REPUBLIC OF UGANDA
MINISTRY OF HEALTH

THE UGANDA HEALTH INFORMATION EXCHANGE AND INTEROPERABILITY GUIDELINES

JANUARY 2023

Foreword

The Government of the Republic of Uganda recognises the use of Information and Communication Technology (ICT) in the National Development Plan III 2020/21 - 2024/25 as an enabler to improving the delivery of services to its citizens across its sectors. The Ministry of Health Strategic Plan 2020/21 – 2024/25 also recognises digital health as a key enabler for supporting the health system to deliver good health to the population.

In addition, the Health Information and Digital Health Strategic Plan 2020/21 – 2024/25 guides how to use ICT to facilitate improvement in the flow of information, through electronic means, to support the delivery of health services and the management of the health system in a bid to facilitate universal access to care, health sector efficiency, and social transformation.

The Government of Uganda is committed to improving the application of digital health technologies to facilitate the attainment of its overall objective of delivering high-quality health services to all citizens.

The Government, Partners, and Private institutions have continued to invest in various digital health initiatives. However, most of these initiatives remain fragmented or siloed systems with minimal exchange of health information to enable high-quality health service delivery.

The Health Information Exchange and Interoperability Guidelines present how standards defined in the Uganda Digital Health Enterprise Architecture, Standards and Knowledge Guidelines are to be applied to digital health systems. This will strengthen information exchange in the national health services network to facilitate quality health service delivery and support achieving Universal Health Coverage (UHC).

All stakeholders are therefore called upon to adopt and use these guidelines while implementing digital health initiatives.

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Dr. Henry G. Mwebesa

DIRECTOR GENERAL HEALTH SERVICES

Preface

Interoperability guidelines are a major milestone in the journey towards quality, responsive, accessible, and cost-effective Health Information Services (HIS). A well-developed digital health information system is a fundamental and crucial component of any health system. The use of information exchange is not only a key enabler of direct patient care but also a vital tool in health program monitoring. Therefore, it requires necessary attention and well-planned investment of resources to realise its function. These Health Information Exchange and Interoperability Guidelines generally align with the goals and strategies as stipulated in the Uganda Health Information and Digital Health Strategic Plan 2020/21-2024/25 for strengthening information exchange in the national health services network to facilitate adequate health service delivery support to achieve the Universal Health Coverage (UHC).

In the past decade, health services in Uganda have seen tremendous improvement in technology support. This is a result of both technology evolution and funding in these areas which has been progressively acknowledged by the Ministry of Health (MoH), its partners in health and stakeholders. Following MoH guidance in the planning and implementation of HIS for health services, the Uganda HIE will accelerate the achievement of the expected program benefits towards strengthening health information management in both the Public and Private Sectors. MoH is committed to strengthening the coordination and quality of health information management to support the attainment of Universal Health Coverage (UHC).

All stakeholders are therefore called upon to examine the Health Information Exchange and Interoperability Guidelines, assess their involvement, and thereafter align their present and future health information exchange implementations with the guidelines laid out in this document.

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Dr. Sarah Byakika

Commissioner Health Services

Department of Planning, Financing and Policy

Acknowledgement

The Ministry of Health expresses its profound gratitude to all departments and programs, the Health Information Innovation and Research Technical Working Group (HIIRE TWG) and the Digital Health Subcommittee who contributed technical inputs leading to the successful completion of this document. Special appreciation goes to the Ministry of Health Division of Health Information Management (DHIM) and the Information Communication Technology (ICT) Section for the overall guidance to ensure the guidelines are aligned with the Uganda Health Information and Digital Health Strategic Plan 2020/21-2024/25.

The Ministry of Health acknowledges and thanks all development, implementing and technology partners that provided financial and technical support towards the development of these guidelines, specifically CDC, MUSPH/METS, PATH, HISP and the Technical Assistance Platform (TAP). DHIM is grateful for all the support, sacrifice and contribution invested in the successful development of these guidelines.

Finally, the Ministry of Health is grateful to the Ministry of Information Communication Technology and National Guidance (MoICT&NG), National Information Technology Authority Uganda (NITA-U), Uganda Health Informatics Association (UgHIA), Makerere University and all those institutions and individuals who have not been specifically mentioned above, but who directly or indirectly contributed to the successful development and finalisation of these Health Information Exchange and Interoperability Guidelines.

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Mr. Paul Mbaka

Assistant Commissioner Health Services

Health Information Management

Document Reviews and Approvals

These guidelines shall be reviewed once a year and the changes shall be documented and approved by the relevant authorities. Relevant sections that shall need to be added to the document shall follow the standard MoH approval processes, these shall include: -

- Assign a new version number
- Document the date of approved updates.

Version	**Owner**	**Author**	**Approver**	**Date of Approval** *(MMDDYY)*
01	Ministry of Health	Division of Health Information Management	Top Management Committee	18.09.2024

Abbreviations and Acronyms

API	Application Programming Interface
ANSI/TIA	American National Standards Institute / Telecommunications Industry Association
EMR	Electronic Medical Record
EHR	Electronic Health Record
HIE	Health Information Exchange
HIDH	Health Information and Digital Health Strategic Plan 2020/21-2024/25
HIM	Health Information Mediator
HIIRE	Health Information Innovation and Research
HIS	Health Information System
ICT	Information and Communication Technology
ICD	International Classification of Diseases
IFMIS	Integrated Financial Management Information System
IL	Interoperability Layer
IP	Implementing Partner
IT	Information Technology
MFL	Master Facility List
OHIE	Open Health Information Exchange
PII	Personally, Identifiable Information
SDGs	Sustainable Development Goals
TWG	Technical Working Group
VHT	Village Health Team
OSI	Open Systems Interconnection

Definitions of Terms

Health Information Exchange: is the transfer of electronic health information among information systems based on agreed and recognised standards.

Interoperability: is the ability of different information systems, devices and applications ('systems') to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organisational, regional and national boundaries.

Health Information System: is a system designed to manage healthcare data.

Foundational Interoperability: is the ability of one IT system to send data to another IT system in a manner that the receiving IT system does not necessarily need to be able to interpret the exchanged (received) data, it must simply be able to acknowledge the receipt of the data payload. It's the most basic type of interoperability.

Structural Interoperability: the uniform movement of healthcare data from one system to another such that the clinical or operational purpose and meaning of the data are preserved. To achieve structural interoperability, the receiving system should be able to interpret information at the data field level. This is the intermediate level of interoperability.

Semantic Interoperability: the ability of health IT systems to exchange and interpret information and then actively use information that has been exchanged. This is the highest level of interoperability. Semantic interoperability takes advantage of both the structuring of the data exchange and the codification of the data including vocabulary so that the receiving IT systems can interpret the data.

"New" Organizational Interoperability: includes governance, policy, social, legal and organisational considerations to facilitate the secure, seamless and timely communication and use of data both within and between organisations, entities and individuals.

Digital Health: refers to the use of information and communications technologies in health service delivery.

Client Registry: is a directory that lists all clients and their relevant personal information (names, addresses, etc.). A client registry is designed to assist in uniquely identifying individuals who receive health care services by supporting the centralised storage and retrieval of the client (i.e. patient) identification data and enterprise client identifiers (ECIDs).

Electronic Health Facility Registry: this is an application that allows users to access the list of all health facilities in the country (Master Facility List (MFL)). It provides a focused service to collect, curate, store, and distribute standardised and updated health facility details and resource data to the diverse network of digital health systems in a country.

Health Worker Registry: this is an application that allows authorised stakeholders to access the list of health workers within the various health facilities and the community in the country based on agreed-upon standards. It comprises a minimum dataset on all providers of healthcare services that can be shared with all systems that need them.

Shared Health Record: It is an operational transactional subset of normalised data for a patient from various systems such as Electronic Medical Records (EMRs), Laboratory Information Management System (LIMS) etcetera. This record is queried and updated between the different institutions and systems that are authorised to do so.

Terminology Services: comprises a standardised set of terms explaining what type of service a patient receives, improves communication during clinical procedures, and enables everyone involved in the process of treatment and care to perform more efficiently for the patient's benefit.

HIE Governance: refers to the establishment and oversight of a common set of behaviours, policies, and standards that enable trusted electronic health information exchange among a set of information systems and participants.

Information Model: is a representation of concepts, tools, data flows and the relationships, constraints rules, and operations to specify how systems or data sources are linked.

OSI Model: This is a conceptual framework used to represent how applications communicate over a network.

1. Introduction

1. 1.1 Background

The Government of Uganda through the Ministry of Health (MoH) is committed to leveraging Information and Communications Technology (ICT) in transforming healthcare service delivery in Uganda by enabling information access and supporting healthcare operations, management, decision-making making and policy formulation. This is evidenced by the inclusion of digital health as one of the priorities in the Ministry of Health Strategic Plan [1], listing ICTs as a key enabler for supporting better healthcare service delivery. This has been expounded in the Uganda Health Information and Digital Health Strategic Plan 2020/21-2024/25 [2] whose goal is to strengthen the health information system by leveraging digital health to support health service delivery that achieves Universal Health Coverage (UHC) by 2030.

Health information systems have proved valuable in supporting patient care and improving population health outcomes by making data readily available for decision-making at all levels of the health sector. However, these health information systems are typically isolated within communities, hospitals, clinics, laboratories, district offices, partners, pharmacies, or other organisations. This results in fragmented health records and reports, with each component separate and unlinked from the other. Ultimately, this fragmentation may prevent timely access to necessary information leading to duplication and delayed decision making hence the need for standardised and interoperable health information exchange (HIE). HIE is the secure electronic transfer of health information among healthcare organisations using nationally recognised communication protocols and safety standards.

The implementation and use of HIE technology have influenced patient care by allowing providers direct access to health information, reducing the time to obtain this information, and increasing providers' awareness of patient interactions with the health care system.[1] From a broader provider and patient perspective, timely sharing of a patient's clinical information can improve the accuracy of diagnoses, reduce the number of duplicative tests, improve patient safety by reducing medication and medical errors, increase efficiency by eliminating unnecessary paperwork and handling, provide caregivers with clinical decision support tools for

[1] Dixon, Brian & Rahurkar, Saurabh & Apathy, Nate. (2020). 'Interoperability and Health Information Exchange for Public Health.'

more effective care and treatment, engage healthcare consumers regarding their personal health information, improve healthcare quality and outcomes; and reduce health-related costs. From a public health perspective, the exchange of health information fosters a positive relationship with public health agencies, improves public health surveillance, improves public health reporting, and monitoring, and increases the efficiency and quality of public health reporting.

In Uganda, several health information exchange modalities are being used to aid information exchange across systems and organisations; These range from Application Programming Interfaces (APIs), ETL (Extract, Transform, Load) tools, and OpenHIE architecture. In the past years, the HIE modalities faced challenges such as disparate and non-interoperable information technologies, the use of different formats and conventions to exchange health data, no set prior standards, lack of capacity, and a variety of governance challenges around information sharing.

Therefore, there is a need to standardise HIE bearing in mind the known limitations and preconditions as well as provide guidance on best-known practices. These are used to address a specific clinical health interoperability/HIE need such as providing the ability to seamlessly access clients' information generated by different HIS and the possibility of progressively enriching the data at different locations whenever the clients interact with health systems across the country.

The goal of HIE is to facilitate the secure and seamless exchange of patient health information in a standardised format, ensuring that relevant and timely data is available.

It is against this background that the Ministry of Health has developed Guidelines for Health Information Exchange and Interoperability.

2. 1.2 Review of Health Information Exchange

Over the past two decades, large investments in the health sector have led to an increase in the deployment of digital health solutions in Uganda. Most of these solutions are limited in scale, likely to be proprietary and operate in isolation. Lack of interoperability has been recognized as a critical obstacle to realising the potential benefits of digital health in the country.

There have been ad-hoc attempts to implement HIE use cases within the sector, such as data exchange within some aggregate reporting systems, EMRs exchanging data with the national Viral Load Information System, and surveillance mTrac system exchanging data with the

national eHMIS system, among others. However, all these were not premised on nationally endorsed HIE and Interoperability guidelines.

Given the benefits and success stories of implementing health information exchange in some African countries like Rwanda[2] where Individual Patient Care (Clinical) for HIV disease management was improved and the healthcare administration of facilities was further made more efficient.

The Government of Uganda has made considerable efforts to spell out the overall vision of how different sectors including the health sector would be exchanging information in the Uganda e-Government Interoperability Framework[3]

MoH as a custodian of the healthcare system in the country has embarked on developing its national HIE and Interoperability guidelines to ensure that health data collected is capable of being shared and facilitate primary and secondary uses of patient health information (i.e. any health data collected should be available to appropriate users to improve health outcomes).

It is also important that for any two or more heterogeneous systems to exchange data meaningfully, there must be a mutual standard for data exchange or communication between those systems. Health information exchange standards provide clear guidelines for robust and interoperable solutions.

Therefore MoH shall advocate for the use of proven free and open standards, open innovation, open data and where feasible open software, and collaborate with open software organisations to extend existing products to meet HIE needs.

3. 1.3 Document Development Process

The development of the guidelines was carried out by the Digital Health Subcommittee of the Health Information Innovation and Research (HIIRE) Technical Working Group (TWG) in consultation with various committees within MoH and other stakeholders from MDAs, Academia, as well as Development, Implementing and Technology partners.

[2] HIE, O. (2023) 'Creating a Health Information Exchange System in Rwanda'. Available at: https://ohie.org/impact-stories/creating-a-health-information-exchange-system-in-rwanda/
[3] NITAU (2021) 'Uganda e-Government Interoperability Framework (e-GIF)'. Available at: https://www.nita.go.ug/sites/default/files/2023-03/e-GIF.pdf.

Feedback from the various stakeholders was incorporated into the document during the development, validation and approval process.

Reference was made to the Uganda Digital Health Enterprise Architecture, Standards and Knowledge Guidelines [4], the African Union Health Information Exchange Guidelines and Standards [26], internationally recognised standards and guidelines governing HIE and Interoperability that include system standard guidelines, communication and connectivity protocols, messaging standards, and vocabulary standards.

The guidelines were then presented to the HIIRE TWG and the Senior Management Committee for endorsement and then to the Top Management Committee for approval.

4. 1.4 Purpose and Scope of Document

The purpose of HIE is to facilitate the secure, standardised and efficient exchange of electronic health information between digital health systems enabling seamless access to patient data for improved care coordination, patient safety, and healthcare outcomes.

Therefore, this document outlines the guidelines to develop and implement health information exchange and interoperability for digital health systems in Uganda. Whilst the health sector may use a combination of both paper-based and digital exchange solutions for interactions, this document focuses on electronic data, digital data exchange, and protocols to assist the MoH in defining and specifying a framework to guide its long-term implementation of the Health Information and Digital Health Strategic Plan (2020/21-2024/25) [2].

5. 1.5 Target Audience

The document is intended for:

i. Policymakers at all levels.
ii. System Developers and Integrators.
iii. Health and Information Practitioners.
iv. Project and Program Managers.
v. System Implementers.
vi. Researchers and Academia.
vii. Implementing and Development Partners.
viii. Information and Systems Key Stakeholders.

ix. Ministries, Departments and Agencies

x. Private Sector

2. Section A: HIE & Interoperability Guidelines for Digital Health Systems

This section describes the system standard guidelines, communication and connectivity protocols, messaging standards, and vocabulary standards for health information exchange.

6. 2.1 Systems Standard Guidelines

The MoH aspires towards a more integrated, open, and flexible digital health solution. Specifically, common global goods have been recognized across public and private entities as a fundamental course of action towards building interoperable, cost-effective, easy-to-use infrastructure components.

However, digital solutions must be tailored to national needs, circumstances, and resources. Each solution should support incremental extension into a fully integrated national health information system without substantial reengineering. It is not practical to either discard the existing systems or have only one system in place to solve the interoperability problem given that we have many siloed or fragmented systems. At the same time, the MoH encourages the use and application of newer and more modern technologies that have proven real-world application to maximise long-term benefits.

7. 2.2 Communication and Connectivity Protocols

The following communication protocols for digital health systems communications shall be implemented;

Guidelines for Communication Protocols:

1. For sensor communications, standards ISO/IEEE 11073-10101 (Nomenclature) [5], IEEE 11073-10201™ (Domain information model) [6] and IEEE 11073-20101™ (Application profile base standard) [7] shall be used for supporting interoperable communication among sensor devices and computers.
2. For secure internetworking between entities and local area networks, use transport protocols guided in Section B.

3. The health sector shall adopt ANSI/TIA-1179-A [8] for standardised connected health systems. MoH shall ensure that implementing entities procure end-user ICT devices that meet the recommended specifications for all health service delivery points as stipulated in the Uganda Digital Health Enterprise Architecture, Standards and Knowledge Guidelines.
4. Personal data including health data-sharing shall be conducted securely as stipulated in the Data Protection and Privacy Act 2029 and further elaborated in the Uganda Health Data Protection, Privacy and Confidentiality Guidelines [9].

8. 2.3 Messaging Standards

The internationally known comprehensive and robust data exchange standards shall be used. Below are the messaging standards that shall be adopted.

Messaging Standard 1: HL7/FHIR

Definition: Health Level 7 (HL7) Fast Healthcare Interoperability Resources (FHIR) [10] shall be the standard for the exchange of healthcare information. Based on modern design patterns like RESTful communication and the concept of Resources, FHIR covers a broad range of clinical use cases by providing modular building blocks that can be combined without jeopardising information integrity. The built-in methods for extending a Resource allow FHIR to provide flexibility and adaptability in the clinical environment. FHIR combines the best features of HL7v2, HL7 V3R2 CDA, and web standards (XML, JSON, HTTP, Atom, and others).

Objective: To ensure communication between systems that document and manage the care and treatment of patients in a wide variety of healthcare settings.

Guidelines:

1. For public health and clinical content messaging, FHIR and HL7 V2.5.1 and above shall be used.
2. FHIR/HL7 shall be used to facilitate the exchange of healthcare data about admission data, discharge/transfer data, clinical encounters and observations, treatments, prescriptions and dispensing, orders and results of laboratory tests, and appointment schedules among heterogeneous healthcare systems.

3. For clinical content and structure (including clinical summaries, discharge notes, laboratory, and radiology investigation), use HL7 V3R2 Clinical Document Architecture (CDA). Additionally, the HL7 Continuity of Care Document for the exchange of clinical information, including patient demographics, problems, medications, and allergies shall be used.

Messaging Standard 2: DICOM

Definition: Digital Imaging and Communications in Medicine (DICOM) [11] is a file format and transmission standard for exchanging medical images and associated information between medical imaging equipment made by different manufacturers. The DICOM standards are widely adopted in equipment and information systems used in hospitals, imaging centres, and providers' offices to produce, display, store, or exchange medical images.

Objective: To ensure medical images and associated information are stored, queried, retrieved, and transferred between imaging machinery and information systems in an interoperable manner.

Guideline:

1. For the exchange of digital medical diagnostic images, Use DICOM to facilitate the sharing of images such as radiology, radiotherapy, ophthalmology, ultrasound, digital mammography, pathology, dentistry, dermatology, computed tomography, etc, between imaging equipment and other healthcare applications. It specifies data structure as well as the protocols for the exchange of medical images, among others.

Messaging Standard 3: Aggregate Data e-Xchange (ADX)

Definition: ADX is a messaging standard that shall be used to exchange health indicators, aggregate data and metadata. It is derived from SDMX (statistical data and metadata exchange) and based on XML [12].

Objective: To support automated aggregate data exchange of health indicators, aggregate data and metadata with the national eHMIS and other health information systems.

Guidelines:

1. Aggregate Data eXchange (ADX) profile shall be used to support the exchange of health indicators, aggregate data, metadata, etc. The details for the ADX profile shall provide

a formal specification by the data owners (user departments), to guide the generation and exchange of aggregate data from systems.

2. The reporting frequency shall be determined by data owners (user departments).
3. Metadata (data element names, codes, disaggregates, etc) shall be determined by data owners (user departments).

9. 2.4 Vocabulary Standards

Vocabulary standards facilitate semantic interoperability between health providers and systems. The Ministry of Health adopted the following international vocabulary standards that cover business processes and services for the health sector such as SNOMED-CT, ICD-11, LOINC, RxNorm, and DSM.

MoH shall develop, manage and control a national healthcare data dictionary as a central repository for the terminology service. Below is guidance on the use of the contextualised standards;

Vocabulary Standard 1: SNOMED-CT

Systematized Nomenclature of Medicine - Clinical Terminology (SNOMED-CT) shall be the standard used to support coding terms and synonyms for clinical findings, symptoms, diagnoses, procedures, pharmaceuticals, etc. It has an inbuilt mechanism to cater for local extensions and different languages [13].

Vocabulary Standard 2: ICD-11

International Classification of Disease (ICD-11) shall be used for classifying diseases, health conditions, causes of death, clinical terminology, and coding standards [14].

Vocabulary Standard 3: LOINC

Logical Observation Identifiers Names and Codes (LOINC) shall be the standard used for coding laboratory test reports. LOINC codes can be integrated into the data message content such as HL7 V2.5.1 and HL7 CDA for standardising laboratory reports such as chemistry, haematology, serology, microbiology, and toxicology as well as cell counts, antibiotic susceptibilities, and others [15].

Vocabulary Standard 4: RX-Norm

RX-Norm shall be the standardized naming system to codify clinical drugs to allow computer systems to communicate drug-related information efficiently and unambiguously. RxNorm

provides normalised names for clinical drugs and links its name to many drug vocabularies commonly used in pharmacy management and drug interactions [16].

Vocabulary Standard 5: Diagnostic and Statistical Manual of Mental Disorders (DSM).
Diagnostic and Statistical Manual of Mental Disorders (DSM) shall be used as the nomenclature that clinicians can reference to enhance clinical practices and as a language for communicating diagnostic information. It contains descriptions, symptoms and other criteria for diagnosing mental disorders [17].

Guidelines for Vocabulary Standards:

1. All users shall ensure they are using the latest copy/ version of the vocabulary standard adopted by MoH.
2. MoH guides that reference to international authorities behind these standards as a source e.g., WHO (ICD11), SNOMED-CT, OCL (Open Concept Library), etc.
3. All users shall ensure that all data elements are mapped to the correct codes.
4. Modalities shall be put in place for MoH and other stakeholders to ensure that the proper skill sets are in place to support the implementation of the vocabulary data elements and codes (for example, workshops facilitated by experts, online training, and community meetings, among others)
5. Public health vocabulary data to support MoH messaging system development, sharing with potential digital health system users, and dissemination of the latest vocabulary and terminology information.

3. Section B: Governance Foundations for HIE and Interoperability Standards

Governance for digital health aims to harmonise, and strengthen the capabilities and skills needed for countries to promote, innovate and scale up digital health technologies. Currently, the MoH coordinates the implementation of this digitization effort and is charged to the DHIM, Department of Planning, Financing and Policy with strategic advice and support from the HIIRE TWG. The HIIRE TWG has constituted a Digital Health sub-committee that provides technical advisory guidance and support to the HIIRE TWG in the implementation and coordination of digital health aspects like health information exchange and interoperability. The HIIRE TWG comprises representation from MoH departments, implementing and development partners, technology partners, academia, private sector, and civil society organisations.

3.1 HIE & Interoperability Development Principles

As guiding principles for the HIE & Interoperability, the following Principles for Digital Development [24] were adopted and shall be followed;

1. Design with the user
2. Understand the existing ecosystem
3. Design for scale and national adoption
4. Build for sustainability
5. Be data-driven
6. Use of appropriate open standards, open source, open data and open innovation
7. Reuse and improve
8. Address privacy and security
9. Be collaborative

10. 3.2 Standards Management

MoH shall ensure that HIE & Interoperability guidelines are followed and adhered to by all implementers of health information exchange and interoperability.

As and when the need arises, MoH shall convene working groups to continually review these standards and to evolve these standards in a thoughtful and controlled fashion.

11. 3.3 Messaging Exchange Standards Support

MoH shall lead and coordinate the establishment of a message testing environment and the development of a message validation tool to validate messaging implementations and associated vocabularies. As part of message processing, the following minimum functions shall be observed;

- Assign a unique anonymous identifier to case-based records traversing the system; this shall prevent the potential duplication of MoH unique case identifiers.
- Exclude PII as needed when sharing and re-transmitting data as may be required.
- Reformat messages into the appropriate recipient-required format (e.g. Unified Messaging and Collaboration System (UMCS), email, secure file, or web page message).
- Enforce the quality of message structure and content.

12. 3.4 Protocols and Services for Interoperability

The following interoperability service areas are critical to achieving digital health systems interoperability. Each service area as briefly described below should comply with the latest version of the corresponding RFC standard or equivalent service, when and as adopted by the MoH. The initially recommended standard for 2020 is identified below as the baseline for interoperability evolution over time.

MoH guides that all implementers of health information exchange and interoperability shall use known and standard secure transfer protocols e.g., File Transfer Protocol over Transport Layer Security (FTP-TLS) [18], Simple Mail Transfer Protocol (SMTP) over Transport Layer Security (SMTP-TLS) [19], Hypertext Transfer Protocol over Transport Layer Security (HTTP-TLS) [20], SSH Tunnels, SFTP [20], etc.

MoH recommends the use of Representational State Transfer (REST) [21] to support access (GET, POST, PUT, PATCH and DELETE) to facilitate system-to-system and user-to-system services exchange using HTTP APIs.

13. 3.5 Support HIE Platform Best Practices

- HIE platform(s) shall be housed in secure facilities with controlled access for only authorised personnel.
- The HIE platforms shall be protected from unauthorised access.
- HIE platforms shall ensure role-based access for system security purposes.

- Staff managing infrastructure related to HIE shall be trained per the training schedule with the responsibilities stipulated.
- Any HIE incident shall be reported promptly within 24 hours for further action.
- Security of HIE systems shall be implemented through the use of system logs or audit trails
- Access to the HIE systems shall be by authorised users.
- All systems required to exchange health data shall be authenticated.
- A secure, remote recovery/backup site should be available in the event of damage to, or loss of, the primary HIE platform and/or facility.
- MoH shall promote research and development in line with HIE.
- Software and system updates shall be tested and verified on a separate (but potentially scaled down) staging system before deployment and use.

4. Section C: Monitoring and Evaluating the Uganda HIE & Interoperability Guidelines

This Section outlines how to monitor and evaluate the implementation of HIE & Interoperability Guidelines and the impact of the HIE. The implementation of the HIE & interoperability guideline and its impact shall be based on the monitoring and evaluation. This is based on the Monitoring and Evaluation framework stipulated in the Uganda Health Information and Digital Health Strategic Plan 2020/21-2023/24 which is essential for compliance and effectiveness of the guideline. Therefore; the guideline shall be monitored in terms of the:-

- Dissemination of the guideline
- Compliance with the guideline
- Technical capacity building on the usage

The HIE platform shall be monitored based on the following: -

- Number of systems connected to the HIE disaggregated by prioritised patient workflows like patient flow, products and commodities, and aggregate report generation.
- Number of facilities integrated on the HIE platform such as financial institutions, health service providers, payers, and government agencies.
- Number of transactions on the health information exchange in the health information mediator including HISs.
- Number of reported and resolved complaints.
- Percentage uptime of the HIE platform.

The following considerations shall also be made;

1. There shall be routine auditing of systems connected to the HIE platform to ensure compliance with the guidelines and standards.
2. There shall be documentation of the process of resolution of cases.
3. There shall be product assurance- conformity assessment.

A checklist shall be developed to monitor the compliance of implementers with the guidelines.

4.1 Dissemination and adoption of the guidelines

The HIE & Interoperability guidelines shall be disseminated for adoption through:

1. Presentation of the guidelines to stakeholders.
2. Posting of the guidelines on the MoH websites and the electronic Library for access by the stakeholders.
3. Organising quarterly workshops to train stakeholders and innovators.

5. Section D: Sustaining the Health Information Exchange

This section outlines the approaches, strategies, tools and methods that the MoH shall adopt to sustain the health information exchange and interoperability processes, and practices to achieve the UHC goals and the Uganda HIDH Strategic Plan 2020/21 - 2024/25. To effectively implement an HIE more sustainably is not only necessary but also shall support MoH and partners to achieve their long-term impact on improved health outcomes.

Overall the Ministry of Health shall work with the Ministry of Information Communication Technology and National Guidance (MoICT&NG) and the National Information Technology Authority Uganda (NITA-U) as a means to achieve the overarching Republic of Uganda Government Enterprise Architecture (GEA), Digital Government Strategy (NITA, n.d.) and E-Government Interoperability Framework (E-GIF) goals and objectives.

This section highlights the basic tenets of sustainability: capacity building; ensuring user and stakeholder contributions are not minimised due to interruptions such as loss of funding; and creating solutions more likely to be embedded into policies, daily practices, and workflows.

A Sustainable Business Model for Uganda HIE

HIEs need high performance, high availability, reliable ICT infrastructure and compatible future technologies. MoH shall utilise its existing infrastructure and data centres provided by the Government of Uganda to host the HIEs at the national and district levels. At the facility level, MoH shall utilize the existing infrastructure to host the individual EMRs at the health facilities. MoH is encouraged to critically evaluate and address the following;

- Procurement framework as per the Public Procurement and Disposal of Public Assets Act 2003, and the NITAU Procurement of ICT Goods and Product Guidelines that

includes content that guides infrastructure procurement, disposal, replacement, upgrade, and other pursuits related to ICT infrastructure maintenance.

- Alignment with the Data Protection and Privacy Act 2019 and the Health Data Protection, Privacy and Confidentiality Guidelines.
- Budget development to encompass monetary quantification of infrastructure initial cost and subsequent operational cost.
- Linkage to the country's digital health investment framework, which possibly adopts common principles such as collaboration, digital global goods, participatory budgeting, instrument tracking plan, and overall capacity building on technical skills for digital health.
- HIE facilitates the interoperability of health information systems allowing for collaboration and information sharing within and across organisational boundaries to advance the health of individuals and communities and the effective delivery of health care to them. Implementing a fully functional HIE infrastructure and ecosystem is no mean feat and requires the presence and interplay of several fundamental components. Indeed, investment in HIE should be considered within the wider digital health ecosystem. The WHO and ITU eHealth strategy toolkit highlights the need to understand a country's "national context for eHealth" when considering digital health investment (TAP).
- Linkage with other sector information management systems as guided in the e-Government Interoperability Framework.

6. Section E: References

1. (MoH), M.o.H., *Ministry of Health Strategic Plan 2020/21 - 2024/25*. 2020, Ministry of Health (MoH): Kampala.
2. MoH, M.o.H., *Health Information and Digital Health Strategic Plan (2020/21-2024/25)*. 2023.
3. Bowen, R., et al., *HIE management and operational considerations.* J ahima, 2011. **82**(5): p. 56-61.
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