	patient form
7	history of present illness	Free text	patient form
8	Past Medical History	free text	past history
9	Surgical History	free text	patient form
10	Gynecologic history	free text	patient form
11	Family and social history	free text	patient form
12	Surgical interventions	free text	patient form

S.No	Data Element /Field	Data type/ Format	Form (data source)
13	BMI (Kg/M^2)	numeric in range	Patient form
14	Weight	Numeric	Patient form
15	Height/length	Numeric	Patient form
16	Head circumference (cm)	numeric	Patient form
17	MUAC	numeric	Patient form
18	General appearance	text	Patient form
19	Blood Pressure: Systolic	Numeric	Patient form /Vital sign chart
20	Blood Pressure: Diastolic	Numeric	Patient form /Vital sign chart
21	Temperature (0c)	Numeric	Patient form /Vital sign chart
22	Pulse pressure	Numeric	Patient form /Vital sign chart
23	Respiratory rate	Numeric	Patient form /Vital sign chart
24	Oxygen saturation	Numeric	Patient form /Vital sign chart
25	Pain score	Numeric	Patient form /Vital sign chart
26	HEENT	Text	Patient form
27	Glands	Text	Patient form
28	Chest	Text	Patient form
29	Cardiovascular	Text	Patient form
30	Respiratory	Text	Patient form
31	GI	Text	Patient form
32	Renal	Text	Patient form
33	Integumentary	Text	Patient form
34	Musculoskeletal	Text	Patient form
35	Other	Text	Lab request and result form
36	Lab tests	Text	Lab request and result form
37	Lab Results	Alphanumeric	Lab request and result form
38	Medications Prescribed	Text	Prescription form
39	other investigations requested	Text	Investigation form
40	Investigation results	Text	Investigation form
41	Diagnosis, problem list, procedures	Text	Lab request and result form
42	Admission information	Text	Admission form
43	Final outcome	Text	Patient form
44	Treatment plan	Text	Patient form

1.5. Inpatient Module Minimum Data Sets

SN	Data element/field	Data format	Form (Data Source)
1	Chief Complaint	Text	Patient form
2	Duration of C/C	Numeric	Patient form
3	Physician evaluation/admission note	Text	Patient form
4	Risk factor	Text	Patient form
5	Underlying Illness	Text	Patient form
6	Past Medical History	Text	Patient form
7	Past Surgical history	Text	Patient form
8	Past gyn/obs History	Text	Patient form
9	Family history	Text	Patient form
10	Personal/Social history	Text	Patient form
11	Allergy history	Text	Patient form
12	Systolic Blood Pressure	Numeric	Patient form/VS form
13	Diastolic BP	Numeric	Patient form/VS form
14	Pulse Rate	Numeric	Patient form/VS form
15	Respiratory Rate	Numeric	Patient form/VS form
16	Temperature	Numeric	Patient form/VS form
17	Oxygen Saturation	Numeric	Patient form/VS form
18	Pain Score	Numeric	Patient form/VS form
19	Random Blood Sugar	Numeric	Patient form
20	Weight	Numeric	Patient form
21	Height	Numeric	Patient form
22	Body Mass Index	Numeric	Patient form
22	General Appearance	Text	Patient form
28	Findings in HEENT	Text	Patient form
29	Findings in LGS	text	Patient form
30	Findings in Respiratory system	Text	Patient form
31	Findings in Cardiovascular system	Text	Patient form
32	Findings in GIS	text	Patient form
33	GUS	Text	Patient form
34	MSS	Text	Patient form
35	Integumentary	Text	Patient form
36	Nervous system	Text	Patient form
37	Assessment	text	Patient form
38	Treatment plan	text	Patient form
40	Investigation order	text	Order form

SN	Data element/field	Data format	Form (Data Source)
41	Diagnostic test order	text	Order form
42	imaging study order	text	Order form
43	Pathology test order	text	Order form
44	Medication order	text	Order form
45	Follow up order	text	Order form
46	Nursing care order	text	Order form
47	progress	text	Order form
48	Dietary order	text	Order form
49	Advice/Counselling	text	Admission/Discharge form
50	Appointment (date, Unit)	text	Admission/Discharge form
51	Investigation result	numeric/text	Admission/Discharge form
52	Nursing assessment	text	Admission/Discharge form
53	Nursing progress	text	Admission/Discharge form
54	Follow up care	text	Admission/Discharge form
55	Nursing care	text	Admission/Discharge form
56	Medication sheet	text	Admission/Discharge form
57	medication profile	text	Admission/Discharge form
58	drug therapeutic problem	text	Admission/Discharge form
59	Clinical pharmacist care plan	text	Admission/Discharge form
60	pharmacologic progress	text	Admission/Discharge form
61	medication reconciliation	text	Admission/Discharge form
62	length of stay	numeric	Admission/Discharge form
63	Bed occupancy rate	Numeric	Admission/Discharge form
64	mortality rate	Numeric	Admission/Discharge form
65	Admission date	text	Admission/Discharge form
66	Admission history	text	Admission/Discharge form
67	Discharge status	text	Admission/Discharge form
68	Anesthesia note	text	Anesthesia form
69	Pre-OP, OP and Post-OP notes	text	Operation form
70	Progress note	percentage	Progress note form
71	Adverse drug reaction	text	Admission/Discharge form
72	care provider name	text	Admission/Discharge form
73	Consultation note	text	Admission/Discharge form
74	Referral note	Text	Admission/Discharge form

1.6. Maternal, Neonatal and Child Health Module Minimum Data Sets

SN	Data Element /Field	Data type/Format	Format (Data Source)
General medical and obstetric history			
1	Past medical history	Text	Woman's Card; Integrated RH card
2	Previous Obstetric history-Year of pregnancy	Date	Woman's Card; Integrated RH card
3	Previous Obstetric history- outcome of pregnancy	Text	Woman's Card; Integrated RH card
4	Previous Obstetric history-mode of delivery	Text	Woman's Card; Integrated RH card
5	Previous Obstetric history-Complica-tions	Text	Woman's Card; Integrated RH card
Status of Current Pregnancy			
6	Multiple pregnancy	Text	Integrated RH card
7	Age more than 40	Text	Integrated RH card
8	Age less than 16	Text	Integrated RH card
9	RH iso-immunization	Text	Integrated RH card
10	Vaginal bleeding	Text	Integrated RH card
11	Pelvic mass	Text	Integrated RH card
Laboratory Investigations and Prescriptions			
12	Laboratory tests performed-Date	Date	Lab order form
13	Laboratory tests performed-type of test	Text	Lab order form
14	Laboratory tests performed-result	Text	Lab order form
15	Prescriptions provided-Date	Date	prescription order form
16	Prescriptions-Drug name	Text	prescription order form
17	Family Planning Data		
18	Date of visit	Date	Woman's card
19	Blood Pressure	Numeric	Woman's Card
20	Weight	Numeric	Woman's card
21	Type of FP clients	Text	
22	Type of FP method provided	Text	Woman's Card
23	Reason for method switch	Text	Woman's Card
24	Date of next visit	Date	Woman's Card
25	TT immunization data		
26	Date of vaccination	Date	Woman's Card
27	TT vaccination provided	Text	Woman's Card
Counselling and testing			
28	Counselling date	Date	Woman's Card
29	Counselling service provided-STI	Text	Woman's Card
30	Counselling service provided-HIV	Text	Woman's Card
31	Counselling service provided-FP	Text	Woman's Card

SN	Data Element /Field	Data type/Format	Format (Data Source)
32	Counselling service provided-Others	Text	Woman's Card
33	Testing result for HIV	Text	Woman's Card; Integrated RH card
34	Testing result for VDRL	Text	Woman's Card; Integrated RH card
Antenatal care service			
35	General examination	Text	Integrated RH card
36	Gyn exam	Text	Integrated RH card
37	Danger signs	Text	Integrated RH card
38	Date of visit	Date	Integrated RH card
39	Visit number	Number	Integrated RH card
40	Gestational Age	Numeric	Integrated RH card
41	BP	Numeric	Integrated RH card
42	Weight	Numeric	Integrated RH card
43	Pallor	Text	Integrated RH card
44	Uterine height	Numeric	Integrated RH card
45	Fetal Heartbeat	Numeric	Integrated RH card
46	Uterine test	Text	Integrated RH card
47	Blood group and RH test result	Text	Lab order form
48	Iron folate	Alpha-numeric	Integrated RH card
49	Next appointment date	Date	Integrated RH card
50	Danger signs and investigations	Text	Integrated RH card
Intrapartum care (Monitoring labour)			
51	Date and time of admission	Date and time	Partograph
52	Rupture of membranes	Text	Partograph
53	Rupture of membranes-Time	Time	Partograph
54	Fetal heartbeat	Numeric	Partograph
55	Amniotic fluid	Text	Partograph
56	Moulding	Text	Partograph
57	Cervical dilation	In cm	Partograph
58	Contractions per 10 min	Number	Partograph
59	Oxytocin (U/L)	Text	Partograph
60	Oxytocin (drops/min)	Numeric	Partograph
61	Drugs and fluids given	Text	Partograph
62	Pulse	Numeric	Partograph
63	BP	Numeric	Partograph
64	Temperature	Numeric	Partograph
65	Urine_Protein	Alphanumeric	Partograph
66	Urine_Acetone	Alphanumeric	Partograph
67	Urine_Volume	Alphanumeric	Partograph

SN	Data Element /Field	Data type/Format	Format (Data Source)
Delivery Summary			
68	Delivery date and time	Date and Time	Integrated RH card
69	Mode of delivery	Text	Integrated RH card
70	Active third stage of labour management	Text	Integrated RH card
71	Placenta	Text	Integrated RH card
72	Laceration	Text	Integrated RH card
73	Newborn_number	Text	Integrated RH card
74	Newborn_Sex	Text	Integrated RH card
75	Newborn_Apgar score	Numeric	Integrated RH card
76	Newborn_Weigt	Numeric	Integrated RH card
77	Newborn_height	Numeric	Integrated RH card
78	Newborn_GA	Text	Integrated RH card
79	Still birth	Text	Integrated RH card
80	Still birth_status	Text	Integrated RH card
81	Newborn_vaccine and medication	Text	Integrated RH card
82	Obstetric complications	Text	Integrated RH card
Postnatal care			
83	Date and number of visit	Date	Integrated RH card
84	VItal signs (BP, pulse, Temp…)	Numeric	Integrated RH card
85	Uterine contraction	Text	Integrated RH card
86	Urine	Text	Integrated RH card
87	Vaginal discharge	Text	Integrated RH card
88	Preventions provided	Text	Integrated RH card
89	Newborn status	Text	Integrated RH card
90	linkage of HIV pos to HIV clinic	Text	Integrated RH card
Immunization and GM			
91	Date of registration and number of visit	Date and number	Immunization card
92	Antigens received	Text	Immunization card
93	Neonatal tetanus protection	Text	Immunization card
94	Weight	Numeric	Immunization card
95	WFA	Numeric	Immunization card
Other Services			
96	Abortion care information	Text	
97	Child diagnosis and treatment information (per IMNCI guide)	Text	
98	Nutritional screening	Text	
99	Nutrition treatment information	Text	
100	Adolescent and youth service data	Text	
101	Sexual health	Text	

1.7. Non-Communicable Diseases Module Minimum Data Sets

SN	Data Element /Field	Data type/ Format	Form (Data source)
1	Screening for NCDs	Text	
2	Screening type	Text	
3	Screening result	Alphanumeric	
4	Counselling provided	Text	
5	BP measurement	Numeric	
6	Fasting blood sugar and its result	Alphanumeric	
7	Random blood sugar and its result	Text	
8	Diagnosis	Text	
9	Treatment provided, by type and dose	Text	
10	Drugs provided at 3 months	Text	
11	Treatment outcome at 3 months	Text	
12	Drugs provided at 6 months	Text	
13	Treatment outcome at 6 months	Text	
14	Drugs provided at regular intervals (12 mo, 18 mo, 24 mo…)	Text	
15	Treatment outcome regular interval (12 mo, 18 mo, 24 mo…)	Text	
16	Appointment	Text	
17	Referral	Text	

1.8. Chronic HIV Care/ART Module Minimum Data Sets

S.No.	Data element	Data type/format	Form (Data source)
Socio-demographic and family care			
1	Name	Text| First name, Father, Grand father's name	ART intake form
2	Date of birth	Date | DD/MM/YYYY	ART intake form
3	Date of registration	Date | DD/MM/YYYY	ART intake form
4	Sex	Text | Male or Female	ART intake form
5	Marital status	Text|Married, single, separated, widow etc	ART intake form
6	Address: Region	Text| name of region	ART intake form
7	Address: Zone/Woreda	Text | Zzone, woreda	ART intake form
8	Address: household number	Alpha numeric	ART intake form
9	Telephone	Number|+251-----	ART intake form
10	Contact information	Text| Name	ART intake form
11	MRN	Number | 000000 six digits	ART intake form
12	Unique ART number	Number |	ART intake form
13	Date of HIV test	Date | DD/MM/YYYY	ART intake form
14	Date tested HIV positive	Date | DD/MM/YYYY	ART intake form

S.No.	Data element	Data type/format	Form (Data source)
15	Past medical history	Text	
16	Past opportunistic infection	Text	
17	Past prophylaxis/treatment	Text	
18	All other data in intake form A and B	Text, numeric	
Status at entry to HIV care			
19	Functional status	Text	ART intake form
20	Weight	Numeric	ART intake form
21	Height/length	Numeric	ART intake form
22	MUAC	Numeric	ART intake form
23	BMI/Weight for age	Numeric	ART intake form
24	Nutrition screening status/Food support	Text	ART intake form
25	Viral load	Numeric	ART intake form
26	Pregnancy status	Text	ART intake form
27	Breast feeding status	Text	ART intake form
Cervical Cancer Screening and Treatment			
28	Type of cervical screening	Text	ART followup form
29	Result of cervical screening	Text	ART followup form
30	Management of cervical screening with cervical lesion	Text	ART followup form
31	Referral service for Cervical ca screening and management	Date | DD/MM/YYYY	ART followup form
TB/HIV co-infection			
32	Screening for TB	Text	ART followup form
33	TB screening result	Text	ART followup form
34	GeneXpert and its result	Text	ART followup form
35	TB treatment start and end date	Date | DD/MM/YYYY	ART followup form
36	TPT (TB Prophylaxis treatment)	Text	ART followup form
37	Other prophylaxis	Text	ART followup form
ART follow up and summary			
38	Date ART is started	Date | DD/MM/YYYY	ART followup form
39	Original regimen	Text|Code of 1st line regimen	ART followup form
40	Substitution regimen 1st line	Text|Code of 1st line regimen	ART followup form
41	Reason for substitution	Text|Code of reason	ART followup form
42	Switched regimen to 2nd line	Text|Code of 2nd line regimen	ART followup form
43	Reason for switch	Text|Code of reason for switch	ART followup form
44	Switched regimen to 3rd line	Text|Code of 2nd line regimen	ART followup form
45	Reason for switch	Text|Code of reason for switch	ART followup form
46	Functional status	Text|Coded status	ART followup form
47	Weight	Numeric	ART followup form

S.No.	Data element	Data type/format	Form (Data source)
48	Height/length	Numeric	ART followup form
49	MUAC	Numeric	ART followup form
50	BMI/Weight for age	Numeric	ART followup form
51	Nutrition screening status/Food support	Text	ART followup form
52	Date Viral load is tested	Date | DD/MM/YYYY	ART followup form
53	Viral load (detectable/undetectable	Alpha numeric	ART followup form
54	Enrollment date to appointment spacing model	Date | DD/MM/YYYY	ART followup form
55	Cotrimoxazole start date	Date | DD/MM/YYYY	ART followup form
56	Cotrimoxazole stop date	Date | DD/MM/YYYY	ART followup form
57	Use of family planning	Text (FP used)	ART followup form
58	ART interruption date	Date | DD/MM/YYYY	ART followup form
59	Lost status	Text (Yes/No)	ART followup form
60	Lost date	Date | DD/MM/YYYY	ART followup form
61	Lost to follow up status	Text (LTFU or not)	ART followup form
62	Lost to follow up date	Date | DD/MM/YYYY	ART followup form
63	Drop status	Text (drop from Rx o not)	ART followup form
64	Drop date	Date | DD/MM/YYYY	ART followup form
65	Death date	Date | DD/MM/YYYY	ART followup form
66	Transfer out date	Date | DD/MM/YYYY	ART followup form
Other information			
67	New diagnosis/OIs	Text	Patient form
68	Admission		Patient form
69	Laboratory tests done	Text	Lab request from
70	Laboratory result	Alphanumeric	Lab request form
71	Prescriptions	Text	Prescription from
72	Referral to other facilities	Text	Referral from
HIV Exposed Infant (HEIInformation			
73	HIV test provided	Text	Patient form
74	Type of test		Patient form
75	Result of test		
76	Cotrimoxazole Prophylaxis	Text	Lab request from
77	ARV Prophylaxis	Alphanumeric	Lab request form
78	Other HEI information	Text	Prescription from
VCT information			
79	Test done	Text	Patient form
80	Result of test		Patient form
81	Partner test		
82	Result of partner test	Text	Lab request from
83	Index test	Alphanumeric	Lab request form
84	Result of index test	Text	Prescription from

1.9. Tuberculosis and leprosy Module Minimum Data Sets

S.No.	Data Element /Field	Data type/ Format	Form (Data source)
Basic Demographic data			
1	Date of Birth	Date	Patient folder
2	Age	Numeric	Patient form
3	Date of registration to TB clinic	Date	Patient card
4	Sex	Text	Patient folder
5	Marital status	Text	Patient folder
6	Address: Region	Text	Patient folder
7	Address: Zone/Woreda	Text	Patient folder
8	Address: household number	Text	Patient folder
9	Telephone	Number|+251-----	Patient folder
10	Contact information	Text| Name	Patient folder
11	MRN	Number	Patient folder
Entry to TB Treatment program (Non-DR TB)			
12	Unit TB number	Number	TB register
13	TB most at risk group	Text	TB register
14	Anti-TB treatment start date	Date	TB register
15	Category of Patient	Text	TB register
16	Laboratory test date	Date	Lab order form
17	Laboratory test type	Text	Lab order form
18	Laboratory test result	Text	Lab form
19	Weight	Numeric	Tb register
20	Height	Numeric	Tb Register
21	BMI	Numeric	Tb register
22	MUAC	Numeric	Tb register
23	Nutritional status	Text	TB register
24	Intensive phase treatment- drug	Text	TB register
25	Intensive phase treatment- dose	Numeric	TB register
26	Intensive phase treatment- daily monitoring chart	Text	TB register
27	Continuation phase treatment - drug	Text	TB register
28	Continuation phase treatment - dose	Numeric	TB register
29	Continuation phase treatment - monitoring chart	Text	TB register
TB-HIV Co-infection			
30	HIV test date	DD | DD/MM/YYYY	TB register
31	HIV test result	Text	TB register
32	Population category of HIV test	Text	TB register
33	CPT start date	Text	TB register
34	Linkage to chronic HIV care	Text	TB register

S.No.	Data Element /Field	Data type/ Format	Form (Data source)
Nutritional assessment and Intervention			
35	Nutrition assessment and its result	Text and numeric	TB register
36	Type of nutritional treatment provided	Text	TB register
37	Outcome of nutritional RX		TB register
Treatment outcome			
38	Treatment outcome	Text	TB register
DRUG RESISTANCE TB REGISTRATION AND TREATMENT			
39	DR TB registration date	Date	DR TB form
40	DR TB number	Numeric	DR TB form
41	Type of Resistance	Text	DR TB form
42	Site of infection	Text| Pulmonary, Extra pulmonary	DR TB form
43	Treatment start date		
44	Registration group	Text	DR TB form
45	Drug sensitivity test date	Date	
46	Drug sensitivity test result	Text	
47	Previous treatment status (first line drug)	Text	DR TB form
48	Previous treatment status (Second line drug)	Text	DR TB form
49	TB/HIV activities	Text	DR TB form
50	Eligibility	Text	DR TB form
51	Nutritional screenign and classification	Text	DR TB form
52	Nutritional management	Text	DR TB form
53	Nutritional treatment outcome	Text	DR TB form
54	DR TB Regimen - Intensive phase	Text	DR TB form
55	DR TB Regimen - Continuation phase	Text	DR TB form
56	Smear and culture result monitoring	Text	DR TB form
57	DR TB treatment outcome	Text	DR TB form
Leprosy REGISTRATION AND TREATMENT			
58	Leprosy smear result	Text	DR TB form
59	Leprosy patient category	Text	DR TB form
60	Type of leprosy (MB, PB)	Text	DR TB form
61	Disability grade at diagnosis-eyes	Text	DR TB form
62	Disability grade at diagnosis-hand	Text	DR TB form
63	Disability grade at diagnosis-feet	Text	DR TB form
64	Date leprosy treatment is started	Text	DR TB form
65	Number of household contacts	Text	DR TB form
66	Number of household contacts evaluated	Text	DR TB form
67	No. of HH contacts diagnosed with leprosy	Text	DR TB form
68	Treatment attendance table	Text	DR TB form

S.No.	Data Element /Field	Data type/ Format	Form (Data source)
69	Treatment stopped date	Text	DR TB form
70	Disability grade at completion of Rx-eyes	Text	DR TB form
71	Disability grade at completion of Rx-hand	Text	DR TB form
72	Disability grade at completion of Rx-feet	Text	DR TB form
73	General condition at completion of Rx	Text	DR TB form
74	Household contacts evaluated	Text	DR TB form
75	Follow up	Text	DR TB form
76	Rehabilitation	Text	DR TB form

1.10. Laboratory Module Minimum Data Sets

S.No	Data Element /Field	Data type/ Format	Form (data source)
1	Sample ID/barcode	Text	Lab order form
2	Sample type	Text	Lab order form
3	Date and time of Sample collection	Date	Lab order form
4	Date and time sample is received	Date	Lab order form
5	List of lab tests	Text	Lab order form
6	Demographic and clinical Information	text	Lab order form
7	Test urgency/Priority	Text	Lab order form
8	Anatomic site of origin of the sample	text	Lab order form
9	Test price	numeric	Lab order form
10	Payment status	text	Lab order form
11	Sample collector name	text	Lab order form
12	Sample received by (name)	Text	Lab order form
13	Comments on specimen quality	numeric	Lab order form
14	Specimen acceptance/rejection	text	Lab order form
15	Reason for rejection	text	Lab order form
16	Presence of sample interference	text	Lab order form
17	Notification alerts to authorized health professionals	text	Lab order form
18	Quality control result and statistical analysis	alphanumeric	Lab order form
19	Test done by (name), Test approved by (name)	text	Lab order form
20	Test result (test report)	alphanumeric	Lab order form
21	Date and time of the report	text	Lab order form
22	Turnaround time	numeric	Lab order form
23	Lab reference interval	text	Lab order form
24	Panic/critical result notification	text	Lab order form
25	Interpretive comments on results	text	Lab order form
26	Lab bin card management	alphanumeric	Lab order form
27	Blood and blood products management information	alphanumeric	Lab order form
28	Pathological test management information	alphanumeric	Lab order form

1.11. Diagnostic and imaging Module Minimum Data Sets

S.No	Data Element /Field	Data type/ Format	Form (data source)
1	Imaging ID/Study ID	Numeric	
2	Patient Category (internal, External)	Text	
3	Diagnostic study/intervention ordered	Text	
4	Reason for order	Text	
5	Referring/Ordering physician	Text	
6	Order date	Date	
7	Reading priority Status	Alphanumeric	
8	Patient order status	Text	
9	Diagnostic Modality	Text	
10	Known Chronic disease	Text	
11	Allergic reaction	Text	
12	Protocol of study	alphanumeric	
13	Protocol Date	Date	
14	Diagnosis	Text	
15	Laboratory Results	Alphanumeric	
16	History & Physical Examination	Text	
17	Previous Imaging studies	Image/Blob	
18	Previous Imaging studies report	Text	
19	Previous Image study report date	Date	
20	Pre procedure checklist	Text	
21	Procedure note	Text	
22	Drug name	Text	
23	Drug dosage	Text	
24	Procedure performed by	Text	
25	Patient consent	Text	
26	Procedure date	Date	
27	Diagnostic image	image	
28	Diagnostic report	Text	
29	Diagnostic report Date	Date/Time	
30	Reported by	Text	
31	Diagnostic Price	Decimal	
32	payment status	Boolean	
33	Appointment date	Date/Time	
32	Advice note	Text	
33	List of pharmaceutical	Text	

1.12. Pharmacy Module Minimum Data Sets

S.No	Data element/field	Data type	Form (Data Source)
1	Diagnosis	text	prescription
2	Drug name - Generic	Text	prescription
3	Drug strength, dosage form, dose	Alphanumeric	prescription
4	Frequency, duration, quantity	Alphanumeric	prescription
5	Route of administration	text	prescription
6	Date of prescription	Date	prescription
7	Prescribers information (Name, qualification, registration number, signature)	text	prescription
8	Evaluator information (Name, qualification, registration number, signature)	text	prescription
9	Counsellor's information (Name, qualification, registration number, signature)	text	prescription
10	Minimum and Maximum stock and emergency order levels	text	RRF
11	Type by source (Program, budget, RDF, donation)	Text	RRF
12	Product code and description	text	RRF
13	Unit of issue	text	RRF
14	Beginning balance and ending Balance	Numeric	RRF
15	Quantity received	Numeric	RRF
16	Loss/adjustment	Numeric	RRF
17	Calculated consumption	Numeric	RRF
18	Days out of stock	Numeric	RRF
19	Maximum stock quantity	Numeric	RRF
20	Quantity needed to reach maximum	Numeric	RRF
21	Quantity ordered	Numeric	RRF
22	Near expiry stock description	text	RRF
23	Receiving/issuing vaucher number	text	bin card
24	Received from or issued to	text	bin card
25	Quantity received	text	bin card
26	Quantity issued	text	bin card
27	Batch number	text	bin card
28	Supplier information	text	Voucher
29	Unit selling price	text	model 22
30	Retail price per retail unit	text	model 22
31	Issued by, received by (name,sign)	text	model 22
32	Retail unit	text	cash/credit sales ticket
33	Retail quantity	text	cash/credit sales ticket
34	Retail price	text	cash/credit sales ticket
35	Total retail price	text	cash/credit sales ticket
36	Name of Patient and Bed Number (for inpatient)	text	

S.No	Data element/field	Data type	Form (Data Source)
37	Number of tickets used	text	Daily Cash Dispensary Summary Form
38	Total cash collected (medicine, compounding fee)	text	Daily Cash Dispensary Summary Form
39	Over/under collected	text	Daily Cash/ credit Dispensary Summary Form
40	Total number of drugs dispensed by type	text	Daily Cash Dispensary Summary Form
41	Total adjusted sales	Numeric	Daily Cash Dispensary Summary Form
42	Total number of voided tickets	Numeric	
43	Physical quantity	Numeric	SDU, Pharmacies Inventory form
44	Bin location information (type and number of bin)	text	SDU, Pharmacies Inventory form
45	Total Stock at hand & ordered	text	Stock Status Analysis Form (SSA)
46	Average Monthly or last month Consumption if increasing	Numeric	Stock Status Analysis Form (SSA)
47	Months of Stock (MOS)	Numeric	Stock Status Analysis Form (SSA)
48	Additional stock needed for the next 4 months (stock in unit,stock in months)	Numeric	Stock Status Analysis Form (SSA)
49	Total cost of medicines damaged	Numeric	Monthly Financial Reporting Form (MFRF):
50	Total cost of medicines expired	Numeric	Monthly Financial Reporting Form (MFRF):
51	Total cost of ending balance (calculated)	Numeric	Monthly Financial Reporting Form (MFRF):
52	Compound preparation details	text	compounding prescription registration form
53	Compounder's details	text	compounding process registration form
54	ADR and or allergies	text	inpatient medication profile form
55	Immunization status	text	inpatient medication profile form
56	Current medications (indication, drug and dosage regimen, start date, end date)	text	inpatient medication profile form
57	Pharmacist assessment and care plan	text	inpatient medication profile form
58	Recommendations and interventions	text	inpatient medication profile form
59	Discharge medications and counselling		inpatient medication profile form

1.13. Rehabilitation care Module Minimum Data Sets

S.No.	Data Element /Field	Data format	Form/data source
1	Diagnosis/problem list	Text	Rehab/Palliative form
2	Current medications	Text	Rehab/Palliative form
3	Chief complaint today	Text	Rehab/Palliative form
4	Brief history of present illness	Text	Rehab/Palliative form
5	Interim events since last visit	Text	Rehab/Palliative form
6	Physical findings	Text	Rehab/Palliative form
7	Vital signs	Alphanumeric	Rehab/Palliative form
8	Lab results	Alphanumeric	Rehab/Palliative form
9	Diagnostic and imaging findings	Text	Rehab/Palliative form
10	Neuro screening – Motors/myotoms (weak/strong)	Text	Physiotherapy form
11	Neuro screening – sensation/dermatomes	Text	Physiotherapy form
12	Neuro screening – Reflex/DTR	Text	Physiotherapy form
13	Manual muscle test	Text	Rehab/Palliative form
14	Pain assessment - Pain type	Text	Rehab/Palliative form
15	Pain assessment - Pain severity	Numeric	Rehab/Palliative form
16	Non-Pain symptoms	Text	Rehab/Palliative form
17	Social issues	Text	Rehab/Palliative form
18	Illness understanding by the patient	Text	Rehab/Palliative form
19	Illness understanding by the family members	Text	Rehab/Palliative form
20	Emotional/spiritual issues	Text	Rehab/Palliative form
21	Medications provided	Text	Rehab/Palliative form
22	Palliative care plan	Text	Rehab/Palliative form
23	Type of rehab/physiotherapy provided	Text	Physiotherapy form
24	Home advice	Text	Physiotherapy form
25	Evaluator's name	Text	Rehab/Palliative form

1.14. Billing Module Minimum Data Sets

SN	Data Element /Field	Data type/Format
1	Billing ID or invoice number	Auto-number
2	Billing Date	Date/time
3	Reason for payment	Text
4	Payment type (credit, insurance, Self-sponsored)	Demographic
5	Payment Method (Bank transfer, Cash)	Text
6	Name of payer/Insurer	
7	Date of Service obtained	Date/Time
8	Unit of price per service type	Numeric
9	Total price	Numeric
10	Amount paid	Numeric
11	Amount deducted	Numeric
12	Balance	Numeric
13	Unit price of the service	Decimal

Annex 2: Readiness Assessment Checklist

Category	Response	Remark
General Data		
Facility Name		
Facility Type		
Region		
Zone/Subcity		
Woreda		
Respondent Name		
Data collector Name		
Baseline Data		
Number of functional departments		
Number of Service delivery points		
Number of inpatient Departments		
Number of emergency units		
Number of Outpatient service units		
Number of Drug dispensing units /pharmacy units/		
Number of drug stores		
Number of Lab service units		
Number of MRU Windows		
Number of Triage Units		
Number of Nurse stations		
Average Number of patient seen per-day		
Technical Staffs		
Number of Specialists		
Number of GPs		
Number of Health officers		
Number of Nurses (all types)		
Number of Midwives		
Number of Lab technologists		
Number of Pharmacists		
Number of others		

Category	Response	Remark
Supportive Staffs		
Number of Admin and Finance officers		
Number of Cashiers		
Number of MRU workers		
ICT Structure and Professionals		
Availability of IT Structure (Yes/No)		
Number of IT professionals		
Number of IT professionals with BSc/MSc		
Number of IT professionals with diploma		
Number of Permanent IT professionals		
Number of Contractual IT professionals		
Other Software Information		
Other Software Available(Yes/No)		
Software1 Name and Purpose		
Software2 Name and Purpose		
Software3 Name and Purpose		
Laboratory with LIS (Yes/No)		
EHR implemented (other than MRU)? (Yes/No)		
Number of Service units using EHR		
Ever used EHR for patient management? (Yes/No)		
Ever used the previous EMR for monitoring Facility's performance (Yes/No)?		
Ever eHMIS/PHEM extracted data from EMR (Yes/No)?		
ICT infrastructure		
Availability of Generator as power backup (Yes/No)?		
If Yes, Generator capacity (KVA)		
Number of Computers available (excluding admin units)		
Number of Functional Computers with Network card		
Number of Server computers		
Number of portable devices (Laptop/Tablet)		

Category	Response	Remark
LAN /WAN Connectivity		
Functional LAN? (yes/No)		
Availability of VPN? (Yes/No)		
Number of Departments with LAN connection		
Connectivity test done ? (Yes/No)		
Number of Nodes per department		
Wireless connection availability? (Yes/no)		
Departments covered by wireless network		
Internet/VPN Connection Bandwidth		
Printers		
Number of printers available		
Number of Network printers		
Number of functional UPS		
EHR READINESS DATA		
Leadership /Management/ (Yes/No)		
Is the Strategic plan integrated with EHR implementation?		
Is EHR considered as a key tool to meet goals?		
Do EHR implementation goals and objectives are set?		
Do Leadership understand EHR benefits?		
Management is willing to plan and implement EHR?		
Does the management willing to allocate appropriate resources?		
Finance and Budget (Yes/No)		
Facility can allocate budget for IT maintenance?		
Facility can allocate budget for the ongoing EHR implementation process?		
Budget is available to hire IT professionals?		
Information /Data management (Yes/No)		
Management recognized the importance of a single unified health IT system?		
Management recognized timeliness, completeness and accuracy as data quality features?		
Does data/information from EHR can be used to support decision making?		

Category	Response	Remark
IT infrastructure, Management & Support (Yes/No)		
Computers LAN and other hardware devices requirement assessment for EHR implementation performed?		
The existing IT infrastructure is compliant to EHR standards?		
Staffs are trained on EHR?		
IT staffs are experienced in EHR system implementation and providing support?		
IT staff hiring for EHR implementation is included in the facility's annual plan?		
Workflow and Process		
Current service units workflow and processes are identified and documented?		
Service units where EHR can best applied are identified?		
Ways how EHR improve workflows/ processes are identified?		
Clinical /Administrative/ staffs		
Facility has identified and trained those staffs that can lead the EHR implementation?		
Motivational incentives are planned for the staffs implementing EHR?		
Facility has planned to use champions/ super EHR users?		
Staffs understand data flow and their roles in providing care?		
A staff assigned as project manager?		
Training and Support		
Budget allocated for EHR training for staffs?		
EHR training plan includes all relevant staffs & doesn't affect the routine hospital activities?		
Management agreed to support staffs at the initial stage of the change and learning curve of EHR?		
EHR training is planned to be institutionalized?		
Communication		
EHR staff sensitization conducted?		
EHR implementation stakeholders are identi-fied?		
EHR implementation stakeholders achieved good understanding of EHR benefits?		
Each stakeholder understands their roles for the implementation success?		

Annex 3: Minimum Specifications of Required EHR Infrastructure

Items	Health center	Primary Hospital	General hospital	Specialized hospital	Specification	Remark
Computer	Minimum one Desktop /laptop computer for each clinic	Minimum one Desk-top /laptop computer for each clinic	Minimum one Desktop /laptop computer for each clinic	Minimum one Desktop /lap-top computer for each clinic Minimum one Desktop / laptop computer based on clinical Unit	Core I7 with 8 GB of RAM and 4 CPUs	• Adequate computer should be provided based on readiness assessment • Number of computers is based on the number of service units(Desk units) at a facility
Printer	Networked printer	Networked printer	Networked printer	Networked printer	Medium duty for health centers and primary hospitals and heavy duty printer for others	• Quantity is based on the number of places where patient summary data produced or number of nurse station • Pre implementation assessment should address the required quantity
Scanner	A4 scanner	A4 scanner	A4 scanner	A4 and A3 scanner	Medium scanner	*Quantity is One per facility/ MRU *not mandatory for Health centers
Barcode Printer	Barcode Printer	Barcode Printer	Barcode Printer	Barcode Printer	Barcode Printer	• Quantity is one per MRU • *not mandatory for Health centers
Barcode Reader	Barcode reader	Barcode reader	Barcode reader	One Barcode reader for each laboratory	USB Barcode reader	• Quantity is based on service units requiring barcode reader *not mandatory for Health centers
UPS	One UPs per PC , Server & switches	One UPs per PC , Server & switches	One UPs per PC , Server & switches	One UPs per PC , Server & switches	With enough capacity to transition the devic-es to alternate source of power	• Depending the situation a facility can implement shared UPS for PCs and Servers

Items	Health center	Primary Hospital	General hospital	Specialized hospital	Specification	Remark
Server	Medium end server	Medium end server	One High end and one Medium end servers	One High end and one Medium end servers	Server Minimum requirement • **Processor** 2xIntel Xeon Gold 6242 2.8G, 16C/32T, 10.4GT/s, 22M Cache, Turbo, family • **Memory Capacity :** 32GB RDIMM, 2666MT/s, Dual Rank • **Operating System Support:** Ubuntu, Hypervisor, Microsoft Windows Server, VMware ESXi **Dimensions:** Form factor: Rack mountable (2U) • **Hard Drives:** (5) 1.2TB 10K RPM SAS 12Gbps 512n 2.5in Hot-plug Hard Drive	• One server per health center and primary hospitals and • Two servers for the General and Specialized hospitals(1 high end server and 1 medium end server)

Items	Health center	Primary Hospital	General hospital	Specialized hospital	Specification	Remark
External storage device	1TB USB Hard disk	device for data backup 5TB USB Hard disk	device for data backup >=10TB USB /Network Hard disk	Establish Disaster Recovery site or >=10TB USB/ Network Hard disk	Facilities shall maintain a backup plan that documents backup procedures and routines.	• The facility should take backup and defines standards for Daily Backup, On-site and Off-site backup, Backup Log Template, Backup of Patient Data • Backup Medium size can be defined based on the facility data size. • Backup should be kept at separate place other than the Storage Server
LAN connectivity	All service units should be connected via LAN	All service units should be connected via LAN	All service units should be connected via LAN	All service units should be connected via LAN	CAT 6 UTP for intera-facility connectivity and fiber cable for back end connection.	• Number of nodes should be greater or equal to the number of computers per service units • Pre implementation assessment(number of nodes, uplink/back bone connection option, etc.) should address the required quantity • Back end and building to building could be connected by fiber optic cable depending on the site.
Wireless connection	Minimum one per floor /based on floor distance/	Minimum one per floor /based on floor distance/	Minimum one per floor /based on floor distance/	Minimum one per floor / based on floor distance/	Industry standard wireless devices	• The number of access point could be determined based on network coverage and signal strength for each service units • Adequate number of access points to cover all service units with good strength

Items	Health center	Primary Hospital	General hospital	Specialized hospital	Specification	Remark
WAN/VPN	At least one connection line • 6Mb/s data	At least one connection line • 8 Mb/s data	At least one connection line • 10 Mb/s data	At least one connection line • 12 Mb/s data	VPN data, connection	• The Bandwidth size could be determined based on throughput or size of data transact(shared) to the central shared Server
IT professionals	Two • System admin • Technical Support	Three • System Admin • Network Admin and/or • Technical Support	Five • System Admin • Network Admin and/or • Three Technical Support	Five • System Admin • Network Admin and/or • Three Technical Support	Degree on Computer science or related fields and minimum 2 years work experience for System(EHR) and Network Administration	• Depending on the size and type of facility, required professionals must be determined during the readiness assessment.
Mini data center	Required	Required	Required	Required	Server, UPS,Security mechanism, cooling option and Network equipments,Rack	The Size of data center could be decided based on facility type and size
Operating system	Minimum Windows 10, 64bit /Linux Ubuntu 16.04 and above/ for desktop computers and Microsoft windows server 2012 datacenter edition with hyper v for servers	Minimum Windows 10, 64bit /Linux Ubuntu 16.04 and above/ for desktop computers and Microsoft windows server 2012 datacenter edition with hyper v for servers	Minimum Windows 10, 64bit /Linux Ubuntu 16.04 and above/ for desktop computers and Microsoft windows server 2012 datacenter edition with hyper v for servers	Minimum Windows 10, 64bit /Linux Ubuntu 16.04 and above/ for desktop computers and Microsoft windows server 2012 datacenter edition with hyper v for servers	Licensed Windows Server 2012 and above with hypervisor	Licenced Windows server
Antivirus	Licenced antivirus for each desktop/ Laptop/ computers and Servers	Licenced antivirus for each desktop/ Laptop/ computers and Servers	Licenced antivirus for each desktop/ Laptop/ computers and Servers	Licenced antivirus for each desktop/ Laptop/ computers and Servers	The type of antivirus is run in different types of operating systems...	Minimum licence is for one year

TECHNICAL GLOSSARY

Terms	Definition
Interoperability	The ability for a system to securely communicate and exchange data in an accurate, reliable, and meaningful way with another information system so that the clinical or operational purpose and meaning of the data are preserved and unaltered.
Actors	People or information systems who interact with the EHR system.
Data Exchange	The act of information exchange is often referred to as data sharing. Data Sharing uses the term to refer to the collection of practices, technologies, cultural elements, and legal frameworks that are relevant to transactions in any kind of information digitally, between different kinds of organizations. This term is more broadly applied to all types of data sharing, but can also be specifically used for health-related data.
Data Ownership	Data ownership is the act of having legal rights and complete control over a single piece or set of data. It defines and provides information about the rightful owner of data assets and the acquisition, use, and distribution policy implemented by the data owner.
EMR	Electronic medical records (EMRs) are a digital version of the paper charts in the clinician's office.
EHR	An Electronic Health Record is the systematized collection of patient and population electronically stored health information in a digital format. These records can be shared across different health care settings.
Module	A self-contained software component that interacts with a larger system. A software module (program **module**) comes in the form of a file and typically handles a specific task within a larger software **system**.
Security	A collection of approaches that address issues covering physical, electronic, and procedural aspects of protecting the information collected as part of health care.
Privacy	Privacy is both a legal and an ethical concept. The legal concept refers to the legal protection accorded to an individual to control both access to and use of personal information and provides the overall framework within which both confidentiality and security are implemented.
Accountability	completeness and correctness of data to maintain its integrity.
Responsibility	Sharing of data is not harmful to the public interest or the national interests and security, and does not affect the privacy and ownership rights of individuals.
Confidentiality	Confidentiality measures protect information from unauthorized access and misuse.
Transparency	Transparency implies actions of openness and accountability while maintaining security. Transparency doesn't imply success or failure of information security; it dictates actions at questionable cross roads.
System Architecture	A system architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.