

FAIR Equivalency with Regulatory Framework for Digital Health in Ethiopia

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ABSTRACT

This paper investigates whether or not there is a policy window for making health data ‘Findable’, ‘Accessible’ (under well-defined conditions), ‘Interoperable’ and ‘Reusable’ (FAIR) in Ethiopia. The question is answered by studying the alignment of policies for health data in Ethiopia with the FAIR Guidelines or their ‘FAIR Equivalency’. Policy documents relating to the digitalisation of health systems in Ethiopia were examined to determine their FAIR Equivalency. Although the documents are fragmented and have no overarching governing framework, it was found that they aim to make the disparate health data systems in Ethiopia interoperable and boost the discoverability and (re)usability of data for research and better decision making. Hence, the FAIR Guidelines appear to be aligned with the regulatory frameworks for ICT and digital health in Ethiopia and, under the right conditions, a policy window could open for their adoption and implementation.

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ACRONYMS

eHA	eHealth Architecture
FAIR	Findable, Accessible, Interoperable, Reusable
FE-Score	FAIR Equivalency Score
HMIS	Health Management Information System
HSTP	Health Sector Transformation Plan
ICT	information and communication technology
M&E	monitoring and evaluation
VODAN	Virus Outbreak Data Network

1. INTRODUCTION

Globally, health systems have been using digital technologies for more than 50 years. Early practices focused on electronic systems for the collection of data at points of service and the aggregation of information across different organisational levels of the health system. With the advent of the Internet, artificial intelligence, genomics and other aspects of the Fourth Industrial Revolution, the health sector has shown remarkable progress in the use of digital technologies and in generating big data [1]. To enhance data use, it is recommended that databases be federated [2] and that the data generated from different federated systems be stored in a defined data repository, so that stakeholders can make use of the data according to clearly defined data sharing and access policies [3].

Although the demand for data and information in low and middle-income countries is poor, data collection by health systems is growing [4]. National and sub-national repositories store a high inflow of data, sometimes without any framework or governance in place to check its quality and use by different stakeholders. In Ethiopia, digital health information systems have been used since 2008 [5], with the introduction of electronic medical records (EMRs) called ‘Smart Care’ and the Electronic Health Management Information System (eHMIS). After nearly 10 years of uncontrolled and ungoverned health information, the Government of Ethiopia commenced an ‘information revolution’ to introduce interoperability among the disparate systems, enhance data sharing, and ensure privacy and data security through an infrastructure based on a systematic enterprise architecture. Towards this end, the Government of Ethiopia has developed an Information Revolution Roadmap [6], a blueprint to improve methods and practices of collecting, analysing, presenting, and disseminating information, which is part of the Health Sector Transformation Plan I (HSTP I) (2015–2020) [7] and HSTP II (2020–2025) [8]. The information revolution mentioned in these plans could provide fertile ground for the adoption and implementation of FAIR Guidelines.

The FAIR Guidelines require the datasets stored in different repositories, in different geographical locations, and across disciplines to be Findable, Accessible, Interoperable, and Reusable (FAIR). However, research data, patient data, and other digital resources are currently siloed and resided in either local or cloud repositories, making it difficult, if not impossible, for them to be found and retrieved by researchers. The FAIRification of data would allow the automatic discovery and analysis of data by machines and humans [9].

It is seldom possible to find the four FAIR Guidelines together in any of the policies, strategies, or plans in Ethiopia. These documents usually mention vocabularies or phrases semantically similar to the FAIR Guidelines separately: findability and accessibility appear more often in information roadmaps and strategies, whereas interoperability and reusability are emphasised in the eHealth Architecture (eHA). The digitalisation of health systems in Ethiopia has become a centre piece of discussions between the Federal Ministry of Health and the various health sector stakeholders. The findability, accessibility, interoperability, and reusability of data and services is believed to be vital to information-driven decision making in health facilities. Therefore, it would be beneficial to include the FAIR Guidelines in the regulatory frameworks for information and communication technology (ICT) and digital health in Ethiopia.

The FAIR Guidelines do not represent any specific standard, technology, protocol, or solution—they are technology independent. These guidelines are enablers of the digital health revolution and expected to overcome the fragmentation of digital health data and services [10]. This study aims to assess the extent to which health-related documents in the eHealth sector in Ethiopia mention the FAIR Guidelines or FAIR Equivalent principles, thereby determining whether or not a policy window is open for the adoption and implementation of the FAIR Guidelines in Ethiopia.

2. THEORETICAL FRAMEWORK

For new ideas to reach the public policy agenda it is necessary for the problem stream, the policy stream and the political stream to come together [11]. The problem stream relates to the problem identified as worthy of consideration, the policy stream considers the available policy options to address the problem, and the political stream looks at the importance of any one problem at any point in time. Kingdon considers that the policy agenda is a dynamic social process in which people within and outside the administration have a role to play as, what he calls, ‘policy entrepreneurs’ [11]. These can be people in the administration, but also experts, stakeholders or interest groups outside the administration. The level of convergence around the problem between people engaging with the policy agenda can be referred to as cultural entropy; this can be regarded as a measure of convergence around values that constitute a particular problem [10].

3. EVOLUTION OF ICT AND DIGITAL HEALTH POLICIES IN ETHIOPIA

The use of ICT infrastructure and solutions in the Ethiopian health system started 15 years ago with the introduction of standardised routine health information indicators and Microsoft Excel spreadsheets for data collection. Since then, several efforts have been made to expand this by introducing electronic system applications at different levels of the health system. The 2014–2015 National Assessment on eHealth Applications identified the fragmentation and duplication of efforts in the implementation of different health information systems in Ethiopia. To address this problem, the government introduced the ‘One plan, one budget and one report’ policy to track initiatives in one pipeline. Accordingly, using the Information Revolution Roadmap [6] as an umbrella document, the national and sub-national offices and agencies of the Federal Ministry of Health prepared different domain-specific policies, strategies and directives. Most

of these documents focus on establishing a resilient health information system that capacitates service delivery towards universal health coverage.

To understand how ready Ethiopia's digital health sector is to adopt the FAIR Guidelines it is necessary to understanding the regulatory framework for digital health in Ethiopia. Ethiopia's national eHealth vision is mainly set out in two documents: the Information Revolution Roadmap [6] and the eHealth Architecture (eHA) [12]. The Information Revolution Roadmap consists of two pillars: (i) cultural change to health information systems, and (ii) the digitalisation and scaling up of health information systems [6]. Each pillar embraces several focus areas with actionable and measurable interventions. The first pillar, cultural change, is focuses on data usage culture and the second pillar, digitalisation and scaling up of health information systems focuses on point of service systems. Frontline data demands and information use, increasing the availability and quality of data, data comparability and synthesis across multiple information sources, the reinforcing of data transparency and openness, and fair and secure patient data sharing are among the many interventions in health information systems under cultural change.

The second document, the eHA, replaces the current obsolete health system and operating procedures with a blueprint that sets out the business, data, technology and process principles to be used in every component and participating system [12]. The eHA envisions smooth communication among health systems and furthers the goals of the Information Revolution Roadmap by creating new applications in different layers of the architecture and realising standardised data sharing and interoperability. The eHA encourages implementers to use any technology and innovation, as long as they use the agreed business processes and principles, with uniform terminology and standards for data.

4. METHODOLOGY

4.1 Study Design

This replication study analysed ICT and digital health-related policy documents published by different ministries and government bodies in Ethiopia from 2008 to 2021 to determine the degree to which they are compliant or aligned with the FAIR Guidelines. The methodology is replicated from Basajja et al. [13].

4.2 Identification of Relevant Documents

A desk review was conducted to identify the policies, strategies, and planning documents that provide the basis for digital health activities in Ethiopia. The following 13 documents were selected to investigate the research question in this study.

- Health Management Information System (HMIS)/Monitoring and Evaluation (M&E)—Strategic Plan for Ethiopian Health Sector (2008)
- mHealth in Ethiopia: Strategy for a New Framework (2011)
- Health Sector Transformation Plan I (2015/16–2019/20)
- Information Revolution Roadmap I (2016)

- Health Information Technology Directive—ICT Policy (2017)
- Ethiopian Public Health Institute Guideline for Data Management and Sharing (2017)
- Consultation on the Recommendations and Working Text of the National Open Data Policy of the Government of Ethiopia (2018)
- Ethiopian eHealth Architecture (2019)
- Information Revolution Roadmap II (2020)
- National Health Data Access and Sharing Directive (2020)
- Health Sector Transformation Plan II (2020/21–2024/25)
- National Digital Health Strategy (2020–2029)
- Health Information System Strategic Plan (2020/21–2024/25)

These documents were chosen because they are the most recent ICT and digital health-related documents in Ethiopia, except for the ‘Health Management Information System (HMIS)/Monitoring and Evaluation (M&E)—Strategic Plan for Ethiopian Health Sector’, which was published in 2008. The documents consist of two policies, four strategies, one guideline, two roadmaps, one architecture, two plans, and one directive—which are collectively referred to as ‘policy documents’ hereafter. These policy documents were drafted and published by, or under, the Federal Government of Ethiopia. Among the 13 documents, 11 were obtained from the Federal Ministry of Health, 1 from the Ethiopian Public Health Institute, and 1 from the former Ministry of Communication and Information Technology, currently known as the Ministry of Innovation and Technology. Two policy documents—the Health Sector Transformation Plan I and Information Revolution Roadmap I—were excluded because they have been updated by the Health Sector Transformation Plan II and Information Revolution Roadmap II. Therefore, a sample of 11 policy documents were analysed (see Table 1).

4.3 Coding-Labeling Method

A coding-labelling method was used to analyse the selected policy documents to determine whether or not the FAIR Guidelines were mentioned. FAIR are domain-independent, high-level guidelines that were designed by minimally defining each principle [14]. Therefore, the policy documents that contain vocabularies or phrases with an intent semantically similar to either of the four FAIR Guidelines were considered as FAIR Equivalent.

After collecting the terms from each policy document, the data were arranged in a tabular form, with the policy documents as rows and the FAIR Guidelines (labelled as F, A, I, R) as columns. In addition, each policy document was analysed against the four guiding principles by pinpointing the FAIR Equivalent terms or phrases (statements) in the documents. Hence, each policy document was assigned the binary code ‘1’ if the FAIR Guidelines or FAIR Equivalent terms were mentioned and ‘0’ if they were not mentioned (see Table 2).

Table 1. Policy documents analysed for this study.

No	Document	Code	Type of document	Year	Source	Web address
1	Health Management Information System (HMIS)/ Monitoring and Evaluation (M&E)—Strategic Plan for Ethiopian Health Sector	PD1	Strategy	2008	Federal Ministry of Health	https://phe-ethiopia.org/resadmin/uploads/attachment-58-Health_Management_Information_System_(HMIS).pdf
2	mHealth in Ethiopia: Strategy for a New Framework	PD2	Framework	2011	Federal Ministry of Health	http://bibalex.org/baifa/en/resources/document/452566
3	Health Information Technology Directive—ICT Policy	PD3	Policy	2017	Federal Ministry of Health	Grey literature
4	Ethiopian Public Health Institute Guideline for Data Management and Sharing	PD4	Guideline	2017	Ethiopian Public Health Institute	Grey literature
5	Consultation on the Recommendations and Working Text of the National Open Data Policy of The Government of Ethiopia	PD5	Policy	2018	Federal Ministry of Health	https://www.coursehero.com/file/53379414/Draft-Open-Data-Policy-and-Guidelinepdf/
6	Ethiopian eHealth Architecture	PD6	Architecture (draft)	2019	Federal Ministry of Health	Grey literature
7	Information Revolution Roadmap II	PD7	Roadmap	2020	Federal Ministry of Health	http://repository.iifphc.org/bitstream/handle/123456789/316/Information%20Revolution%20Roadmap.pdf?sequence=1&isAllowed=y
8	National Health Data Access and Sharing Directive	PD8	Directive (final draft)	2020	Federal Ministry of Health	Grey literature
9	Health Sector Transformation Plan II	PD9	Plan (draft)	2020	Federal Ministry of Health	http://www.moh.gov.et/am/node/152
10	National Digital Health Strategy	PD10	Strategy (draft)	2020	Federal Ministry of Health	Grey literature
11	Health Information System Strategic Plan	PD11	Strategy (draft)	2020	Federal Ministry of Health	Grey literature

Note: PD = policy document. Documents which have not been published or uploaded online are referred as ‘grey literature’; all of the policy documents in this table were in force at the time of this study in one way or another.

4.4 FAIR Equivalency Score

The policy documents were further investigated to determine their degree of FAIR Equivalence. This was done by checking the occurrence of the 15 FAIR facets in the documents. These are Findability (‘F1’, ‘F2’, ‘F3’, ‘F4’); Accessibility (‘A1’, ‘A1.1’, ‘A1.2’, ‘A2’); Interoperability (‘I1’, ‘I2’, ‘I3’) and Reusability (‘R1’, ‘R1.1’, ‘R1.2’, ‘R1.3’), as presented by Wilkinson et al. [14] and depicted in Appendix 1.

Table 2. Mention of FAIR Guidelines or FAIR Equivalent in selected policy documents.

Policy document	FAIR Mention	FAIR Equivalent
HMIS/M&E—Strategic Plan for Ethiopian Health Sector	0	1
mHealth in Ethiopia: Strategy for a New Framework	0	1
Health Information Technology Directive—ICT Policy	0	1
Ethiopian Public Health Institute Guideline for Data Management and Sharing	0	1
Consultation on the Recommendations and Working Text of the National Open Data Policy of the Government of Ethiopia	0	1
Ethiopian eHealth Architecture	0	1
Information Revolution Roadmap II	0	1
National Health Data Access and Sharing Directive	0	1
Health Sector Transformation Plan II	0	1
National Digital Health Strategy	0	1
Health Information System Strategic Plan	0	1
Total	0	11
Percent (%)	0	100

Following Basajja et al. [13], a detailed and comprehensive analysis of the mention of the FAIR facets in each of the policy documents was carried out using a coding-labelling approach. In this analysis, mention of a FAIR facet was labelled by appending the code of the appropriate facet (i.e., ‘F1’, ‘F2’, ‘F3’, ‘F4’; ‘A1’, ‘A1.1’, ‘A1.2’, ‘A2’; ‘I1’, ‘I2’, ‘I3’; ‘R1’, ‘R1.1’, ‘R1.2’, or ‘R1.3’) to the corresponding statement. The policy documents were arranged in rows while the FAIR facets were arranged in columns. For each policy document, the mention of FAIR facets was labelled ‘1’, while lack of mention was labelled ‘0’ in the corresponding data cell of the Microsoft Excel spreadsheet (see Table 3). From this data, the FAIR Equivalency Score (FE-Score) was calculated by adding the occurrence of all facets per policy document, with the maximum score equal to the total number of FAIR facets, which is 15.

5. RESULTS

5.1 Mention of FAIR Guidelines

None of the policy documents analysed mentioned the FAIR Guidelines, however, all (100%) contained FAIR equivalent terminology (Table 2).

5.2 FAIR Equivalency Score

The policy documents were thoroughly reviewed for the mention of the 15 FAIR facets (Findability: F1, F2, F3, F4; Accessibility: A1, A1.1, A1.2, A2; Interoperability: I1, I2, I3; and Reusability: R1, R1.1, R1.2, R1.3). The following facets were mentioned, presented in descending order from most to least mentioned: R1.3 (91%, n=10); A1, I1 (82%, n=9); R1 (72%, n=8); R1.2 (45%, n=5); F1 (36%, n=4); A1.2 (27%, n=3); A1.1, I3, R1.1 (18%, n=2); and F2, F3, F4 (9%, n=1). A2 and I2 were not mentioned in any of the policy documents. Reusability facets (R1 + R1.1 + R1.2 + R1.3) were mentioned most frequently (25 times),

followed by accessibility (A1 + A1.1 + A1.2 + A2) (14 times) and interoperability (I1 + I2 + I3) (11 times). Findability (F1 + F2 + F3 + F4) was least mentioned (7 times) (see Table 3).

The FE-Score was calculated for each document. The highest FE-Score was recorded for the recently released National Health Data Access and Sharing Directive, 2020, which had a score of 13 out of 15 (see Table 3 and Figure 1).

Table 3. FAIR Equivalency in the policy documents analysed.

Policy document	FAIR Equivalency															FE-Score
	F1	F2	F3	F4	A1	A1		A2	I1	I2	I3	R1	R1			
						1	2						1	2	3	
PD1 (2008)	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	4
PD2 (2011)	1	0	0	0	0	0	1	0	0	0	0	1	0	1	1	5
PD3 (2017)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
PD4 (2017)	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	3
PD5 (2018)	1	0	0	0	1	0	0	0	1	0	0	1	1	0	1	6
PD6 (2019)	1	0	0	0	1	0	1	0	1	0	0	1	0	0	1	6
PD7 (2020)	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	5
PD8 (2020)	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	13
PD9 (2020)	0	0	0	0	1	1	0	0	1	0	1	1	0	1	1	7
PD10 (2020)	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	4
PD11 (2020)	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	3
Average	0.36	0.09	0.09	0.09	0.82	0.18	0.27	0	0.82	0	0.18	0.72	0.18	0.45	0.91	
Percent	36	9	9	9	82	18	27	0	82	0	18	72	18	45	91	
n	4	1	1	1	9	2	3	0	9	0	2	8	2	5	10	

Note: PD = policy document; Findability: F1, F2, F3, F4; Accessibility: A1, A1.1, A1.2, A2; Interoperability: I1, I2, I3 and Reusability: R1, R1.1, R1.2, R1.3. Each mention of any of the 15 FAIR facets was scored '1', while no mention was scored '0' across all documents. An FE-Score was obtained by aggregating the scores for all the 15 facets per document, with the highest possible score being 15.

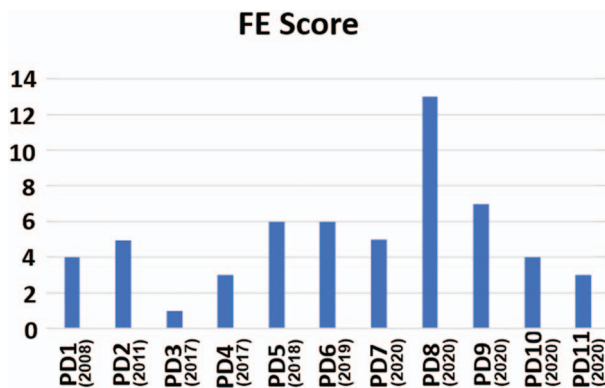


Figure 1. FE-Score for policy documents.

5.3 FAIR Equivalency

The most frequently mentioned FAIR Guidelines are Reusability (25 times), followed by Accessibility (14 times), and Interoperability (11 times). The least mentioned was Findability (7 times). The most mentioned FAIR facets are R1.3, followed by A1 and I1. A2 and I2 were the only facets not mentioned at all, perhaps because they specifically deal with detailed data and metadata, which is not the subject of the policy documents.

5.4 Findability

Findability is the most important FAIR Guideline, as it is the first step in (re)using data. This principle contains four facets: F1, F2, F3, and F4. All of these sub-principles were mentioned in National Health Data Access and Sharing Directive. The most mentioned facet was F1, which was found in the Ethiopian eHealth Architecture V1.5 and the Consultation on the Recommendations and Working Text of the National Open Data Policy of the Government of Ethiopia. These three policy documents also mentioned that Ethiopia has been working towards the establishment of a national Public Key Infrastructure, which will provide unique digital identities for users. This is equivalent to facet F1, which states that data and metadata should be assigned a globally unique and persistent identifier [14].

5.5 Accessibility

Accessibility deals with protocols for retrieving digital resources, which should be made explicit for both machines and humans [9]. It has four facets: A1, A1.1, A1.2, and A2. A1 appears in almost all policy documents. This is because 82% of the documents discussed how to access data and stipulate that data should be retrievable by obeying certain standards and protocols. Both A1.1 and A1.2 were mentioned in the National Health Data Access and Sharing Directive, which emphasises fetching data from different sources for health data analytics activities using rigorous techniques and advanced technologies to generate evidence. However, facet A2 is not mentioned in any of the documents.

5.6 Interoperability

Interoperability allows for the exchange of data through: I1: (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation; I2: (meta)data use vocabularies that follow FAIR Guidelines; and I3: (meta)data include qualified references to other (meta)data. None of the policy documents mentioned anything equivalent to I2. This indicates that such vocabularies are not yet being used in any health systems in Ethiopia. Facet I3 is mentioned in two policy documents: the Health Sector Transformation Plan II and the National Health Data Access and Sharing Directive. All of the policy documents, except for the Health Information Technology Directive ICT Policy (2017), contain terms and statements equivalent to facet I1.

5.7 Reusability

Reusability equivalent terms and phrases were mentioned in almost all the policy documents, including: standardisation, reusability, sharing protocols, appropriateness of data use across the health systems, messaging and terminology standards, data open format, open licence, freely use and reuse data, and terminology codes. All of the facets of reusability were represented, although in vague terms. Facet R1 was mentioned in relation to meta(data) being richly described with a plurality of accurate and relevant attributes. Facet R1.2 was also mentioned in reference to the reusability of data in a specific system or between different systems. Two documents—the National Health Data Access and Sharing Directive and the Consultation on the Recommendations and Working Text of the National Open Data Policy of the Government of Ethiopia—mentioned facet R1.1, which requires data to be in a machine-readable format that is publicly available under an open licence or Microsoft Excel and/or csv formats under a Creative Commons Attribution open licence. Almost all policy documents (91%) mentioned R1.3 equivalent terms and phrases, relating to standardisation, data standards, terminology codes, and messaging standards.

6. DISCUSSION

The policy documents were collected from the official websites of the relevant ministries, directorate portals, and grey literature. None of the documents mentioned any of the FAIR Guidelines directly. However, all the policy documents used FAIR Equivalent terms such as open-access data, access to information, aggregate, interoperable, and standard data (Table 2). This shows that the policy documents were crafted with similar intentions as the original FAIR Guidelines set out by Wilkinson and colleagues [14]. Hence, there appears to be a small amount of convergence of ideas and the cultural entropy on this issue is diminishing, making the adoption of the FAIR Guidelines on the policy agenda a more realistic possibility. It is concluded that a policy window could open on the issue or at least that there is a converging idea about the need for the inclusion of the equivalent of FAIR Guidelines. This finding is consistent with research on FAIR Equivalency carried out in other African countries (Uganda, Kenya, Zimbabwe, Nigeria) and Indonesia [3, 15–19].

7. CONCLUSION

Ethiopia has been implementing digital health solutions for over a decade and half, as part of its transformational agenda in the health sector. This has been carried out through national and global actors. These solutions have been generating big health data, giving rise to the need to find ways to use this health data for decision making at various levels. With data becoming an invaluable resource, making it Findable, Accessible, Interoperable and Reusable (FAIR) is of paramount importance. Accordingly, various national policies, strategies, and plans have been prepared by Ethiopia's Federal Ministry of Health to regulate and promote data use. The aim of this analysis was to determine the alignment of digital health policies, strategies, and plans in Ethiopia with the FAIR Guidelines.

The study consisted of the qualitative analysis of ICT and digital health documents published by different ministries and government bodies in Ethiopia from 2008 to 2021. Following the methodology on FAIR Equivalency developed by Basajja et al. [13], a total of 11 documents were examined. A coding-labelling method was used to analyse the documents for mention of FAIR Guidelines or use of FAIR Equivalent terminology. The degree of compliance (FE-Score) was determined by analysing the occurrence of the 15 FAIR facets in the documents using the coding-labelling method.

The analysis found that although none of the documents explicitly mention the FAIR Guidelines, all documents (100%) mention FAIR Equivalent principles. The following FAIR facets were mentioned (presented in descending order from most mentioned to least): R1.3 (91%, n=10); A1, I1 (82%, n=9); R1 (72%, n=8); R1.2 (45%, n=5); F1 (36%, n=4); A1.2 (27%, n=3); A1.1, I3, R1.1 (18%, n=2); and F2, F3, F4 (9%, n=1). Facets A2 and I2 were not mentioned in any of the policy documents.

The findability, accessibility, interoperability, and reusability of data and services is believed to be vital to information-driven decision making in health facilities. Therefore, it would be beneficial for the FAIR Guidelines to be considered when establishing the regulatory frameworks for ICT and digital health in Ethiopia. As most of the FAIR facets (13 out of 15) were mentioned in the policy documents analysed, it appears that a policy window could open for the adoption of the FAIR Guidelines for data curation in the digital health sector in Ethiopia.

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AUTHORS' CONTRIBUTIONS

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CONFLICT OF INTEREST

All of the authors declare that they have no competing interests.

ETHICAL STATEMENT

Tilburg University, Research Ethics and Data Management Committee of Tilburg School of Humanities and Digital Sciences REDC#2020/013, June 1, 2020-May 31, 2024 on Social Dynamics of Digital Innovation in remote non-western communities

Uganda National Council for Science and Technology, Reference IS18ES, July 23, 2019-July 23, 2023.

Letter of Endorsement by the Government of the National Regional State of Tigray, Bureau of Health. Ethiopia, SAS/277/2020, October 7, 2020

Data Processing Agreement between Kampala International University and Musa Ango Abdullahi, Registrar, IBBUL (Nigeria), November 9, 2020

Data Processing Agreement between Kampala International University and Addis Ababa University, Dr Wondimu Ayele (Ethiopia), November 10, 2020

Data Processing Agreement between Kampala International University and Mekelle University, Dr Araya Medhanie (Ethiopia), February 3, 2020

SUPPLEMENTARY MATERIALS

<https://drive.google.com/file/d/1gSbk3nlGJPYnVz06LBM9polO3ZjgQBcC/view?usp=sharing>
<https://drive.google.com/file/d/1z8RKNNzAEaMNBUrO4uE5SMi39V6k7m7H/view?usp=sharing>
<https://drive.google.com/file/d/1jAFkjmNqf25K4PR2-debOdy5XM7eFOtR/view?usp=sharing>

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APPENDIX 1. FAIR FACETS

To be Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

To be Accessible:

- A1. (meta)data are retrievable by their identifier using a standardised communications protocol
 - A1.1 the protocol is open, free, and universally implementable
 - A1.2 the protocol allows for an authentication and authorisation procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available

To be Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation
- I2. (meta)data use vocabularies that follow FAIR Guidelines
- I3. (meta)data include qualified references to other (meta)data

To be Reusable:

- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
 - R1.1. (meta)data are released with a clear and accessible data usage licence
 - R1.2. (meta)data are associated with detailed provenance
 - R1.3. (meta)data meet domain-relevant community standards