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ICT in Business and the Public Sector

Improving Satu Data Indonesia With FAIR Elements: A Model to Extend Satu Data Indonesia Principles in COVID-19 Data Management

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MASTER'S THESIS

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Abstract

This explorative study focuses on the similarity and difference of Satu Data Indonesia principles and the FAIR Principles, and how FAIR elements can help Satu Data Indonesia to strengthen Satu Data Indonesia principles in COVID-19 data management. For this, both principles were studied aiming to understand the connection between the two principles and what are the health regulatory frameworks in order to find a model to extend Satu Data Indonesia principles with FAIR elements. The semi-structured interview with four interviewees from the Indonesian ministries and two interviewees from Virus Outbreak Data Network (VODAN) was chosen to get insight from the Satu Data Indonesia relation to FAIR and how the principle applies in COVID-19 data management. Besides, the researcher participated as Training of Trainers (ToT) technical support in the Virus Outbreak Data Network (VODAN) Africa, one of the joint activities carried out by GO-FAIR to observe the creation and deployment of FAIR data related to COVID-19. The connection and the possibility to use FAIR elements for Satu Data Indonesia was investigated by using Theory of Agenda-Setting of Kingdon to check the similarity and difference from the three streams: problem, policy, and political. It is concluded that the two principles are harmonious due to their similarity in the objective and principles. All of the FAIR principles can answer the goal of Satu Data Indonesia's principles. According to these analyses, it can be concluded that if data management in Satu Data Indonesia following the FAIR principles, it also meets the Satu Data Indonesia requirement. Therefore, a model of FAIR implementation for COVID-19 data management for VODAN Africa can be applied to improve COVID-19 data management in Indonesia.

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1. Introduction

The Indonesian government has been encountering data gap problems among its ministries and institutions. Land data, agricultural production, and unemployment rate are often controversial and heavily discussed within the internal government. The President of Indonesia expressed his dissatisfaction with data differences between several ministries and institutions during the 2016 Economic Census coordination meeting, which often led to incorrect and inaccurate policies being adopted (Alvin, 2016). Also, the Indonesian Employers' Association (APINDO) complained due to the Ministry of Agriculture's corn production data increased while the APINDO data and satellite imagery showed a decrease in the rate of production (Hendartyo, 2018). Therefore, there is an urgent agenda to establish better management to synchronize data in Indonesia.

In recent years, growing numbers of governments have begun to open up their data around the world. This so-called open government movement led to introducing various open data portals and infrastructure, offering the same access point for the government and encouraging greater public involvement, collaboration, and cooperation (Máchová & Lněnička, 2019). By implementing a bureaucratic reform program to strengthen public services in 2014, the Indonesian government has recognized the ability to reinforce internal organizational processes. The report released by the President's Executive Office found that there are no standard data management activities across government departments in data management (UKP-PPP, 2014). The ministry and department work in a silo and lacks a transparent data sharing and collaboration strategy when developing their data management practice,

To overcome this issue, the Indonesian government has developed a policy on Satu (one) Data Indonesia that sets guidelines for the data management system and offers guidance for public agencies to limit overlapping programs, improve data quality, interoperability, and accessibility, including data licensing and formats. This program started with the pilot implementation of nine national ministries in 2016 and 2017 (UKP-PPP, 2014). The Indonesian Government issued the 2019 Presidential Decree No. 39 for Satu Data Indonesia two years since the pilot implementation, containing the concepts of data, central and regional data organizations and require data producers to adhere to data interoperability for synchronizing data between ministries and agencies. The Indonesian

government transform the policy by creating Satu Data Indonesia portal to support transparency and accountability; however, the data portal only provides free data for public and may not solve how to integrate data that is not accessible by public, for example personal data, between ministries and agencies.

At the Lorentz "Jointly Designing a Data Fairport" workshop in 2014, the FAIR principles, an acronym for Findable, Open, Interoperable, and Reusable, began to be debated (Wilkinson et al., 2016). This workshop sets out 15 principles and sub-principles as a guiding element for a data management system that aims to make data easier to locate, open and interoperable, more transparent, and allow data to be exchanged and reused (da Silva Santos; Luís Ferreira Pires, 2020). The FAIR Guiding Principles identify distinct criteria that promote manual and automated deposition, discovery, sharing, and reuse in contemporary data publishing environments (Wilkinson et al., 2016). In theory, FAIR is not equivalent to open data since "A is available on well-defined terms, which means it can be free, but in an exact condition, it must be protected on a valid basis, such as personal privacy, national security, and competitiveness. The FAIR principles are implemented mainly in European geographies (67%) and on a smaller scale in American regions (14%), representing 81% of all implementation activity (van Reisen; Mia Stokmans; Mariam Basajja; Antony Otieno Ong; Christine Kirkpatrick; Barend Mons, 2020).

Although the idea originated from a different situation, the principles of Satu Data Indonesia and FAIR are initiatives that arise from a growing interest in data generated by many activities. The FAIR principle appears to be in line with the aim of Satu Data Indonesia. Both FAIR and Satu Data Indonesia's objective is guidance for a data management system to define how data is opened, easy to reuse, and interoperable. Satu Data Indonesia follows an open data framework in the early implementation by creating a data portal to meet the principle requirement. However, the Satu Data Indonesia principles is about data transparency to the public and enhances data interoperability between ministries and agencies. Therefore, the FAIR principle may extend Satu Data Indonesia in integrating data within the Indonesian government, especially to strengthen data standards by its elements.

1.1 Problem Statement

There is an increasing number of system information and technology implementation in Indonesia. A survey by Sanjaya et al. (2013) about IT implementation shows that 63,38% of 71 hospitals in the Province of Yogyakarta adopted hospital management system information. A severe weakness with this adoption, however, is the capability of sharing patient information between hospitals. Moreover, the difficulties of interoperability were experienced between the different hospitals and within the hospital itself.

In a time of health crisis such as a pandemic, the health system's interoperability and transparency are need to amplified. Indonesian Ministry of Health adopted Satu Data Indonesia by creating its data principles called Satu Data Kesehatan to implement Satu Data Indonesia Policy that initiated by Indonesian government. This effort is expected to solve the interoperability problem and provide better data management to contribute to good governance and sustainable health development (Biro Komunikasi dan Pelayanan Masyarakat Kementerian Kesehatan RI, 2019)

COVID-19 Pandemic started in Wuhan, China, is a big challenge for every country to decide the best method to fight the pandemic. The science models are essential tools to anticipate, predict, and react to biologically, socially and environmentally complex crises like pandemics (Barton et al., 2020). The local and national governments can use scientific models to design health, social, and economic policies to manage and reduce disease spread. Therefore, data management in a country will determine the success of making a scientific model strengthen the pandemic policy.

Although the policy of Satu Data Indonesia applied by the Ministry of Health to enhance data transparency in the COVID-19 system, the Indonesian government was criticized by the public on COVID-19 data due to lack of important information and data gap between national and regional data (*Virus Corona: Data Kematian Pasien Covid-19 Termasuk PDP Mencapai Lebih 1.500, Angka Yang Perlu Disertakan Pemerintah, Kata Pakar - BBC News Indonesia*, n.d.). Furthermore, the researcher cannot access scientific data, such as genomic data, related to Indonesia's COVID-19 patients' treatment (Arif, n.d.). This problem may indicate that the Satu Data Indonesia principles is not optimal to support COVID-19 data management. Little is known about Satu Data Indonesia's performance

when implemented within the Indonesian Government, and it is not clear what factors can enhance the principle. Therefore, due to the capabilities of FAIR, which can be used and further studied in many contexts, FAIR principles provide an opportunity to improve Satu Data Indonesia. This idea raises the following research question: what is the similarity and difference of Satu Data Indonesia principles and the FAIR Principles, and how FAIR elements can help Satu Data Indonesia to strengthen its principle in COVID-19 data management?

1.2 Objectives and Research Questions

The research sub-questions and the research objectives presented in Table 1 are derived from the main research question.

Table 1. Objectives and Research Questions

OBJECTIVES	SUB QUESTIONS:	METHOD	FINDING
To make comparation between FAIR and Satu Data Indonesia in both principle and objective	What is the difference and similarity of FAIR and Satu Data Indonesia in the objective and principles?	Literature Review	Chapter 5
To check the regulatory framework of health data in purpose to know the context of Indonesia and check the equivalency with FAIR	What is the governance and regulatory framework for digital health data in Indonesia and how is the FAIR equivalency?	Literature Review	Chapter 6
To highlight the current situation of data management and the effort in integrating COVID-19 data within Indonesian government	How current situation of data management by the Indonesian government in integrating COVID-19 data?	Literature Review Interview	Chapter 7

To create a model to strengthen Satu Data Indonesia with FAIR elements	How Satu Data Indonesia can use FAIR elements to strengthen its principle?	Literature Review Interview	Chapter 8
To develop a suitable model for Satu Data Indonesia to use FAIR elements to extend its principle in COVID-19 data management.	What would be a suitable model for Satu Data Indonesia to use FAIR elements in order to extend its principle in COVID-19 data management?	Observation Interview	Chapter 9

1.3 Research Relevance

1.3.1 Academic Relevance

This research is the first study to explore the principle of Satu Data Indonesia and its implementation during the COVID-19 pandemic. Many countries are starting initiatives to integrate data within ministries and agencies and provide data transparency to the public, however, Satu Data Indonesia policy may considered unique policy due to the Indonesian government following the "open" requirement and producing four principles to strengthen data integration. Satu Data Indonesia is fundamental to developing COVID-19 data management; however, one of the most significant challenges is the patient data that must be protected but should be available to support essential decisions in fighting a pandemic. FAIR principles are primarily adopted in European geography and are also widely used in Bio-and natural sciences. In this research, the FAIR principles tries to improve the COVID-19 data management and improve the Satu Data Indonesia principles by its elements. Therefore, this work will generate fresh insight into the understanding of Satu Data Indonesia and FAIR.

1.3.2 Societal Relevance

Many countries have a different approach to mitigating the effect on local communities of COVID-19 spread. Data management is an essential element in the process as each

pandemic calculation will determine whether the government can collect health information to establish a scientific model (Barton et al., 2020). The Indonesian government is drawing more public attention when it comes to tackling the COVID-19 pandemic.. Some researchers told the media about the difficulties to access the scientific data related to COVID-19. Also, the COVID-19 data management system shows the differences between central and local government data. Satu Data Indonesia principles can play an important role in addressing data differences; thus, an improvement should be made to the current system for developing better COVID-19 data management and may help the principle to face another challenge of health data in the future.

1.4 Research Outline

There are ten chapters provided in this research. The research background is described in Chapter 1, which explaining the problem and formulating the research question for resolution. The theoretical framework used in this investigation will be discussed in Chapter 2. Chapter 3 describes detailed research methodologies such as research design and data collection methods used in this research. Chapter 4 contains the explanation of this research's context, for example, the geographical, regulation, and cultural. Chapter 5 presents the finding of Satu Data Indonesia and FAIR comparison from their objectives and principles. Chapter 6 presents the finding of COVID-19 data management in Indonesia. Chapter 7 presents the finding of FAIR equivalency within the Indonesian health data regulatory framework. Chapter 8 shows how Satu Data Indonesia can merge with FAIR elements to improve its principles. Chapter 9 proposed a model to optimize Satu Data Indonesia in fighting a pandemic based on the FAIR principles, and the last chapter is conclusions and recommendations.

2. Theoretical Framework

The chapter sets out the theoretical concepts that use as the guidelines of the research. Kingdon Public Policy Agenda is the primary framework used in the research to understand the public policy agenda-setting of Satu Data Indonesia in COVID-19 data management. Therefore, the possibility of opening the policy window can be known to extend Satu Data Indonesia by FAIR elements for data management.

2.1 FAIR Principles

At this time, when the internet and digitalization are playing an important role, about 2.5 quintillion bytes of data generated every day at our current pace (Marr, 2018) are projected to double the amount of data and information every two years (Katal et al., 2013). The "big data" concept is now familiar with this large amount of data and information. Recent developments in big data and applications such as machine learning and artificial intelligence have raised expectations in government that these innovations will strengthen public service capacities and also solve the national problem in all fields, such as the economy, the health care system, the production of jobs, natural disasters and terrorism. (Kim & Chung, 2014). The use of ICT in the healthcare sector will streamline healthcare organizations' administration, enhance the quality of clinical services, and expand the scope of public health awareness for people (WHO, 2008). The healthcare sector fabricates vast quantities of data produced by health records, test results, diagnostics, and wearables, combined with demographic data from multiple sources.

Moreover, patients now also produce more and more data from fitness apps related to health, diet, and medical conditions. This trend is an enormous promise to improve personal and public health by producing meaningful insights from the collected data. However, the health data challenge is that the data itself must be available for everyone to make it reusable while the provider of the data should understand the legal position around data ownership and secrecy can vary markedly. With its four principles, FAIR could respond to the challenge of health data.

Instead of as an objective itself, proper data management is the primary channel that leads to the discovery and innovation of knowledge and the community's subsequent integration and reuse of data and knowledge after the data publication process (Wilkinson et al., 2016). Wilkinson (2016) states that the existing digital system has not helped us take full advantage of our research investment in academic data publishing. There is an urgent need for technology that facilitates the reuse of educational information. At the workshop "Jointly Designing a Data Fairport" in Lorentz in 2014, the FAIR concepts, an acronym for findable, accessible, interoperable, and reusable, were first discussed (Wilkinson et al., 2016). The FAIR principles emphasize how computers should use data and encourage their reuse automatically.

Also, the FAIR term varies from the Open Data, so that the FAIR and Open Data concepts should not be combined. FAIR necessarily does not mean open; information can be exchanged under FAIR and restricted (Commission, 2018). Unlike the concept of open data, FAIR does not require data should be open in all circumstances for the public. For example, data that contain personal or confidential information should not release to the public. Therefore, data can be FAIR or Open, both or neither. European Commission has introduced the term as "open as possible, as closed as necessary" (Commission, 2018)

2.1.1 FAIR Foundation Principles

The FAIR principles encourage computer system capacity to locate, navigate, interoperate and reuse data without or with minimum human interference (machine actionability) due to human beings increasingly rely on compute support to manage the data that increase in volume, complexity, and generation speed (GO-FAIR, n.d.). There are four FAIR data principles :

Findable

The first step in (re)use data is to find it. For both humans and machines, digital instruments should be easy to locate. Comprehensive machine working metadata is crucial in the FAIRification process for an automated finding of associated datasets and services. (Jacobsen, de Miranda Azevedo, et al., 2020). The Findability principle allows both humans and machines first to discover data from wherever they are stored. In particular, with decentralized data, the definition allows data to be accompanied by metadata and adequately defines it. (Wilkinson et al., 2016).

Accessible

For both humans and computers, protocols for the digital information processing should be made clear, including well-defined procedures for obtaining permission to access protected data. (Wilkinson et al., 2016). The registered ID is used to collect (meta)data, and the procedure can be modified anywhere in the world via "standardized

communication protocol". Moreover, the principle also states that despite data that is no longer accessible, a data user should be able to access metadata (Wilkinson et al., 2016).

Interoperable

The ability to incorporate or function with data or tools from non-cooperating resources with minimum effort is interoperable (Wilkinson et al., 2016). Data can be combined with other data and communicate with analysis, storage, and retrieval applications or workflows (GO-FAIR, n.d.). The concept of interoperability, therefore, requires (meta)data to use similar terms commonly used in different fields and vocabulary in compliance with the FAIR principles (Wilkinson et al., 2016).

Reusable

Optimizing the reuse of data is the ultimate objective of FAIR. In order to achieve the reuse of data optimization to be repeated and/or mixed in different environments, metadata, and data should be well defined (GO-FAIR, n.d.). Information of provenance and "domain-relevant community standard" should accompany the (meta)data.(Wilkinson et al., 2016).

2.2 Kingdon Public Policy Agenda

This research will use Kingdon's theory of public policy agenda to understand how to improve Satu Data Indonesia by FAIR in fighting COVID19. According to Kingdon (1995), the agenda is the list of issues or concerns to be discussed by public officials and non-governmental that are closely connected to such officers at all times. In the fragmented US political system, Kings suggested a way to explain the public policy agenda based on first-hand and secondary how the US agenda relied on three kinds of reviews of the agenda processes. (Quirk, 1986). It defines explicitly independent (and interdependent) variables that interact to generate a window of opportunity to set the agenda. As shown in Figure 1, these three variables are problematic streams, policy streams, and policy streams.

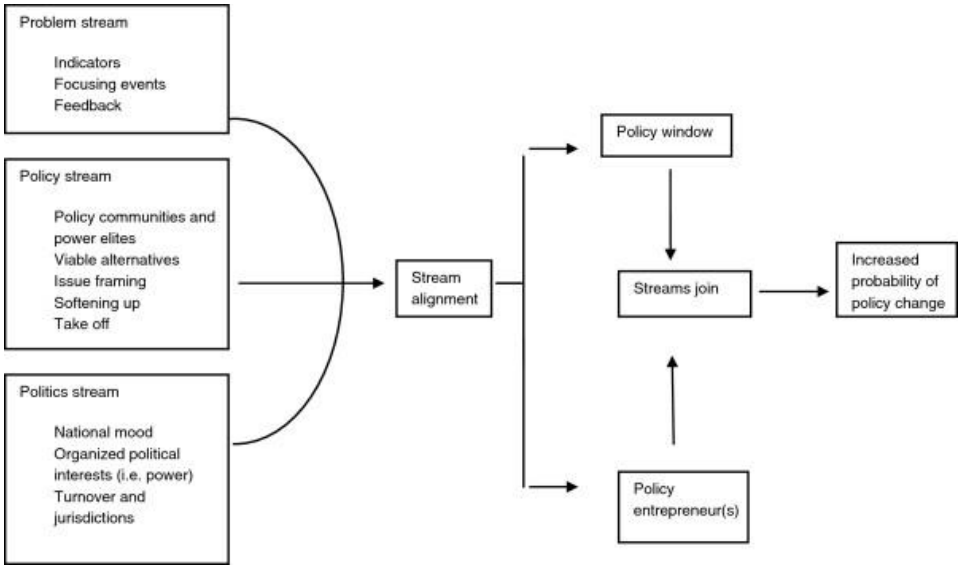

Figure 1 John W. Kingdon's multiple streams model (Gagnon & Labonté, 2013)

All such three elements work largely independently, even though actors may overlap in each. The successful establishment of the agenda calls for at least two components to meet at a crucial moment when a "policy window" opens (Kingdon, 1995). For instance, advocates may create a policy proposal, wait for the right problem, and apply their proposal to it (Ross, 2007). Researchers may otherwise recognize an issue, but it will only be on the agenda until the policy changes(Ross, 2007). However, political windows are not just opportunities; they can be created as well. In this research, Kingdon's theory could examine both principles, Satu Data Indonesia, and FAIR. Knowing all of the streams for both principles will be essential to compare the similarity and differences. Moreover, this theory will also check the agenda-setting of the Satu Data Indonesia policy in the COVID-19 data management case to know how FAIR can improve the system to fight a pandemic.

2.1.1 Problem stream

Problems include persuading policy decision-maker to concentrate on one problem over another (Ross, 2007). As a policy initiative on the agenda is more likely if the relevant issue is considered serious, the identification of a problem is important . Problems are more or less characterized by structural indicators (Kingdon, 1995) that display less of critical events than the issue (Quirk, 1986). In this research, the Indonesian Government experiences data differences within ministries and agencies and proposes a policy to eliminate it. However, COVID-19 data management that applied the Satu Data Indonesia

principles is still criticized by the public due to the inability to provide interoperability and transparency. FAIR may not directly use the existing data management system in Indonesia, but it can help Satu Data Indonesia by its elements. Therefore, knowing the problem stream between the principles is vital to know the similarity and differences.

2.1.2 Policy Stream

Policy streams are the mechanism by which policies are made, debated, updated, and taken seriously. Since the competitive proposals may be connected to the same problem, it usually takes time and effort to propose the shortlist (Ross, 2007). Policies are proposed and formulated by government or government-run citizens (Kingdon 1995). Policy-making processes can be affected even by individuals outside the government. These ideas are developed, refined, and suggested. Ideas can be chosen when their value is potentially agreed upon, and if possible, constraints are predicted (Kingdon 1995). The policy stream of Satu Data Indonesia was written in a blueprint document published in 2014 by the Indonesian government. The general idea is to make data can be more integrated by improving interoperability and reusability. The FAIR principles, on the other hand, also has the same idea.

2.1.3 Political Stream

The final stream is the political flow that impacts the agenda, such as shifts in elected officials, political moods, and voices of defenses or opposition groups (Ross, 2007). The stream is a concern with the policymaking where a proposal can be considered if the political climate is good (Wilson, 1993). A "policy window" is a brief period within which all sources meet, and the circumstances allow us to make policy changes.(Quirk, 1986).

2.1.4 Policy Enterpreneurs

The model of Kingdon reflects that entrepreneurs play a key role in "softening" the system and linking it to concerns, policies, and policy outlets. Political reforms cannot take place without political entrepreneurs' contribution.(Gagnon & Labonté, 2013). Kingdon described policy entrepreneurs as agents that are not typically found in the policy community at a single location. They may be elected or appointed, interest groups, or

research organizations in government or out of government. However, their defining characteristic, as in the case of an entrepreneur, is their ability to spend resources in anticipation of future returns – time, energy, reputation, and sometimes money. Policy entrepreneurs can put forward their proposals for solving problems or advocate proposals from the current of proposals when the political climate is good (Wilson, 1993). When chances are made, they can push an agenda; this is called “policy window”.

3. Research Methodology

3.1 Research Design

This study will use qualitative and exploratory research because the nature of the research only focuses on particular analysis cases and attempts to understand a specific phenomenon more thoroughly. The case study was chosen as a research design to explore the Satu Data Indonesia principles based on the multiple streams and compare the FAIR principles to propose the best model to distend Satu Data Indonesia with a FAIR enabling element. The case study is a data collection method that gathers, organizes, interprets, and presents comprehensive descriptive information about specific individuals or cases (Marrelli, 2007).

The research's first goal is to find how different Satu Data Indonesia and FAIR are in their objective and principle. The second purpose is to know the entire picture of digital health governance and regulatory framework in Indonesia. The next goal is to know the current situation of data management COVID-19 while the last goal is to evaluate the multiple streams of Satu Data Indonesia and find the aspect of FAIR elements that can extend Satu Data Indonesia to improve the data management, particularly in the current pandemic. Literature analysis, evaluation, and interviews were the methods used to obtain qualitative data. The study of the phenomenon gave insight into model development.

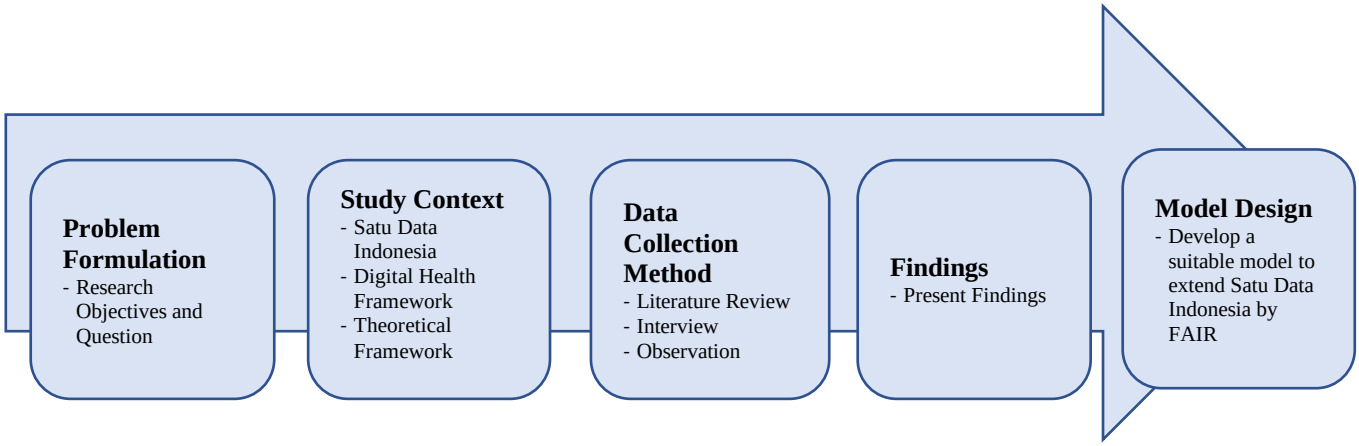

Figure 2. Research Process

3.2 Data Collection

3.2.1 Literature Review

The literature review is conducted to identify the information related to FAIR, Satu Data Indonesia, and Indonesia's digital health governance and framework. Mainly, a literature review was performed to compare the FAIR data principle and Satu Data Indonesia and understand the regulation of Indonesia's digital health. The used literature includes primary research such as government legislation, action plans and research undertaken by independent institutions, secondary research in the form of publications and reliable papers, and tertiary research in the form of systemic reviews. In finding the papers on related topics in these inquiries, structures and snowball strategies have played a key role.

Satu Data Indonesia portal (https://data.go.id) will be the main source to gather specific information about Satu Data Indonesia. The website contains several reports and regulations related to the development of the Satu Data Indonesia principles. In the development of relevant sources, particularly those linked to FAIR principles and digital health policies and regulations in Indonesia, the snowballing search strategy was more productive than searching for FAIR and digital health regulation topics in Google searches and Google scholars, which yielded restricted results.

3.2.2 Interview

The semi-structured interview was chosen to get insight from the Satu Data Indonesia relation to FAIR and how the principle applies in COVID-19 data management, interviews

were conducted with key persons ascertained as particularly relevant to this case study. In practice, semi-structured interviews provide the best of all interviews, incorporating a list of questions to be answered in combination with the ability to follow-up points where appropriate (Thomas, 2009). This interview set out to gain a better understanding the principle of Satu Data Indonesia from different perspective of stakeholder and check how FAIR elements can help Satu Data Indonesia extend the principle by investigating both principles from three different streams.

The interviewees in this research were recruited based on their relevance to key issues in the agenda-setting process. The individuals for the interviews were selected based on the participation in the Satu Data Indonesia project and implementation in FAIR Data Principles. Four out of six interviewees are from four Ministries in Indonesia, which had an important role in the Satu Data Indonesia principles due to their involvement in the discussion of the Satu Data Indonesia blueprint and responsible for the principle implementation in their ministry. Two of the Ministries: Ministry of National Development (BAPPENAS) and Central Bureau of Statistics (BPS), are the main drivers of Satu Data Indonesia, while the Ministry of Health is responsible for COVID-19 data management. The interviewees from FAIR are actively involved in FAIR implementation network, especially in Africa. Virus Outbreak Data Network (VODAN) is a GO-FAIR Implementation Network set up to help combat COVID-19 Coronavirus, and the VODAN deployment network aims to build the internet of equal data and services. One interviewee is from GO-FAIR and another interviewee is executive coordinator in VODAN implementation network in Africa (VODAN Africa).

The interviewees were contacted via e-mail, and once they agreed to the interview, an appointment was made for the interview session. The interviews were conducted via Skype and zoom and lasted about 40 minutes. The information letter and consent form was sent before the researcher interviews to ensure that the interviewee understood the purpose of the interviewee's involvement and that he/she agreed to the conditions of his/her participation in the research. The semi-structured interview questions were based on Kingdon's agenda-setting to mapping the data management by three streams; problem, policy, and political.

Table 2. Interview Question List

No O	Stream	Interview Question
1	Introduction	Could you tell me a little bit about yourself? (gender, what project are you working on, position in the office/project, and education level)
2		Which one of the following projects do you know: Satu Data Indonesia? Yes/No FAIR? Yes/No? VODAN? Yes/No? Are you involved in one or more of these, of so, which ones? What is your level of knowledge about these projects?
3		When did you start participating in the Satu Data Indonesia/VODAN project?
4		Can you explain what Satu Data Indonesia/VODAN project is about?
5		What is the general purpose of Satu Data Indonesia/VODAN?
6	Problem	What does findability mean in Satu Data Indonesia/ VODAN?
7		What does accessibility mean in Satu Data Indonesia/VODAN?
8		What does interoperability mean in Satu Data Indonesia/VODAN?
9		What does reusability mean in Satu Data Indonesia/VODAN?
10		What is the main problem that you want to solve in Satu Data Indonesia/VODAN? And to what extent that problem related to Findability/Accessibility/Interoperability/Reusability?
11		How is the ownership of the data in Satu Data Indonesia/VODAN project? What is that means?
12		How has Satu Data Indonesia been used or applied in the context of the COVID-19 crisis?
13	Policy	What is the policy and regulatory framework of Satu Data Indonesia/VODAN?
14		What is the background to the launching of the Satu Data Indonesia policy? Which stakeholders and which people played an important role in this? What policy issues were the challenges? Was their opposition to the policy?
15		What are the key elements of the policy of Satu Data Indonesia/VODAN?

16		Does this policy regulate the ownership of the data in Satu Data Indonesia/VODAN?
17		How do the policies apply in improving data findability in Satu Data Indonesia/VODAN?
18		How do policies apply in improving data accessibility in Satu Data Indonesia/VODAN?
19		How do the policies apply to improve data interoperability in Satu Data Indonesia/VODAN?
20		How do the policies apply to improve data reusability in Satu Data Indonesia/VODAN?
21	Political	Who cares about Satu Data Indonesia/VODAN? What are they interested in?
22		Which stakeholders are driving Satu Data Indonesia, and which stakeholders are most interested to Satu Data Indonesia/VODAN?
23		Who formally and informally drives Satu Data Indonesia/VODAN in a certain direction? And to what extent this direction related to Findability/Accessibility/Interoperability/Reusability?
24		Which stakeholders are also the owner of the data in Satu Data Indonesia/VODAN?
25		What is the focus of data management in Satu Data Indonesia/VODAN?

3.2.3 Observation

Observation is used as a tool for gathering knowledge about individuals, processes, and cultures in the social sciences (Kawulich, 2012). The observer category chosen is participant observation, where the researcher is a participant and an observer in the study setting. The researcher participated as Training of Trainers (ToT) technical support in the Virus Outbreak Data Network (VODAN) Africa, one of the joint activities carried out by GO-FAIR that has the primary goal to show the creation and deployment of FAIR data related to COVID-19. The researcher joined every webinar from May 2020 to understand the FAIR concept and VODAN Africa implementation. Moreover, the researcher actively participated in the development of FAIR architecture implementation by helping the trainee check the problem during the installation and manage the documentation. The researcher recorded all of the personal discussions in a research log and rechecked the

webinar's content by watching the video from the first session until the last session of the project.

3.3 Data Analysis

When all data had been collected, an analysis will be carried out to extract information from data. This research will use the content analysis method to analyze documents and interviews transcript. Content analysis is a tool for the analysis of written, verbal, or visual messages (Cole, 1988) This kind of method describes and quantifies phenomena (Krippendorff, 2004) in a systemic, objective manner. It is often referred to as a tool for analyzing documents. The content analysis helps the researcher to test theoretical issues to strengthen data comprehension (Elo & Kyngäs, 2008). Words may be condensed into smaller categories of content through content analysis. Therefore, names, sentences, and the like have the same meaning when grouped into the same category (Cavanagh, 1997). Coding is an essential step in the analysis of content because the method determines the data being analyzed. (Gibbs, 2007) This process identifies and finds a connection in a text or other data item (photography, image), searches, and identifies concepts.

The interviewee transcription and relevant documents of FAIR and Satu Data Indonesia were code based on open coding, axial coding, and selective coding. Open coding aims to create a tentative label that summarizes the content of the interviewee and documents. The next step was to do axial coding and use FAIR equivalency as the label to know what relationship between the open code is. Finally, the last step is to do selective coding based on the Kingdon agenda-setting label to identify the core variable.

4. Context

4.1 Indonesia Profile

Indonesia is situated in the Maritime South East of Asia between the Indian Ocean (to the south) and the Pacific Ocean, with the world's largest archipelago (to the north). It is enclosed in Timor islands with Malaysia, Borneo, Papua New Guinea, Timor-Leste, New Guinea, East Timor. Indonesia has international ties with Japan, Malaysia, Palau, the Philippines, Singapore, Thailand, and Vietnam. It has 17.504 islands, and Sumatra, Java, Borneo (known as "Kalimantan"), Sulawesi, and New Guinea are among the largest

islands (Hidayat et al., 2020). Indonesia is the largest and most populated nation in South East Asia and the fourth largest globally, with an area of 1,910,931 km2 and a population of 271 million in 2019 (*Indonesia | Facts, People, and Points of Interest | Britannica*, n.d.). Indonesia is a rapidly rising middle-income nation, with 262 million people from over 300 ethnic groups and 730 languages distributed across 17,744 islands (Agustina et al., 2019). This diversity of ethnic groups is understood as a heritage of cultural richness that promotes state unity, as expressed in Bhinneka Tunggal Ika, Indonesia's national slogan or as "Unity in Diversity" Human growth in Indonesia continues to progress amid its huge population and high ethnic diversity. The Human Development Index of Indonesia (HDI) was up to 71.92 in 2019. This number has expanded or risen 0.74% compared to 2018 by 0.53 points. Babies born in 2019 expect to live up to 71.34 years, 0.14 years longer than those born the previous year. In 2019, children who are seven years old had the hope of getting an education for 12.95 years, 0.04 years longer than those of the same age in 2018 (Central Bureau of Statistics, 2020b)

Indonesia's living standards are much higher, and the economy more stable than before, two decades after the Asian financial crisis in 1998 and one decade after the global financial crisis. Over the past two decades, GDP per capita has risen by 70%. Exports and government revenues were the results of the end of the commodity boom. While GDP growth was about 5%, per capita revenues increased by almost 4% per year (OECD, n.d.). In 2019, the Indonesian economies reached IDR 15 833.9 trillion, and GDP per capita reached IDR 59.1 million or the US $ 4 174.9, as measured by Gross Domestic Product (GDP) for current prices. These results showed that the Indonesian economy grew 5.02%, down from 5.17% in 2018 (Central Bureau of Statistics, 2020a)

4.2 ICT Infrastructure and e-Government

The difficulty in improving IT infrastructure is extremely high, being a nation with the world's largest archipelago. Recent research shows that significant development can only be seen in West Indonesia, although current telecom infrastructure is unsatisfactory in the East (Agahari et al., 2018). A Central Bureau of Statistics survey shows significant differences between the two areas, the western and eastern sections, of the Information & Communication Technology Development Index (IP-TIK). Indonesia's eastern region has a low level of information technology and technological capability than the western region.

The high ICT Development Index (IP-TIK) exceeds the national IT IP-TIK in four provinces on Java Island. In comparison, the five lowest IP-TIK provinces are all in the eastern part of Indonesia (Agahari, 2018).

This gap issue in ICT infrastructure was responded by the introduction of the Palapa Ring Project, a major infrastructure upgrade that will provide all Indonesian cities and regenerations with 4G by 2019 (Swiss Business Hub Indonesia, n.d.). At the end of the year, the $1.3 billion projects will be in place. 4G coverage across the entire archipelago is expected to contribute to double-digit broadband penetration (Oxford Business Group, 2019).

Indonesia's Electronic Government initiatives have been developed under Presidential decree No. 50(2000), establishing a high-level task force (TKTI) to encourage and improve electronic media use to facilitate the internal roles, relationships, communications, and transactions of the government.(Harijadi & Satriya, 2000). According to UN e-government readiness result 2018, Indonesia ranked 107, with a score of 0.5258, and ranked high. The index value of Indonesia, however, was well below other countries like Malaysia (0,7174) and Philippines (0.6512). The outcome of e-Government readiness aims to ensure that governments around the world are prepared and willing to benefit from ICT incentives to boost access and the quality of basic social services for people for sustainable human development (United Nations, 2018).

Involving IT in any government project presents Indonesia with a major challenge because it has three e-government areas to fulfill: eAdministration, eCitizen, and eSociety. History shows that many government projects in Indonesia also have corruption issues. Transparency International released its Corruption Perceptions Index in 2019, which gave 40 out of 100 to Indonesia (Transparency International, 2020). The Indonesian is in the same group as the country with a score of less than 50, such as Burkina Faso, Guyana, Kuwait, Lesotho, and Trinidad Tobago, which means those countries considered has a high level of corruption.

Although Indonesia faces various difficulties in implementing e-government, the Indonesian government's effort in improving ICT infrastructure in Indonesia promises great potential. These results showed that the Indonesian economy grew 5.02%, down from

5.17% in 2018. The aim of the various long-term strategic e-government development plans in Indonesia is to modernize e-government to improve the quality of the services and reduce public visits to the service office by modernizing the ICT-based governance structure.(Huda & Yunas, 2016). In 2003, Internet users in Indonesia were only 8 million, just 3% of the population. Many citizens had no Internet access at the time and had no e-government awareness. However, an APJII survey in 2018 reports that internet access has risen to about 171 million, around 64,8% of the population (APJII, 2019).

5. Comparison of Satu Data Indonesia and FAIR

Satu Data Indonesia is a policy about data governance that was published by the Indonesian government in 2019 which contain regulation and principle where departments, ministries, and local government should be followed for the data management standard while FAIR is a principle that set as a guide to improving Findability, Accessibility, Interoperability of digital resources. This chapter will compare Satu Data Indonesia and FAIR and discuss similarity and differences between Satu Data Indonesia and FAIR in their objective and principle.

5.1 Identification of Relevant Document

There are two primary documents of Satu Data Indonesia. The first document is Satu Data Indonesia Blueprint for Sustainable Development, published in 2014 by the Presidential Work Unit for Development Supervision and Control (UKP-PPP) by involving several ministries and departments to draft the Blueprint. This project was funded by the Low Emission Capacity Building (LECB) Programme and United Nations Development Programme (UNDP) and aimed to create a strategy to produce highly integrated data from good data management to support Indonesia's sustainable development (UKP-PPP, 2014). Five years later, the 39th Presidential Decree declares that Satu Data Indonesia has become a data management policy for the Indonesian Government, ensuring that information between ministries and agencies is reliable, up-to-date, synchronized, accounted for, and easily shared (Indonesia, 2019). Information that must be provided, announced, and excluded in Satu Data Indonesia is regulated in the following laws and regulations:

- Law Number 14 of 2008 concerning Openness of Public Information;
- Law Number 25 of 2009 concerning Public Services;
- Law Number 43 of 2009 concerning Archiving;
- Government Regulation Number 61 Year 2010 concerning Implementation of Law No. 14 of 2008 concerning Public Information Openness;
- Government Regulation Number 28 of 2012 concerning Implementation of Law Number 43 of 2009 concerning Archiving;
- Information Commission Regulation Number 1 of 2010 concerning Public Information Service Standards;
- Information Commission Regulation Number 2 of 2010 concerning Procedures for Settling Public Information Disputes.

Both Satu Data Indonesia blueprint for sustainable development and Presidential Decree will use to do a comparison since these two documents elaborate on the objective of Satu Data Indonesia and what kind of principle that use to achieve the policy goal.

Unlike Satu Data Indonesia, the FAIR principles does not have supporting documents such as policies or laws. However, several articles related to FAIR principles and their implementation. One of the articles that explains four foundational of FAIR principles is "The FAIR Guiding Principles for scientific data management and stewardship" (Wilkinson et al., 2016). This article narrates why the FAIR principles was formed by stakeholders and briefly mention the concept of the principles. The other article used in the comparison is "FAIR Principles: Interpretations and Implementation Considerations" (Jacobsen, de Miranda Azevedo, et al., 2020). The document details the interpretation and implementation of FAIR principles to avoid misunderstanding the use of the principle. Therefore, both articles covered the objective and the comprehension of the FAIR principles and comparable with the policy of Satu Data Indonesia.

5.2 Objective of Satu Data Indonesia and FAIR

The implementation of Sustainable Development Goals (SDGs) is the cornerstone of the national development plan for Indonesian government. The SDGs are institutionalized from the highest national level to sub-national entities and integrated into national and sub-national development planning (United Nations, 2019). This plan seeks to bring equitable

prosperity and inclusive economic development to all Indonesians for now and the future and respond to the world development challenges. To achieve the SDGs goal, it requires the high integrity of statistical, administrative, and spatial data produced by ministries and departments. High integrity data comes from proper data management produced by excellent cooperation among government ministries and agencies. Without high integrity data, there can be no integration of development management, but without integrated development management, it is challenging to provide high integrity development data (UKP-PPP, 2014). Satu Data Indonesia is expected to be the key to sustainable development's success by increasing integration, synergy, and consistency.

Several meetings and in-depth discussions with ministries and departments produce depictions of current data management conditions and expected a transformation to accomplish an ideal condition (UKP-PPP, 2014). Multiple problems were detected in each category to help the Indonesian government find the improvement way (UKP-PPP, 2014).

Data Management Condition by Process

1. The coordination mechanism is not clear. Although the coordination mechanism for data management has been regulated, this coordination has not gone well because the procedures are not clearly explained (UKP-PPP, 2014)
2. Communication is not optimum among ministries and departments that affect different perceptions, analytical methods, or data collection methodologies and procedures (UKP-PPP, 2014)
3. There are many channels for data requests. Data can come from various networks in ministries and agencies, not from one source, thus, enabling different data (UKP-PPP, 2014)
4. The data harmonization mechanism does not exist. There is no mechanism for harmonizing data between ministries or institutions (UKP-PPP, 2014)
5. The Non-Tax State Revenue Policy (PNBP) limits wider access to data. Charges for data and data-related services as PNBP sources limit access to data and the potential to improve data integrity (UKP-PPP, 2014)
6. The data format is not easy to use or to be reprocessed. Data formats are mostly not reusable or indirectly reprocessed either by users (not human-readable) or by computing devices (not machine-readable) (UKP-PPP, 2014)

7. Lack of data quality assurance. The quality of data, needs to be guaranteed by specific mechanisms from data collection to presentation. The majority of data producers did not operate the mechanism (UKP-PPP, 2014)

Data Management Condition by Product

1. Inconsistent data between Ministries and the Agencies even though they have the same subjects and themes. The sources of this inconsistency are the different data standards used (UKP-PPP, 2014)
2. Metadata is not attached to data. In many cases, data is not equipped with metadata. Metadata is not generated from every data, and even if it is produced, it is not automatically attached to the data (UKP-PPP, 2014)
3. Data were irrelevant. The data collected and managed is irrelevant or does not satisfy the needs for policy analysis and formulation (UKP-PPP, 2014)

Data Management Condition by Data Producer

1. The metadata structure and format have not been standardized, and the delivery of metadata has not been implemented. Sectoral or thematic data have not used standardized metadata structure and format (UKP-PPP, 2014).
2. Information about the data officer is not clear. There is a lack of clarity in terms of which Ministries/Institutions are data officers from particular data (UKP-PPP, 2014)
3. Lack of technical capacity and was not evenly distributed. Generally, the capability to collect, process, and manage data is still limited at the Ministries, Agencies, and Local Government (UKP-PPP, 2014)
4. The concept of sustainable development requires integrating social, economic, and environmental dimensions and good governance. The implication of this integration is the increasingly critical need for coordination for the substance of the data involving ministries and agencies (UKP-PPP, 2014)
5. Weak data management due to the data officer does not manage data based on good data management rules. For example, not all data can be retrieved quickly and cover a complete data series (UKP-PPP, 2014)
6. Data is seen only as an ordinary activity. In some Ministries and Institutions, data collection and management activities are still seen as ordinary activities, not part of the process to produce information to support decision making and policy formulation (UKP-PPP, 2014)

7. The limited scope of data production activities is limited compared to the scope of activities needed to guarantee reliable data (UKP-PPP, 2014)
8. Indonesian government should affirm the role of data producers. The types of data that produce by Ministries / Agencies have been regulated in the national statistical system (UKP-PPP, 2014).

Data Management Condition by Data User

1. Data is not considered important. Not using data, or in more frequent cases, using low-quality data indicates that the data is not or has not been felt important (UKP-PPP, 2014)
2. The data debate is not about the substance of public policy, but around the data used, i.e., data differences or inconsistent data between ministries and agencies (UKP-PPP, 2014)
3. Low trust between ministries and agencies when sharing data. This condition causes data requests not to be fulfilled, or data delivery is slow (UKP-PPP, 2014)

Overall, there are four data mapping conditions based on in-depth discussions: process, product, producer, and user. Besides, the blueprint also describes the data management condition based on the intersecting category is. Figure 3 presents the condition of data management by the intersections of four categories.

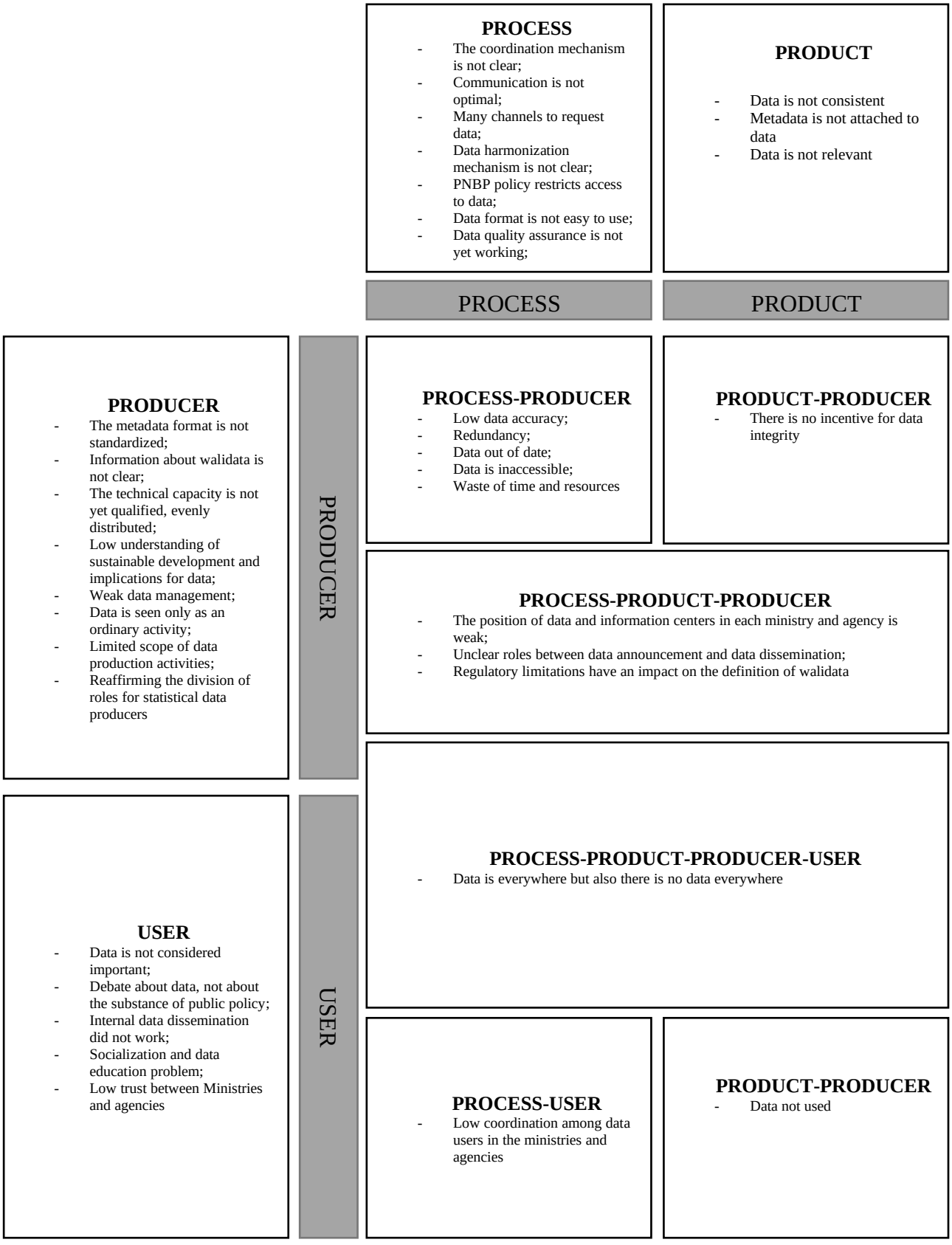

Figure 3. Data Management Condition Mapping (UKP-PPP, 2014)

Identification of the current data management conditions is the background for the desired conditions or ideal conditions. The ideal desired condition per category are:

1. Process Category: Data and Information Centers play an optimal, well-defined role and support the data and information activities of all technical units in the Ministries and agencies (UKP-PPP, 2014)
2. Product Category: High integrity data, metadata, and standard metadata format and structure (for statistical data) documentation, or the reference to single reference of metadata (for geospatial information) (UKP-PPP, 2014)
3. Data Producer Category: Sustainable Development data producers use the same standards, definitions, classifications, units, and assumptions based on mutual consensus (UKP-PPP, 2014)
4. Data User Category: Data with high integrity, updated, and widely accessible for free in a data format that is easy to reuse or share by users (UKP-PPP, 2014)

In 2019, the Satu Data Indonesia policy was published by the Indonesian government to follow up on the strategy from the blueprint of Satu Data Indonesia. The policy includes data management policy and intended to ensure that data standards, metadata, data interoperability, use of reference codes, key data are complied with, integrated and reliably generated, accountable, available and exchanged between central agencies and regional agencies(Indonesia, 2019). Generally, it focuses on institutional coordination arrangements and principles that must be followed in producing data to improve current data management condition by category, as already mentioned in the blueprint. Chapter III on the policy sets out several data management roles to strengthen coordination between ministries, agencies, and local Government. Also, this chapter describes ministries, institutions, and regional governments' duties in each role. Satu Data Indonesia organizer is carried out by:

- Central/Local Steering Board (Dewan Pengarah);
- Central/Local Data Builder (Pembina Data);
- Central/Local Data Officer (Wali Data); and
- Central/Local Data Producer (Data Produsen)

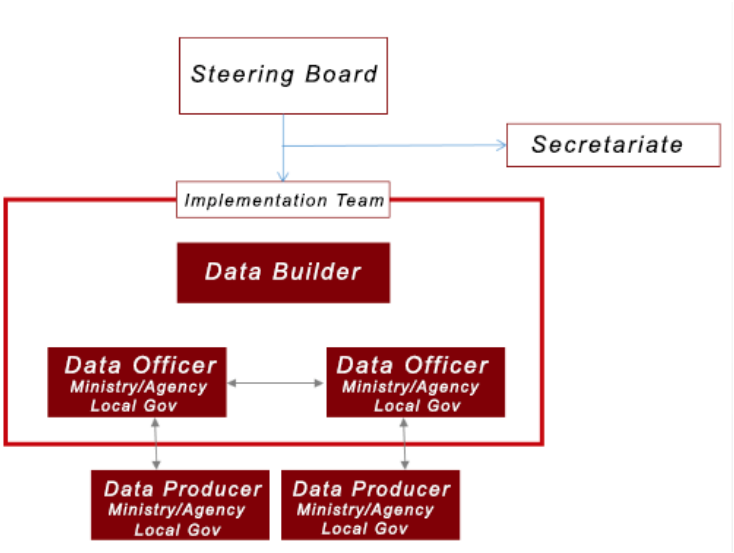

Figure 4. Satu Data Indonesia Coordination Flow (Presidential Staff Office, 2019)

Four principles were also introduced in chapter II to answer the challenge of the data standard. Shortly, every data produce by ministries, agencies, and local government should meet data standard, has metadata, interoperable, and use reference code. The combination of data organizer and principles in Satu Data Indonesia is the strategy to improve data management in the Indonesian government.

FAIR concepts were drawn from the understanding of the current digital environment surrounding academic data publishing, which still prevents people from optimizing our research investment. Science funders, publishers, and government agencies are becoming more and more concerned about data management and data management plans created by publicly funded experiments (Wilkinson et al., 2016). Data stewardship and management aim to get data found and reused for future inquiries, either by themselves or in association with newly generated data. Good data collection and management results are high-quality digital publications, making this phase of exploration, appraisal, and reuse easier and more straightforward in the following studies (Wilkinson et al., 2016).

For decades, the concept of good data management (i.e., maximization of the opportunities for discovery finding and reuse) has existed. Many pioneering societies have already chosen to broaden stewardship with the idea of machine-actionability.(Jacobsen, Azevedo, et al., 2020). A diverse community of stakeholders – including academia, businesses,

funders, and academic publishers – worked together to create an accurate and observable set of principles, known as FAIR data principles (Wilkinson et al., 2016).

The FAIR data principles include four principles: data should be findable, open, interoperable, and reusable for machines and humans. The FAIR elements emphasizing FAIRness were applied to human and machine-driven practices, differing from other previous initiatives (Wilkinson et al., 2016). The principle itself does not mean a standard or a specification in the data management and stewardship, but FAIR act as a guide to data publishers and stewards to assist them in evaluating whether their particular implementation choices make their digital research artifacts Findable, Accessible, Interoperable, and Reusable (Wilkinson et al., 2016). Mons et al. (2017) discussed and clarified the original purpose and meaning of the FAIR's basic principles. They stress that "FAIR is not the norm... FAIR is not equal to RDF, Linked data, or the Semantic web... FAIR is not just about people finding, accessing, reformatting, and finally reuse information... FAIR is not equal to Accessible" (Jacobsen, Azevedo, et al., 2020).

5.5 Principle of Satu Data Indonesia and FAIR

As already mentioned before, both FAIR and Satu Data Indonesia has their principle to apply in the data management and stewardship to achieve its goal. This section will explain both principles before making a comparison to find the similarity and differences. Satu Data Indonesia should be applying four principles in a data management:

1. Data must comply with the data standards. The data standard refers to the same standard in terms of concepts, definitions, classifications, sizes, units, and assumptions underlying specific data. In the context of understanding the Satu Data standard, the concept here refers to the data's idea and the purpose for which the data was produced (UKP-PPP, 2014). Other than Statistical Data and Geospatial Data, the Standard Data can be adjusted based on the data's characteristics (Indonesia, 2019). Article four also encompasses who is responsible for regulating data standards other than statistical and geospatial data.
2. Data must have metadata, which follows the standard structure and standard format (Indonesia, 2019). The Satu Data Indonesia policy did not clarify the standard structure and format. However, the blueprint of Satu Data Indonesia elaborates that

the metadata should contain information in a standard structure and format that describes, explains, places, or facilitates searching, using, or managing information from relevant data. Metadata includes essential aspects of data knowledge, such as content and meaning (UKP-PPP, 2014).

3. Data must comply with data interoperability rules. Data must be consistent in syntax/form, structure/scheme/composition of presentation, semantic/articulation of readability, and stored in an open format that machine-readable. The Ministry of Communication and Information regulates further provisions regarding data interoperability (Indonesia, 2019).
4. Data must be using the reference code and/or main data, which discussed at the Satu Data Indonesia Forum at Central Government Level (Indonesia, 2019). Description and elaboration regarding reference code and main data cannot find in the policy and blueprint. The policy only details how the reference code was agreed upon in the Indonesian data forum and distributed to ministries and agencies.

The policy does not mention what kind of technology will use to fulfill the Satu Data Indonesia principles requirement. However, it states the data dissemination is carried out through the Satu Data Indonesia Portal and other media following the laws and regulations and developments in science and technology.

The FAIR principles stress machine-actionability because people depend on computer support for data management due to growing data volume, complexity, and the speed of data creation (GO-FAIR, n.d.). Four principles of FAIR are:

1. Findable, a principle that states the data should be easy to find by machines and humans. It is important since metadata is essential for the automatic discovery of datasets and services (Jacobsen, Azevedo, et al., 2020),
    - Principle F1: (meta)data are assigned a globally unique and persistent identifier
    - Principle F2: data are described with rich metadata
    - Principle F3: metadata clearly and explicitly include the identifier of the data it describes
    - Principle F4: (meta)data are registered or indexed in a searchable resource

2. Accessible principle means after the user can find the data, can be accessed, possibly including authentication and authorization (Jacobsen, Azevedo, et al., 2020).
    - Principle A1: (meta)data are retrievable by their identifier using a standardized communications protocol.
        a) Sub-Principle A1.1: the protocol is open, free and universally implementable
        b) Sub-Principle A1.2: the protocol allows for an authentication and authorization procedure, where necessary
    - Principle A2: metadata are accessible, even when the data are no longer available
3. Interoperable means of convergence of data with other data and interoperating for analysis, storage, and processing applications or workflows. (Jacobsen, Azevedo, et al., 2020).
    - Principle I1: (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation
    - Principle I2: (meta)data use vocabularies that follow FAIR principles
    - Principle I3: (meta)data include qualified references to other (meta)data.
4. The principle of reusable means that metadata and data should be specifically specified for reuse and can be replicated and/or mixed in various environments. (Jacobsen, Azevedo, et al., 2020).
    - Principle R1: (meta)data are richly described with a plurality of accurate and relevant attributes
        a) Sub-Principle R1.1: (meta)data are released with a clear and accessible data usage license
        b) Sub-Principle R1.2: (meta)data are associated with detailed provenance
        c) Sub-Principle R1.3: (meta)data meet domain-relevant community standards.

The data are used for all digital resources and the metadata is any definition of a resource that can aid findability and/or reusability and/or understanding and/or evaluation of this resource. The data are used not only in the restrained context but also in software tools (Wilkinson et al., 2016)

5.6 The Similarity and Difference Between Satu Data Indonesia and FAIR Objective

Both Satu Data Indonesia and FAIR share a number of key features. Satu Data Indonesia blueprint explained that important data for sustainable development is inconsistent and has limited access. It shows that the Indonesian government was not taking advantage of the data they have right now. FAIR seeks to generate high-quality digital publications to promote and simplify this ongoing discovery, assessment, and reuse in downstream studies because an established digital environment around scholarly data publication prevents stakeholders from taking advantage of this process (Wilkinson et al., 2016). Indonesian government initiates good data management by Satu Data Indonesia to gain better data to support sustainable development. In the same way, FAIR is a data management practice through several principles that want to extract benefit from the scholarly data publication. In contrast to Satu Data Indonesia's scope only for data produced by the Indonesian government, however, FAIR can practically be applied to every kind of data even though it starts the idea from scholarly data publication.

Human and machine-readable are focused on both Satu Data Indonesia and FAIR. Data management condition mapping by the Indonesian government depicts data is not reusable, and data formats are mostly not reusable or indirectly reprocessed either by users (not human-readable) or by computing devices (not machine-readable). Therefore, Satu Data Indonesia requires every data stored in the data portal should provide users with the option to view or download data in the form of numerical data in a format that can be read by users (human-readable) and / or machine (machine-readable). Similarly, the aim of the FAIR initiative is to provide a wise and correct description, reuse, and citation of all digital science artifacts of all kinds, both human and mechanical, over time (Wilkinson et al., 2016).

In contrast to FAIR, Satu Data Indonesia regulates ministry and agency communication by organizing data management coordination roles and structure. Satu Data Indonesia is about data principles and the coordination between ministries and agencies of the Indonesian government in producing data.

5.7 The Similarity and Difference Between Satu Data Indonesia and FAIR Principles

The FAIR principles highlight machine-actionability, while only three out of four principles in Satu Data Indonesia has a connection with machine-actionability. The last principle of Satu Data Indonesia, data should follow code reference, aims to force coordination between ministries and agencies to agree on code reference before publishing data and still unknown whether the code reference can be read by a machine or not. Besides, FAIR principles are about data and metadata, written with (meta)data, while the Satu Data Indonesia principles only specified data as principle object.

The first and fourth principle of Satu Data Indonesia: data should comply with the standard and must be using the reference code, has similarities with the third sub-principle of Reusability (R.1.3), which states (meta)data meet domain-relevant community standards. Standard in Satu Data Indonesia refers to the same standard in terms of concepts, definitions, classifications, sizes, units, and assumptions for a specific data based on criteria established by data builder (pembina data) or widely standard (Indonesia, 2019). It is also stated in R.1.3 of the FAIR principles that meta(data) standards refer to community standards. Where community standards or best practices for data archiving and sharing exist, they should be followed (Jacobsen, de Miranda Azevedo, et al., 2020). Satu Data Indonesia not only explaining who can set the data standard but also mentioned it could use widely standard, it can be defined that the principle wants the data produced following the community standard.

The second principle of Satu Data Indonesia states that data must have metadata, which follows the standard structure and standard format. Satu Data Indonesia blueprints detailed metadata should contain information in a standard structure and format that describes, explains, places, or facilitates searching, using, or managing information from relevant data (UKP-PPP, 2014). Unfortunately, there is not enough information from the policy document about the structure and format that this principle promotes and the practice to achieve the metadata requirement. If this principle is compared with FAIR, all the ideal conditions required in the metadata can use the FAIR principles as a guidance. The connection between the second principle of Satu Data Indonesia and FAIR can be seen in the table below:

Table 3. Metadata Requirement in Satu Data Indonesia and How FAIR Principles Can Fulfil its Goal

Metadata requirement of Satu Data Indonesia Principles	**Similar Principle in FAIR**	**Principle/Sub-principle Statement**
Should contain information that describes and explains data	Findable	• (meta)data are assigned a globally unique and persistent identifier (F1) • data are described with rich metadata (F2) • metadata clearly and explicitly include the identifier of the data it describes (F3)
Should contain information that facilitate searching		• (meta)data are registered or indexed in a searchable resource (F4)
Should contain information that facilitate using or managing information from the data	Reusable	(meta)data are richly described with a plurality of accurate and relevant attributes (R1) • (meta)data are released with a clear and accessible data usage license • (meta)data are associated with detailed provenance • (meta)data meet domain-relevant community standards

FAIR and Satu Data Indonesia have the same concept of interoperability, as the ability to integrate or function in combination with minimal effort. Unlike FAIR that describes the sub-principle to achieve interoperability, the Satu Data Indonesia policy states that the Ministry of Communication and Information will regulate data interoperability's practical and technical details.

There is no principle in Satu Data Indonesia that equivalent to the accessibility principle in FAIR. However, the policy document stated that data producers could apply for data access restrictions in the data forum means the accessibility regulated in the policy but the particular method to regulate the accessibility not stated clearly in the Satu Data Indonesia principles.

5.8 Conclusion

Satu Data Indonesia and FAIR have several differences and similarities in their objectives and principles. Good data management is the objective of both Satu Data Indonesia and FAIR, emphasizing human and machine-readable to extract optimum benefits from the data. However, the scope of Satu Data Indonesia is the Indonesian government data that refer to data production by ministries and agencies, while FAIR practically can be applied to every kind of data even though it starts the idea from scholarly data publication.

From the perspective of Satu Data Indonesia and the FAIR principles, three out of four Satu Data Indonesia's principles have similarities with the FAIR principles. All facet in FAIR principles explains the detailed requirement to achieve three principles of Satu Data Indonesia: data must comply with the data standards, data must have metadata, and data must comply with the interoperability rule.

The evidence from this work suggests that FAIR and Satu Data Indonesia have some similarities and slight differences in both objectives and principles that make FAIR harmonious with Satu Data Indonesia and opens up opportunities of FAIR principles to make improvements for Satu Data Indonesia.

6. Governance and Regulatory Framework for Digital Health Data in Indonesia and the Possibility to Extend the Principle With FAIR

6.1 Health Landscape in Indonesia

The Indonesian government should fulfill the right to health as part of human rights because, in the constitution of 1945, the State is responsible for securing, fostering, implementing, and fulfilling human rights. Indonesia is a rapidly growing nation of medium revenues with 262 million people, representing over 300 ethnic groups and 730 language groups spread across 17744 islands and poses unique health systems problems and universal health coverage.(Agustina et al., 2019). For example, Indonesia has a ratio of doctors per population of 1: 3333, the lowest in Southeast Asia, which has an average of 1: 769 and is still below the World Health Organization (WHO) recommendation to have a ratio of 1 doctor per 1000 population (Sunjaya, 2019). In addition, the distribution

disparity between urban and rural areas is still immense, with just 20% of doctors in rural areas practicing. Problems with stability, low salaries, and delayed budget disbursement due to decentralization and regional autonomy have made practice less attractive in remote and border areas (Anderson et al., 2014). Decentralization is one of the ways that Indonesia has managed to solve some of these issues. Indonesia is committed to ensuring successful decentralization, carried out at the district level since 2001. In the decentralization process, the central government delegating authority from the central government to the local government. The type of decentralization is implementing regional autonomy, which is widely given to the local government of regency and a city (Gunawan & Aungsuroch, 2017).

The National Long-Term Development Plan (RPJPN) for 2005-2025 defines Indonesia's Health Plan in general as one of the points of human resources development. This initiative puts the creation of health care at the center of improving human resources quality and improving education and citizens' buying power. The Ministry of Health developed the "Healthy Indonesia" program, as part of the long-term development plan, through the 2015-2019 National Medium-Term Program. It aimed to improve maternal and child health, control disease, health care accessibility and efficiency, universal health coverage, weaving human health, medication, vaccine resources, and increasing the health system's responsiveness (Ministry of National Development, 2014)

6.2 Digital Health Governance in Indonesia

Digital health uses apps or hardware, often using mobile smartphones or sensor technology, to enhance health and health services for patients or communities (Chen et al., 2019). These innovations include hardware and software, telemedicine and analysis, emails, mobile phones and applications, text messages, wearable devices such as smart watch, and sensors for clinical and remote monitoring. (Widmer et al., 2015). More than 300,000 health applications currently exist worldwide. It is used to access medical facilities to facilitate healthier behavior by regulating diet and nutrition, tracking lifestyle, stress assessment, and even digital sensor ties from devices like a smartwatch (Aitken, 2017). The potential of technology in the health sector is very high. Therefore, at the 58th WHO meeting of Resolution WHA58.28, all of the members are beginning to prepare the implementation of e-health. The WHO has launched the Global Observatory for eHealth

(GOe), a project to help study the development and effect of eHealth in individual countries (WHO, 2012).

Indonesia has an excellent opportunity to answer health challenges by using digital health. The latest Indonesian Internet Service Providers Association (APJII) survey in 2019 reported that internet penetration among the Indonesian population rose 10,12% compared to 2018. It is 171.17 million, or 64.8% percent of Indonesia's population was connected to the internet (APJII, 2019). The same survey also noted that internet penetration in urban areas is 74.1% and in rural areas is 61.6% with smartphones as the most devices to access the internet. Indonesia started using digital health from 1984 by conducting a study to test the use of satellites to provide health and education access to in-depth areas. At that time, the use of health telecommunications was carried out to develop the health of pregnant women in eastern Indonesia (Sunjaya, 2019).

Two government institutions, the Ministry of Health and the Ministry of Communication and Information Technology plays a vital role in the growth of digital health in Indonesia. The Ministry of Communication and Information Technology serves as a regulator and also as a facilitator. The Ministry is also interested in developing ecosystems that support digital health services along with digital health start-ups, which are funded by the Indonesian HealthTech Association (Putri, 2019). The Ministry of Communication and Information Technology also facilitates telehealth by providing the District Internet Service Center (PLIK) facility and District Internet Service Center Car (MPLIK) to give access to internet service facilities to the sub-district level. Telehealth can address difficult access in remote areas for health workers, a major problem in Indonesia (Sunjaya, 2019). The use of health telecommunications can bridge the access and treatment of patients in remote areas because health telecommunications does not have a limitation of time and place between patients and health workers.

On the other hand, the Ministry of Health also acts as a regulator for digital health. Digital health policy started with the publication of Minister of Health Policy No. 374/MENKES/SK/V/2009 on the National Health System (SKN) and recently published Minister of Health Regulation No. 46, 2017 on the National E-Health Strategy. This policy was intended to help develop information and communication technology for health care

and information. The Ministry of Health also introduced four health-related applications. (Ministry of Health, 2018):

a) Sehat Pedia, a health application to accommodate and facilitate the public in obtaining accurate, credible, and reliable health information through live chat consultations, health articles, health service facility information, online outpatient registration, and e-policy.
b) Indonesia Health Facility Finder (IHeFF), an application that has functions to improve health services effectively. Through this application, anyone can easily find health facilities within a 3 km radius using the GPS of their device.
c) Application of Digital Signature System (e-Sign), a system that facilitates the export and import of household health supplies (PKRT) medical devices to make them more effective and efficient. Through this application, the Ministry of Health continues to improve effective, efficient, and accountable public services on an ongoing basis to create a healthy and prosperous Indonesia.
d) The e-postBorder PKRT medical device application. The Ministry of Health builds an electronic post border surveillance system. This application is used to increase the effectiveness of monitoring medical devices.

Besides, the government is also developing telecommunication applications for Indonesia or for short as TEMENIN (Tel-Radiology, TEKG (Electrocardiography), ULTRASS, and Tele-Konsultasi (Tele-USG) in four areas, including telemedicine applications(Putri, 2019)

The private sector also makes digital health products, and eight are predicted to have a potential valuation of above $1 billion. The eight startups are Medigo, Pasienia, PesanLab, Homecare24, HaloDoc, TeleCTG, TanyaDok, and Alodokter (Akhaya, 2019). Indonesia's largest telehealth companies, including Alodokter, Halodoc, and GrabHealth, a joint venture between Singapore ride-hailer Grab and China's Ping An Healthcare and Technology, have all seen consumption skyrocket during the COVID-19 outbreak era. (Delloite, 2020)

6.3 Digital Health Regulatory Framework in Indonesia

From a policy perspective, through the Ministry of Health, the Indonesian government has provided serious support in developing digital health. This support was stated in the Minister of Health Regulation No.374/MENKES/SK/V/2009 concerning the National Health System (SKN), followed by the Minister of Health Regulation No.192/MENKES/SK/VI/2012 regarding Roadmap of Action Plan for Strengthening Indonesian Health Information System. The SKN contain an arrangement of health management and information subsystem to collects various health administration efforts supported by data and information management, development and application of science and technology, as well as integrated and mutually supportive health law arrangements, in order to ensure the achievement of the highest degree of health (Yudho et al., 2010).

Also, the Indonesian government has published two core policies to regulate digital health. The first policy is Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019. This regulation aims to develop and strengthen a national health information system in the next five years to create an ideal health information system. This policy was formed by the Ministry of Health based on the following eight regulations :

i. Law Number 16 of 1997 concerning Statistics (State Gazette of the Republic of Indonesia of 1997 Number 39, Supplement to the State Gazette of the Republic of Indonesia Number 3638);
ii. Law Number 11 of 2008 concerning Electronic Information and Transactions (State Gazette of the Republic of Indonesia of 2008 Number 58, Supplement to the State Gazette of the Republic of Indonesia Number 4843);
iii. Law Number 36 of 2009 concerning Health (State Gazette of the Republic of Indonesia of 2009 Number 144, Supplement to the State Gazette of the Republic of Indonesia Number 5063);
iv. Law Number 23 of 2014 concerning Regional Government (State Gazette of the Republic of Indonesia of 2014 Number 244, Supplement to the State Gazette of the Republic of Indonesia Number 5587) as amended several times, the latest by Law Number 9 of 2015 (State Gazette of the Republic of Indonesia of 2015

Number 58, Supplement to the State Gazette of the Republic of Indonesia Number 5679);

v. Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions (State Gazette of the Republic of Indonesia of 2012 Number 189, Supplement to State Gazette of the Republic of Indonesia Number 5348);
vi. Government Regulation Number 46 of 2014 concerning Health Information Systems (State Gazette of the Republic of Indonesia of 2014 Number 126, Supplement to State Gazette of the Republic of Indonesia Number 5542);
vii. Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan 2014-2019 (State Gazette of the Republic of Indonesia of 2014 Number 220);
viii. Regulation of the Minister of Health Number 92 of 2014 concerning Implementation of Data Communication in the Integrated Health Information System (State Gazette of the Republic of Indonesia of 2014 Number 1954);

The second policy is Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy. This policy generally begins the discussion on the existence of technology capacity that encourages the use of technology and communication in the health sector called e-health that improves the quality, accessibility, sustainability of health services, and increases the availability and quality of health data information. A strengthening strategy is needed in its application because the system is inseparable from problems, which is called e-health. This policy created based on eight regulations :

i. Law Number 11 of 2008 concerning Electronic Information and Transactions (State Gazette of the Republic of Indonesia of 2008 Number 58, Supplement to the State Gazette of the Republic of Indonesia Number 4843);
ii. Law Number 14 of 2008 concerning Openness of Public Information (State Gazette of the Republic of Indonesia of 2008 Number 61, Supplement to the State Gazette of the Republic of Indonesia Number 4846);
iii. Law Number 36 of 2009 concerning Health (State Gazette of the Republic of Indonesia of 2009 Number 144, Supplement to the State Gazette of the Republic of Indonesia Number 5063);

iv. Law Number 23 of 2014 concerning Regional Government (State Gazette of the Republic of Indonesia of 2014 Number 244, Supplement to the State Gazette of the Republic of Indonesia Number 5587) as amended several times, the latest by Law Number 9 of 2015 (State Gazette of the Republic of Indonesia of 2015 Number 58, Supplement to the State Gazette of the Republic of Indonesia Number 5679);

v. Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions (State Gazette of the Republic of Indonesia of 2012 Number 189, Supplement to State Gazette of the Republic of Indonesia Number 5348);

vi. Government Regulation Number 46 of 2014 concerning Health Information Systems (State Gazette of the Republic of Indonesia of 2014 Number 126, Supplement to State Gazette of the Republic of Indonesia Number 5542);

vii. Presidential Regulation Number 96 of 2014 concerning Indonesian Broadband Plan 2014-2019 (State Gazette of the Republic of Indonesia of 2014 Number 220);

viii. Presidential Regulation Number 2 of 2015 concerning the National Medium Term Development Plan (State Gazette of the Republic of Indonesia of 2015 Number 3);

6.4 Level of FAIR Equivalency in Digital Health Policy of Indonesia

6.4.1 Identification of Relevant Document

The objective of the analysis is to check the regulatory framework of health data to know Indonesia's context and explore the possibility of expanding the principle with FAIR. Therefore, the questions should be answered: are the FAIR Guiding Principles mentioned in the policy documents, and what is the level of FAIR Equivalency in the policy documents analyzed?

The first step to answer those questions is to collect several documents related to digital health and then analyze the documents based on the question. Four policies are directly related to digital health, and 12 policies are the basis for making policies on digital health. Five policies were obtained from the Ministry of Health and the other from websites of

relevant government institutions. However, not all of the documents were relevant to ICT/health-related and published by the Indonesian government. The table below shows the availability and the relevancy of the policy to the digital health topics.

Table 4. Availability and Relevancy of Policy Documents to Digital Health Topics

No	Document	Type of Document	Source	Relevant? (Yes/No)	Available? (Yes/No)
1	Minister of Health Regulation No.374/MENKES/SK/V/2009 concerning the National Health System (SKN)	Policy	Ministry of Health	Yes	No
2	Minister of Health Regulation No.192/MENKES/SK/VI/2012 concerning Health Information System Roadmap 2015-2019	Policy	Ministry of Health	Yes	No
3	Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019	Policy	Ministry of Health	Yes	Yes
4	Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy	Policy	Ministry of Health	Yes	Yes
5	Law Number 16 of 1997 concerning Statistics	Policy	Indonesian government	No	Yes
6	Law Number 36 of 2009 concerning Health	Policy	Indonesian government	No	Yes
7	Law Number 11 of 2008 concerning Electronic Information and Transactions	Policy	Indonesian government	Yes	Yes
8	Law Number 23 of 2014 concerning Regional Government	Policy	Indonesian government	No	Yes
9	Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions	Policy	Indonesian government	Yes	Yes
10	Government Regulation Number 46 of 2014 concerning Health Information Systems	Policy	Indonesian government	Yes	Yes
11	Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan	Policy	Indonesian government	Yes	Yes
12	Regulation of the Minister of Health Number 92 of 2014 concerning Implementation of Data Communication in the Integrated Health Information System	Policy	Ministry of Health	Yes	Yes
13	Law Number 14 of 2008 concerning Openness of Public Information	Policy	Indonesian government	Yes	Yes

14	Presidential Regulation Number 2 of 2015 concerning the National Medium Term Development Plan	Policy	Indonesian government	No	Yes

The document's criteria that included doing the analysis are only the document relevant to the research's objective and should be available, which means filled "yes" on the two-last column. Therefore, only eight documents were selected from 2008 to 2017, and six documents were excluded from this research.

Table 5. Selected Document for FAIR Equivalency Analysis

No	Document	Year	Type of Document	Source of Document	Website
1	Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019	2015	Policy	Ministry of Health	https://www.hukumonline.com/pusatdata/detail/lt57f76f52a508a/node/lt50ed1b7acfde5/peraturan-menteri-kesehatan-no-97-tahun-2015-peta-jalan-sistem-informasi-kesehatan-tahun-2015-2019
2	Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy	2017	Policy	Ministry of Health	https://www.kemkes.go.id/article/view/18052200002/peraturan-menteri-kesehatan-republik-indonesia-nomor-46-tahun-2017-tentang-strategi-e-kesehatan-nasi.html
3	Law Number 11 of 2008 concerning Electronic Information and Transactions	2008	Regulation	Indonesian government	https://web.kominfo.go.id/sites/default/files/users/4761/UU%2019%20Tahun%202016.pdf
4	Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions	2012	Policy	Indonesian government	https://jdih.kominfo.go.id/produk_hukum/view/id/6/t/peraturan+pemerintah+republik+indonesia+nomor+82+tahun+2012
5	Government Regulation Number 46 of 2014 concerning Health Information Systems	2014	Policy	Ministry of Health	https://luk.staff.ugm.ac.id/atur/PP46-2014SIKesehatan.pdf
6	Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan	2014	Policy	Ministry of National Development	https://www.Ministry of National Development.go.id/index.php?cID=4848?cID=4848
7	Regulation of the Minister of Health	2014	Policy	Ministry of Health	https://www.kemkes.go.id/resources/download/peraturan/permenkes-no-92-thn-2014.pdf

	Number 92 of 2014 concerning Implementation of Data Communication in the Integrated Health Information System				
8	Law Number 14 of 2008 concerning Openness of Public Information	2008	Regulation	Indonesian government	https://www.kpk.go.id/images/pdf/uu%20pip/UU_No_14_Tahun_2008.pdf

6.4.2 Mention of the FAIR Principles in The Policy Documents

The policy documents that were selected as relevant to the eHealth sector in Indonesia (Table 5) were carefully analyzed by code-labeling (Ranney et al., 2015) on whether they mentioned the FAIR Guiding Principles and/or the FAIR-like (FAIR-Equivalent) principles. A '1' was assigned to the corresponding data cell for cases where the policy documents mentioned either the FAIR-like principles (FAIR-like Mention) or the FAIR Guiding Principles (FAIR Mention), whereas a '0' was assigned for cases where either of the two was not mentioned.

The results of the analysis of whether or not the policy documents refer to the FAIR Guiding Principles indicate that whereas none (0 percent) of the documents refer to the FAIR Guiding Principles, but 6 of the 12 documents (75%) refer to the FAIR Principles (FAIR-like principles) equivalent. Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan and Law Number 14 of 2008 concerning Openness of Public Information are the documents with no FAIR-like principles in the content (see Table 6).

Table 6. Result of FAIR-like Mention and FAIR Mention in Policy Documents

Policy Document	FAIR-like Mention	FAIR Mention
Law Number 11 of 2008 concerning Electronic Information and Transactions	1	0
Law Number 14 of 2008 concerning Openness of Public Information	0	0
Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions	1	0
Government Regulation Number 46 of 2014 concerning Health Information Systems	1	0
Regulation of the Minister of Health Number 92 of 2014 concerning Implementation of Data Communication in the Integrated Health Information System	1	0
Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan	0	0
Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019	1	0
Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy	1	0
Total Mention	6	0
Total Policy Documents	8	0
Percentage (%)	75	0

6.4.3 FAIR Equivalency in the Policy Documents

To answer the second question, what is the level of FAIR Equivalency in the policy documents analyzed? The policy documents were analyzed as to whether they refer to the equivalent of the 15 sub-criteria of the FAIR principles (also known as 'FAIR facets') as enacted in the fundamental FAIR article (Wilkinson et al., 2016). Such FAIR dimensions consist of the following: 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'). A systematic and through review of the mention to the equivalent of 15 FAIR dimensions in each policy document was carried out using a coding-labeling method (Ranney et al., 2015). The policy papers were organized in rows using the Microsoft Excel spreadsheet, while the FAIR elements were arranged in columns. In each policy text, the mention to the FAIR equivalent facet was labeled '1,' while the lack of mention to the FAIR equivalent facet was labeled '0' in the corresponding Microsoft Excel spreadsheet data cell (see Results: Table 7)

Table 7. FAIR Equivalency Result in Policy Documents

Policy Document	FAIR Equivalency															
	F1	F2	F3	F4	A1	A1.1	A1.2	A2	I1	I2	I3	R1	R1.1	R1.2	R1.3	FE Score
Law Number 11 of 2008 concerning Electronic Information and Transactions	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Law Number 14 of 2008 concerning Openness of Public Information	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Government Regulation Number 82 of 2012 concerning Implementation of Electronic Systems and Transactions	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	3
Government Regulation Number 46 of 2014 concerning Health Information Systems	0	1	0	1	1	0	0	0	1	0	0	1	0	0	1	6
Regulation of the Minister of Health Number 92 of 2014 concerning Implementation of Data Communication in the Integrated Health Information System	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2
Presidential Regulation Number 96 of 2014 concerning Indonesia Broadband Plan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	4
Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy	1	0	0	0	1	1	1	0	1	0	0	0	1	0	1	7
Total	1	1	0	2	3	2	4	0	5	0	0	1	1	0	3	
Percentage (%)	12,5	12,5	0	25	37,5	25	50	0	62,5	0	0	12,5	12,5	0	37,5	

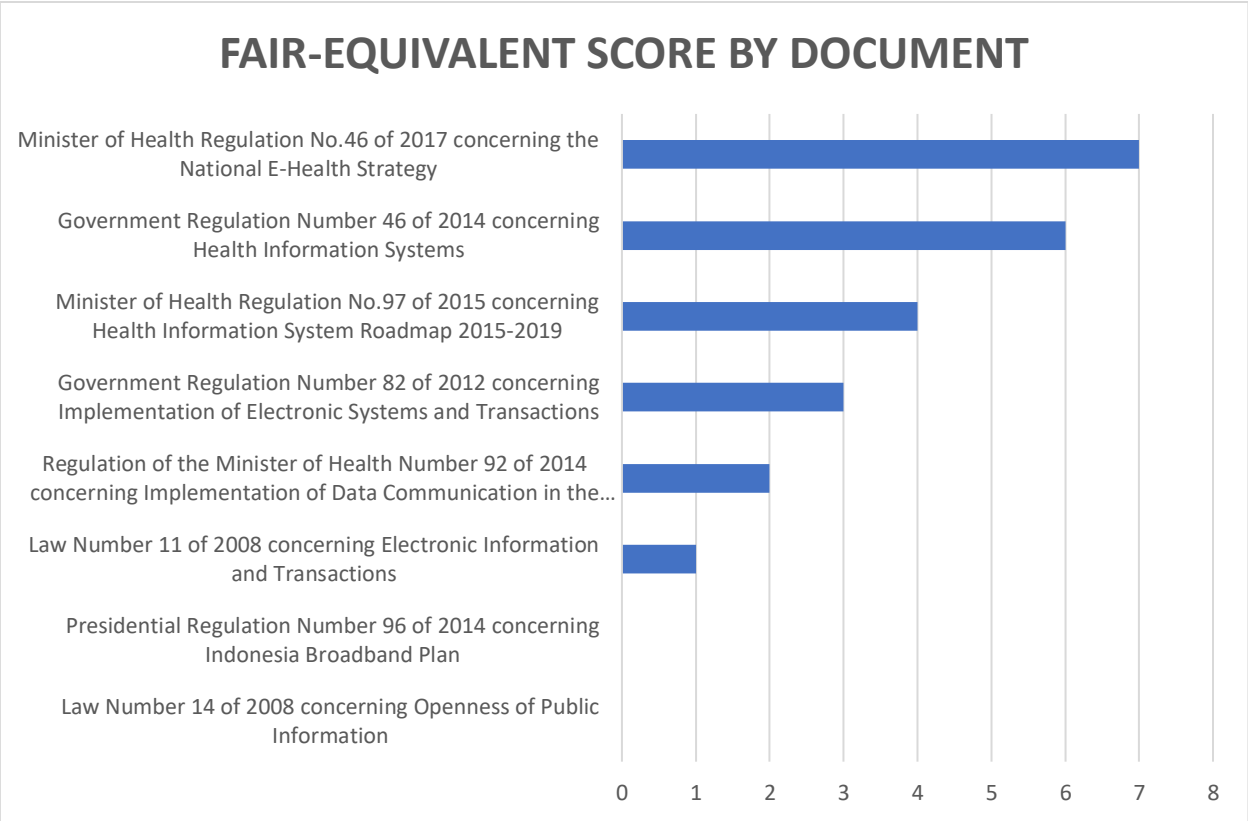

Figure 5. FAIR-Equivalent Score by Document

Figure 5 provides the FAIR equivalency (FE) score on each relevant policy documents. It can be seen that the Minister of Health Regulation No.46 of 2017 concerning the National

E-Health Strategy has the highest FE Score with a score of seven, followed by Government Regulation Number 46 of 2014 concerning Health Information Systems as the second highest with a score of six. Moreover, the graph shows that FAIR-Equivalency does not generally increase over time. However, the last two policies issued by the government, Minister of Health Regulation No.97 of 2015 concerning Health Information System Roadmap 2015-2019 and Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy, scored relatively high compared to other documents. It should be noted that these two documents, which have the highest FAIR equivalence, form the core of the Indonesian eHealth sector governance framework and are the foundation for Indonesia's digital health/eHealth policy. FAIR dimensions contained in the document can be seen in the figure 6:

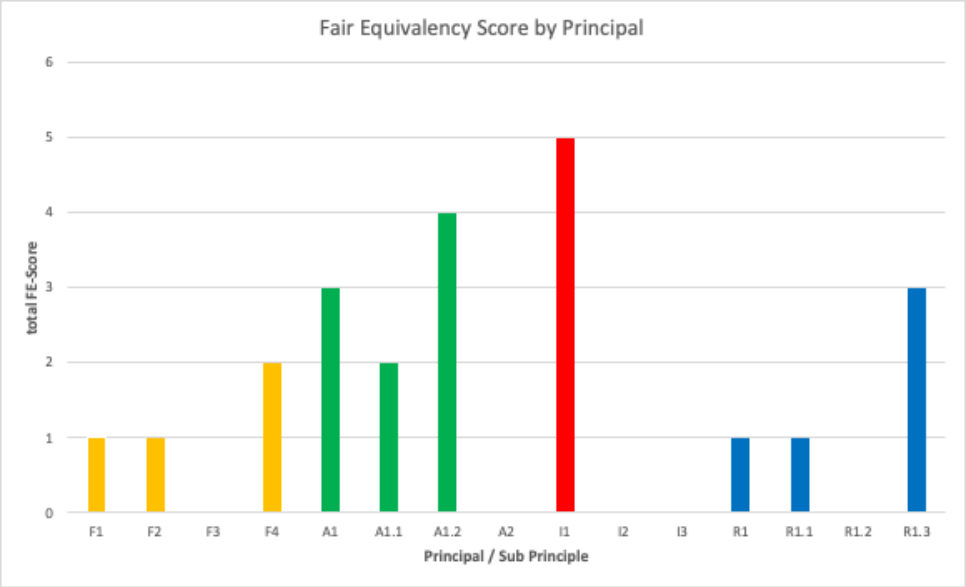

Figure 6. FAIR Equivalency Score by Principle/Sub Principles

It is apparent from this table that all FAIR principles appear in policy documents, but very few sub-principles of FAIR emerge in the documents. Sub-principle I1 has the highest FE-Score, which indicates this sub-principle appears in almost all policy documents. Meanwhile, facet F3, A2, I2, I3, and R1.2 are never mentioned in Indonesian digital health policies. Regarding the least-mentioned FAIR-equivalent facets, Wilkinson and colleagues described these facets as follows: F3 – "metadata clearly and explicitly include the identifier of the data it describes"; A2 – "metadata are accessible, even when the data are no longer available"; I2 – "meta(data) use vocabularies that follow FAIR principles"; I3 – "(Meta)data include qualified references to other (meta)data" ; R1.2 – "(Meta)data are

associated with detailed provenance". These FAIR-Equivalent Facets (F3, A2 , I2, I3, and R1.2) are the least listed in policy documents because they explicitly deal with data and metadata information. It is below the reach of the documents examined since, at the policy level, the documents do not specifically address specific aspects. Therefore, only after the measures or recommendations in the documents have been applied in a particular sense that it is possible to determine whether the actual implementation(s) comply with certain aspects.

Findability Facet Examples in The Policy Documents

Findability contains four facets; they are F1, F2, F3, and F4. Facet F1, F2, and F4 were found on the document while facet F3 never mentioned. Perhaps the most important among the FAIR Principles is 'Findability' , especially facet F1, which requires that to be 'Findable' , data and metadata should be assigned a globally unique and persistent identifier (Wilkinson et al., 2016). Without a unique identity, it would not be easy for humans and machines to identify a digital object, let alone decide whether it is reusable in their context. The remaining three principles of FAIR (Accessibility, Interoperability, and Reusability) are partially or even wholly related to Findability.

Facet F1 was only found in Minister of Health Regulation No.46 of 2017 concerning the National E-Health Strategy. It states in standard and interoperability requirements, which explains using a Population Identification Number (NIK), which has the potential as a unique identifier to support integration and interoperability between existing health care systems.

The Facet F2 notes that data is represented with rich metadata, enabling a machine to automatically carry out routine and tedious sorting and prioritize researchers' tasks in demand. The explanation for this concept is that everyone should find the information that their metadata provides, even without identifying the data (GO-FAIR, n.d.). This facet is found only in Government Regulation Number 46 of 2014 concerning Health Information Systems regarding health data that must follow a standard. Although it states that health data should have the type, nature, format, database, codification, and metadata that can be easily integrated, the policy statement is different with the F2 facet.

The last element to the policy content is F4, which means that (meta)data is registered in a searchable resource or indexed. Identifiers and rich metadata details on the Internet alone will not guarantee 'findability.' Good data services should not be used only because no one knows they exist. There are various ways to search, like indexing, digital tools. (GO-FAIR, n.d.). In article 21, section 8 on Data and Information Storage of Government Regulation Number 82 of 2012 states health data and information is stored in a "database" in a safe place and cannot damaged or lost by using electronic and/or non-electronic storage media. "Database" is a place/container for various data collected regularly in a structured database according to informatics principles that users can access at any time to produce the necessary information by using the concept of the data warehouse. The purpose of the statement in this article is consistent with facet F4, which require a meta(data) should be placed in a searchable resource.

Accessibility Facet Examples in The Policy Documents

Facet A1, A1.1, and A1.2 are mentioned in the policy documents, while none of the documents mentioned a requirement for metadata access to the metadata even when the data are no longer available (A2). Facet A1 acknowledges that it may not always be possible to allow fully automated access to data in the case of highly sensitive data. In these situations, presenting contact information such as e-mail, telephone number, or other communication with a person who can request access to the data also provides FAIR data(GO-FAIR, n.d.). Two late policy that related to digital health mentioned facet A1 in the document. Minister of Health Regulation No.46 of 2017 states standards are the key to success in data transactions between information systems or electronic systems, and these standards can be developed independently or adopted from international standards (ISO / IEC). Besides, it explained that standards could be seen from various perspectives, including functional standards of electronic information systems, data standards and health terminology, security and privacy standards, as well as electronic data communication standards. Minister of Health Regulation No.97 of 2015 mentioned facet A1 by states that access to data and information from across units in the Ministry of Health and across sectors is still challenging. Unavailability of standards and protocols in implementing information systems in each ministry/agency is a central problem of accessibility. Therefore, phase five (2035-2039) of the health information system is directed at strengthening the application of health information systems based on electronic health (e-

health) by an integrated global network that is implemented with quality assurance with international standards.

Interoperability Facet Examples in The Policy Documents

None of the documents contained facet I2 and I3, while five out of eight digital health policy documents mentioned I1. Facet I1 states (meta)data use a formal, accessible, shared and broadly applicable language for knowledge representation. To ensure automatic findability and interoperability of data sets, it is important to use a widely used controlled vocabulary, ontology, thesauri, and a good data model.

Generally, the number of policies that mention interoperability shows the implementation of digital health in Indonesia emphasizes the interoperability aspect. All policies state the importance of communication between systems to achieve data exchanges. Integration includes both technical systems (systems that can communicate with each other) and content (the same data set). Integrated health information system architecture is regulated in Minister of Health Regulation No.97 of 2015 and mentioned facet I1. It explained that the physical form of an integrated health information system is an information system application linked with other applications, so the interoperability data between applications could achieve. Regulation of the Minister of Health Number 92 of 2014 clarifies the definition of an integrated health information system is a system capable of providing a mechanism for interconnecting information subsystems in various ways as needed. In addition, the particular way to achieve interoperability is mentioned in Government Regulation Number 46 of 2014, that states a needs for electronic-based data standard service by utilizing existing technology (web services, API),therefore, it can be utilized by e-health stakeholders, especially for the development of a health service information system.

Reusability Facet Examples in The Policy Documents

In order to be repeated and/or combined in multiple environments, metadata and data should be well defined. Facet R1 of the reusability principle is to simplify the data finding and reuse through the application of various labels attached. The R1 principle relates to F2, but R1 focuses on a user's capacity to assess if data are useful in a specific context

(machine or human) (GO-FAIR, n.d.). Facet R1.3 is found in three documents: it has the highest score compared to the other reusability principles.

Minister of Health Regulation No.97 of 2015 highlighted the need for a standardized arrangement of health information systems, carried out through data codification, preparation of a health data dictionary, and setting priority indicators to address the health data integration and exchange problem. An explanation about standard noticed in Minister of Health Regulation No.46 of 2017 which detailed that standards can be seen from various perspectives, including functional standards of electronic information systems, data standards and health terminology, security and privacy standards, as well as electronic data communication standards (data exchange protocols). Both statements in the policies have an objective to make the data meet domain-relevant community standards.

6.4.4 Conclusion

This study's general objective was to assess the regulatory framework of health data to know Indonesia's context and explore the possibility of FAIR elements use to extend the Satu Data Indonesia principles in the eHealth sector. Although the FAIR Principles were not mentioned in any of the policy documents relevant to the Indonesian digital health sector, six out of eight documents mentioned FAIR-Equivalent efforts. For example, the Population Identification Number (NIK) has the potential as a unique identifier to support integration and interoperability (Findability), a plan to build standards and protocols in the implementation of information systems in each ministry/agency to improve data accessibility (Accessibility), planned/ongoing integration of the various information systems (Interoperability) and highlighted the need for a standardized arrangement of health information systems related to health data following the community standard (Reusability).

Some documents at the essence of Indonesian digital health/eHealth policy have the highest FAIR Equivalence Score, designed in this study as an aggregate score of FAIR equivalent facets in policy documents. The result shows some degree of alignment of the Indonesian digital health implementation vision with the FAIR guiding principles. Although the Ministry of Health as a regulator of digital health will apply the Satu Data Indonesia principles to build a digital health system, this FAIR equivalency score may

indicate Indonesia's digital health plans is open an opportunity to use FAIR principles in achieving its goal through Satu Data Indonesia.

7. Current situation of Data Management by the Indonesian government in Integrating COVID-19 Data

7.1 COVID-19 Pandemic in Indonesia

The world is experiencing negative impacts in various sectors and faces significant challenges in 2020 due to a pandemic. In Wuhan City, Hubei Province, China, a novel coronavirus known as extreme acute respiratory coronavirus 2 (SARS-CoV-2) was first identified in a seafood market at the end of 2019 (Zhu et al., 2020). Contagious respiratory disease caused by this novel coronavirus is known as coronavirus disease 2019 or, in short, COVID-19 (Wu et al., 2020). Later, on March 11, 2020, the World Health Organization (WHO) administered global impact management activities and proclaimed COVID-19 as a global pandemic (World Health Organization, 2020). With more than 26 million confirmed cases in 188 countries, COVID-19 has spread worldwide, and more than 860,000 individuals have lost their lives (BBC News, 2020). COVID-19 pandemic does not only affects the health sector; it also hurts various sectors. Studies have shown that it will take more than a decade for the planet to recover, socially and economically, which could significantly undermine the momentum of the 2030 Plan for Sustainable Development (SDGs) (Djalante et al., 2020).

With a population of more than 250 million and the fourth largest globally, COVID-19 would have a significant adverse effect on Indonesia relative to other countries with smaller populations (Djalante et al., 2020). The Indonesian government evacuated 243 Indonesian nationals from Wuhan, China, in February 2020. Two hundred forty-three citizens were quarantined in Natuna, Riau Islands, and finally released after 14-day quarantine since the result shows that all of them are negative COVID-19 (Fadli, 2020). The Indonesian government also repatriated 68 of its citizens who are crew members aboard the Diamond Princess, a cruise ship docked in Yokohama, at the center of Japan’s coronavirus outbreak (Yoni, 2020). While COVID-19 infected many countries worldwide at the beginning of February 2019, the Indonesian government still maintains that Indonesia is safe from COVID-19. The government was in denial by ignoring a study by

researchers from Harvard University that claimed Indonesia might have unreported events. The Indonesian government intended to give up to 30 percent discounts to draw visitors when several countries imposed tough travel restrictions (Lindsey & Mann, 2020).

Indonesia completely realized on March 2 that COVID-19 had reached the archipelago. . The confirmation of the first Covid-19 case in Indonesia was announced directly by the Indonesian President, accompanied by the Minister of Health. A month later, April 9, 2020, all provinces in Indonesia confirmed the coronavirus's positive cases. The last province to confirm is Gorontalo (Kompas, 2020). The President of Indonesia created the COVID-19 Task Force, headed by the Head of the National Disaster Management Agency, in response to the COVID-19 outbreak. The establishment of the COVID-19 Task Force would contribute to the convergence of Indonesian national forces, both central and regional, involving civil servants, the Indonesian National Army, the Indonesian Police, the private sector, social institutions, and universities (Sebayang, 2020).

7.2 COVID-19 Data Management

This chapter discusses the COVID-19 data management situation of the Indonesian government. It uses interviews held from July 14th and August 26th from five individuals from the four Ministries in the Indonesian government that participate actively in Satu Data Indonesia. One interviewee from the Ministry of Health is responsible for implementing the Satu Data Indonesia principles in COVID-19 data management. This interview provides a complete understanding of the Satu Data Indonesia principles and how the Indonesian government uses the principle in the COVID-19 crisis. The analysis was based on the multiple stream approach proposed by Kingdon (1995) to explore the case from the three different streams : problem, policy, and political.

Problem Stream

Internal data problems within the Indonesian government were noticed by the President of Indonesia in the Economic Census coordination meeting when the President complained about the different poverty data results (Alvin, 2016). All of the interviewees' answers corroborate the statement that they struggle to integrate data from the Indonesian government's internal data producers, such as ministries, agencies, and local government. Weak collaboration between the internal government produces different data from similar

data production activity (Ministry of National Development, personal communication, July 14, 2020). One of the issues that emerge from these findings is the sectoral ego among internal government. Interestingly, all interviewees identified sectoral egos as the root cause of collaboration difficulties. Every ministry and agency chose to keep their data for internal use (BPS, personal communication, July 17, 2020; Ministry of Communication and Informatics, personal communication, August 12, 2020) because of their view of data as a valuable resource (Ministry of Communication and Informatics, personal communication, August 12, 2020). As a result, the Indonesian government experienced misunderstanding when publishing data to the public since data sourced from ministries and agencies overlapped (Ministry of National Development, personal communication, July 14, 2020). Coordination problems are seen as a vital issue that should be solved immediately (Ministry of National Development, personal communication, July 14, 2020). Therefore, it may be the case that these conditions are the reason why different data standards exist between the Indonesian government.

As the COVID-19 data management leader, the Ministry of Health ascertains data management's problem within the Indonesian government will be manifested in the COVID-19 case. Consistent with the finding of the main problem, the interview with the Ministry of Health found weak coordination became an issue in managing COVID-19 data (Ministry of Communication and Informatics, personal communication, August 12, 2020). The Indonesian government sees as unprepared to apply Satu Data Indonesia in COVID-19 data management due the principle was published in 2019 ; therefore, it takes time to break sectoral ego and rise the admission of Satu Data Indonesia principles among ministries, agencies, and local government (Ministry of National Development, personal communication, July 14, 2020). In the same way, the Indonesian government emphasizes fortifying the coordination by forming the COVID-19 task force.

Another important finding was that epidemiology investigation use semi-manual entry with excel. The process of transforming from manual to fully electronic is expected to finish in September 2020. Besides, the lack of human resources in entry data of COVID-19 also adds distress in data management. One of the ideal examples owned by the Ministry of Health is tuberculosis data management. However, it is not feasible to build a reliable system in a pandemic situation such as the tuberculosis system (Ministry of Health, personal communication, August 26, 2020).

Policy Stream

The idea to make better data management of the Indonesian government originally started when the Central Bureau of Statistics was funded by UNICEF to strengthen the sectoral data. The project plans to make data integrated into one source by implementing a principle and expected to improve the interoperability between ministries and agencies (BPS, personal communication, July 17, 2020). The idea transformed into a concept called Satu Data Indonesia by the Ministry of National Development and plan to be part of the National Statistic System. Draft of Satu Data Indonesia was discussed by several ministries and agencies until finally officially published as Presidential Regulation no.39, 2019, about Satu Data Indonesia (All). When the interviewee was asked the background of the policy launching, all of the interviewees commented the purpose of the policy is to communicate the coordination and also force every ministry and agency to follow the principle of Satu Data Indonesia in data production.

All of the interviewees agree that the coordination and the principle are the critical elements of Satu Data Indonesia. This also accords with the problem stream, which showed that the Indonesian government wants to develop data management to enhance data standards and coordination. The interviewee from BPS adds that both key elements are to achieve more efficient data production activity within the Indonesian government (BPS, personal communication, July 17, 2020). The policy of Satu Data Indonesia states about the data coordination organization and the core principles. All of the data produced owned by the Indonesian government, located in every ministries and agency (Ministry of National Development, personal communication, July 14, 2020), and the data privacy protected by law Law Number 11 of 2008 concerning Electronic Information and Transactions (Ministry of Communication and Informatics, personal communication, August 12, 2020)

One interviewee emphasized that Ministries and Institutions only need one data steward in each organization. If every directorate in the ministries or agencies owns their data steward, the data will stay at the directorate and making the coordination even worse (Ministry of National Development, personal communication, July 14, 2020). Besides data steward, Satu Data Indonesia set a role responsible for coordinating the data steward in ministries and agencies called Data Builder (Walidata) (BPS, personal communication,

July 17, 2020; Ministry of National Development, personal communication, July 14, 2020). Moreover, Satu Data Indonesia establishes a workgroup called "Data Forum" as a facilitator to apply the principles to ministries and agencies (BPS, personal communication, July 17, 2020). A typical view of the principle amongst interviewees was that the purpose of Satu Data Indonesia is to augment data standard and interoperability (BPS, personal communication, July 17, 2020; Ministry of National Development, personal communication, July 14, 2020; Ministry of Communication and Informatics, personal communication, August 12, 2020; Ministry of Health, personal communication, August 26, 2020). As standards of producing data set by the policy, all ministries and agencies should actively be involved in Satu Data Indonesia and transform Satu Data Indonesia to their organizations. Ministry of Health takes the initiative to interpret Satu Data Indonesia's principle and create their principle called Satu Data Kesehatan (Ministry of Health, personal communication, August 26, 2020) to undertake the integration problem caused by a variety of health information system. Moreover, the ministry is currently preparing a regulation on adopting Satu Data Indonesia in the health sector. Figure 7 shows the concept of Satu Data Kesehatan.

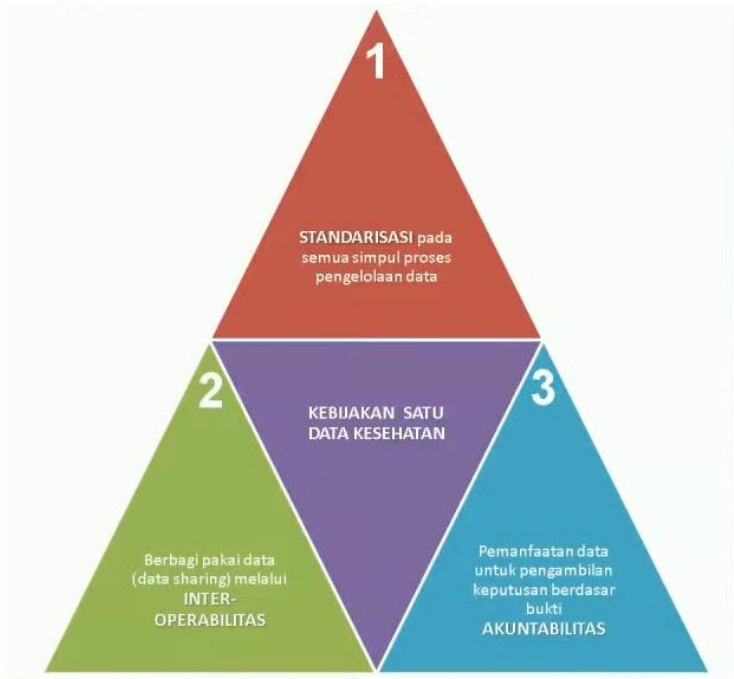

Figure 7. *Satu Data Kesehatan Concept* (Ministry of Health, 2020)

The Satu Data Kesehatan contain of three principles a) standardization at all data management process nodes b) data sharing via interoperability c) use of data for decision making based on evidence of accountability (Ministry of Health, 2020). The principle of

Satu Data Kesehatan is used to develop COVID-19 data management to facilitate several stakeholders of COVID-19 crisis in using data to handle and control the pandemic (Ministry of Health, personal communication, August 26, 2020). Figure 8 presents the architecture of Satu Data Kesehatan in response COVID-19 crisis.

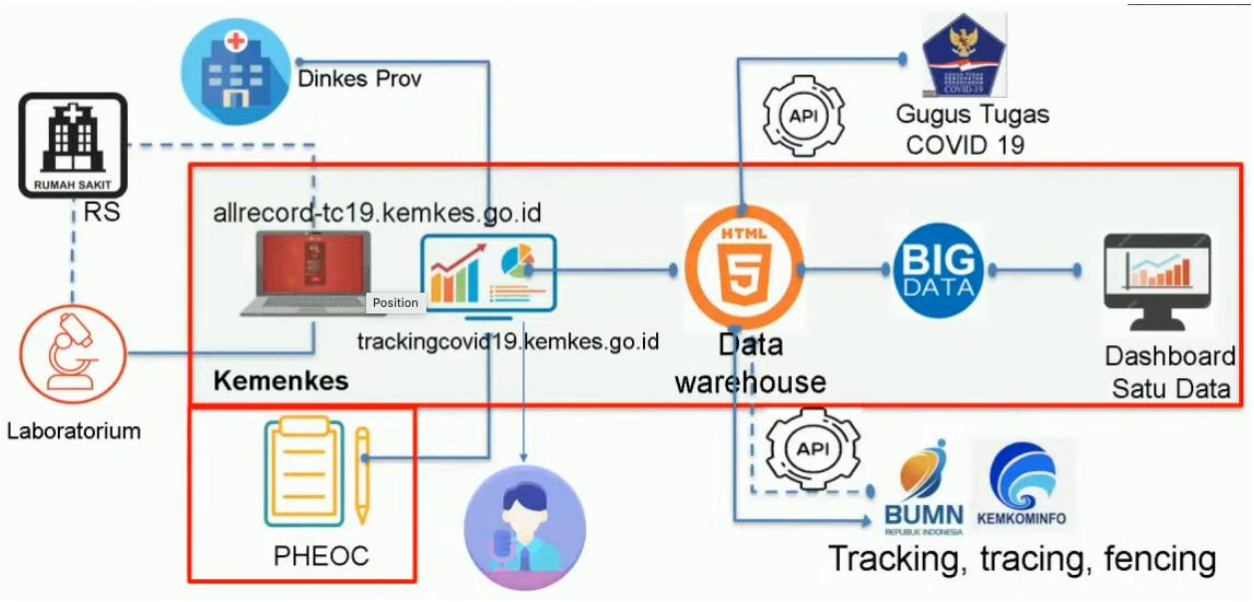

Figure 8 Satu Data Kesehatan for COVID-19 crisis (Ministry of Health, 2020)

All of the data from the hospital and local health agencies will be stored at allrecord-tc19.kemkes.go.id. As seen in the graphic, the data will be located in a data warehouse. All of the stakeholders can access the data and use it based on their responsibilities, such as the Ministry of ICT for tracking, tracing, and fencing or the COVID-19 task force uses the data to analyze the pandemic (Ministry of Health, 2020). Ministry of Health guarantees that patient privacy is a central concern of the system and regulates data protection (Ministry of Health, personal communication, August 26, 2020). However, the data record website at allrecord-tc19.kemkes.go.id only shows a login form, which means the data can be accessed if the Ministry of Health gives permission.

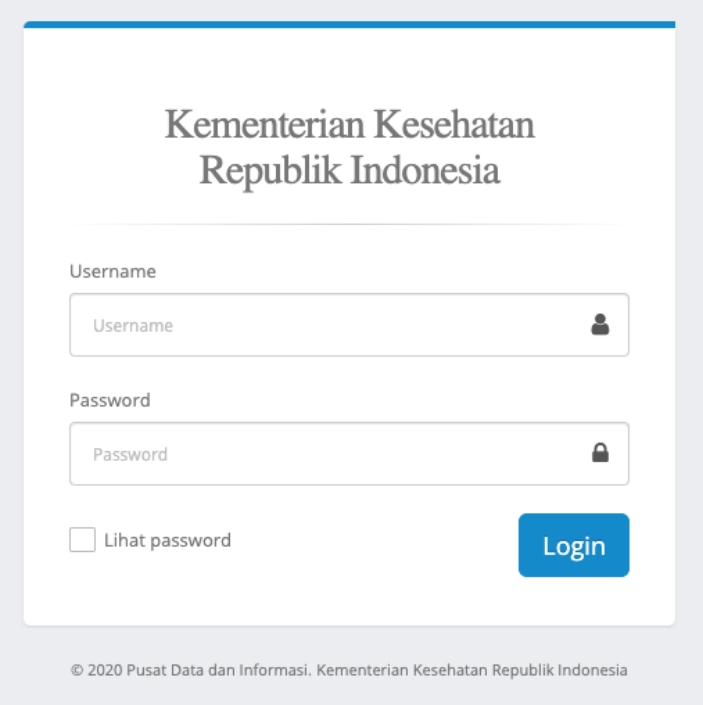

Figure 9 Login form at allrecord-tc19.kemkes.go.id

Political Stream and Policy Entrepreneurs

The discussion within ministries and agencies in the Indonesian government to make better data management by drafting Satu Data Indonesia in 2014 demonstrate a strong willingness to solve the data integrity problem. A blueprint of Satu Data Indonesia's (2014) document elaborates on the Indonesian government's data management problem and propose a solution and produce principle later published in the Satu Data Indonesia policy. Although all interviewees believe the sectoral ego is still the main concern of data management, Satu Data Indonesia proves that the Indonesian government wants to break the ego between ministries and agencies by developing better data management.

Indonesian government's ministries and agencies are the stakeholder of Satu Data Indonesia (Ministry of National Development, personal communication, July 14, 2020). Ministry of National Development mentioned by all of the Interviewee as the driver of Satu Data Indonesia, while the Central Bureau of Statistics settings the metadata rule that should be followed by ministries and agencies (BPS, personal communication, July 17, 2020). There are seven Ministries as a board director of Satu Data Indonesia: Ministry of National Development, Ministry of Communication and Information, Ministry of Home

Affairs, Ministry of Finance, and Central Bureau of Statistics (Ministry of National Development, personal communication, July 14, 2020). President attention also played an important role in accelerating the Satu Data Indonesia policy. One Interviewee points out the Ministry of National Development suggests the President of Indonesia publish the Satu Data Indonesia policy actively (BPS, personal communication, July 17, 2020). In the COVID-19 crisis, the Ministry of Health is the main driver to apply the Satu Data Indonesia principles in data management.

The single most remarkable view to emerge from the interview was that no policy entrepreneurs come from outside the Indonesian government. All of the Interviewee agreed that the Satu Data Indonesia policy will produce reliable data and can be used by the public. However, there is no public involvement in Satu Data Indonesia's development or implementation. No academic or private sector participated in the project since Satu Data Indonesia view as an internal government project (Ministry of National Development, personal communication, July 14, 2020). The interviewees associate the public as the user and only concern the Indonesian government's data with better quality by the Satu Data Indonesia principles. COVID-19 data management system also confirms that none of the policy entrepreneurs came from outside government. Although the researcher is interested in COVID-19 data and actively accesses it from the system, none of the academics contribute to developing COVID-19 data management.

7.3 Conclusion

The internal government's sectoral ego leads to a weak collaboration in data management that produces unreliable data for the public. Weak coordination that causes different data standards between ministries and agencies leads to uncertainty when publishing data to the public since data overlapped. Therefore, the Indonesian government published the Satu Data Indonesia policy to strengthen two essential points to solve the problem: coordination and data principle.

Ministry of Health adopting Satu Data Indonesia by transforming the principle into Satu Data Kesehatan that will be used within the internal organization. There are three principles of Satu Data Kesehatan: standardization, interoperability, and accountability. This concept is implemented in COVID-19 data management by developing a central data

warehouse where every stakeholder can access the data by API to the Ministry of Health. Although the Ministry of Health state COVID-19 data could be free or protected, none of the locations of the COVID-19 dataset can be found.

This research also found that all of the policy entrepreneurs came from the internal government. Ministry of National Development is the driver of Satu Data Indonesia, and the Central Bureau of Statistics is responsible for setting metadata standards. In the COVID-19 data management case, the Ministry of Health is the primary driver who develops the system and coordinates the other stakeholder. Interestingly, the Indonesian government views the non-government side, such as private and academics, as data users. None of the academics contribute to developing COVID-19 data management.

8. A Model to Strengthen Satu Data Indonesia with FAIR

In the previous chapter, the document analysis found Satu Data Indonesia and FAIR has some similarity and difference in their objective and principle. Moreover, six out of eight digital health policy documents mentioned FAIR-Equivalent efforts. Although those results show some similarities that lead to a sign of closeness between Satu Data Indonesia and FAIR, it is still unsure how FAIR could strengthen Satu Data Indonesia. This chapter discusses how Satu Data Indonesia can improve by FAIR's element. It uses documents gathered from the Indonesian government, several FAIR's paper, and the interview result. This chapter will first present Satu Data Indonesia in three streams and compare all of the FAIR elements to check what kind of enhancement can make. It will then develop a model that can improve Satu Data Indonesia based on harmonious elements between two principles.

8.1 The Problem Stream of Satu Data Indonesia and FAIR

The interview result presents that the Indonesian government cannot optimize their data management due to weak collaboration between ministries and agencies. All interviewees from the Indonesian government agreed that sectoral egos are the leading cause of collaboration difficulties. As a result, the standard data difference occurred, and the Indonesian government was not taking advantage of the data they have right now. The issue of data management in the Indonesian government is closely related to sustainable

development. The Indonesian government wants to increase integration, synergy, and consistency in producing data to be the key to sustainable development's completion (UKP-PPP, 2014).

Despite data management in the Indonesian government related to sustainable development's target, it has the same awareness with FAIR. Data management and stewardship plans are considered necessary to make people can extracting maximum benefit from the research investment (Wilkinson et al., 2016). The origin of FAIR was not mentioned about the lack of coordination between several stakeholders like the Satu Data Indonesia problem. However, Both Satu Data Indonesia and FAIR generally want to produce high-quality digital publications. The only difference between these two principles is the origin of the problem. Problem identification in Satu Data Indonesia circulates among the Indonesian government, whereas FAIR emerges from a wider domain such as science funders, publishers, and government agencies.

With the similarity of the problem identified, FAIR should be able to help Satu Data Indonesia for data integration within the Indonesian government. FAIR is not a standard and does not only mean that humans can search, view, reformat, reuse data, and FAIR principles are not equal with open data. (Jacobsen, Azevedo, et al., 2020). Therefore, Satu Data Indonesia has an opportunity to use FAIR elements to extend the principle without changing the policy to solve its problem.

8.2 The Policy Stream of Satu Data Indonesia and FAIR

Due to data management problems were detected from internal government, several meetings and in-depth discussions with ministries and departments were held to produce depictions of current data management conditions and expected a transformation to accomplish an ideal condition (UKP-PPP, 2014). The identification of the current condition is crucial to set the desired or ideal condition. Based on the discussion, the Indonesian government has observed the current data management condition from four categories: process, product, producer, and user.

In general, there are two strategies planned by the Indonesian government to achieve the ideal condition. The first element of Satu Data Indonesia is strengthened collaboration by

developing an organization within the Indonesian government in producing data. Each ministry and agencies classified into several roles in Satu Data Indonesia. The arrangement of Ministries, Agencies, and local government coordination believes could eliminate the sectoral ego since the project forces them to communicate before publishing data to the public (Ministry of National Development, personal communication, July 14, 2020). The second element is the principle of Satu Data Indonesia. Besides coordination, the Indonesian government deems the need for a rule in producing data. Therefore, four data principle was initiated: data must comply with the data standards, data must have metadata, data must interoperable, data using the reference code.

FAIR is not a standard; FAIR's implementation would depend on how the stakeholder uses FAIR for its objective. A growing number of platforms either manually or automatically will assess FAIRness levels under some structure, or it could be in a platform that makes the FAIR principles applied in a data source (Erik Schulte, personal communication, September 29, 2020). Chapter five shows FAIR and Satu Data Indonesia have some similarities and slight differences that make both principles are harmonious. Although FAIR did not set the stakeholder's coordination, the principle can help Satu Data Indonesia achieve its goal. All of Satu Data Indonesia's principles could follow the FAIR principles as guidance.

1. Data standards and code reference principle of Satu Data Indonesia should follow the third sub-principle of Reusability in FAIR (R.1.3) to meet domain-relevant community standards.
2. The interoperability principle of Satu Data Indonesia should follow the interoperability guide from FAIR to make its data interoperable.
3. Metadata principle in Satu Data Indonesia should follow all Findable principle (F1, F2, F3, F4) and Reusable principle (R1) from FAIR to fulfil the metadata requirement.

Despite accessibility not mentioned in Satu Data Indonesia's principle, the policy explained that data producers could set the data restriction. Nevertheless, there is no detailed information on the accessibility settings for restricted data. A comparison of the two principles reveals that Satu Data Indonesia can accomplish its goal by using FAIR. Interestingly, the implementation of FAIR in Satu Data Indonesia will fortify the current principle and make the principle extend the capability considering the object of Satu Data

Indonesia is only data while FAIR concerns both data and metadata. Two interviewees recognize the challenge of the Satu Data Indonesia policy is in creating the data standard and carry out the standard within the Indonesian government (Ministry of National Development, personal communication, July 14, 2020; BPS, personal communication, July 17, 2020). A strong relationship between Satu Data Indonesia and FAIR shows that Satu Data Indonesia can use FAIR elements to extend its principle. Therefore, the Indonesian government could use FAIR as guidance for ministries, agencies, and local government to create a data standard or use a platform to apply the FAIR principles in the data source that will guarantee the data management met the Satu Data Indonesia principles.

8.3 The Political Stream and Policy Entrepreneurs of Satu Data Indonesia and FAIR

Better data management ideas within the Indonesian government came from the awareness to strengthen the sectoral data funded by UNICEF (BPS, personal communication, July 17, 2020). Ministries and agencies were discussed the current problem and set the goal to achieve ideal conditions for data management (UKP-PPP, 2014). The discussion about the Satu Data Indonesia blueprint continued among ministries and agencies until getting the momentum when President of Indonesia wants better data management to eliminate different data within the Indonesian government (BPS, personal communication, July 17, 2020). In 2019, Presidential Regulation about Satu Data Indonesia policy was published to communicate coordination and principle to ministries and agencies in the purpose of optimizing the activity of the Indonesian government in producing high-quality data (Ministry of National Development, personal communication, July 14, 2020; BPS, personal communication, July 17, 2020). Ministry of National Development noticed as the driver of Satu Data Indonesia in initiating the concept and consistently suggests the President of Indonesia make Satu Data Indonesia regulation.

Moreover, all of the stakeholders of Satu Data Indonesia came from the Indonesian government. All interviewees from the Indonesian government view the academic and private sectors as data consumers that only care about data quality. Interestingly, this can be seen in how the Indonesian government applied the Satu Data Indonesia principles in COVID-19 data management. Ministry of Health is the main driver of the COVID-19 data

management and responsible for providing data for the other ministries and the task force, but none of the outside government stakeholders involved.

FAIR theory and technology were not a novel notion. Everybody knew the idea of a framework to manage all of these various methods, and technology in data integration was necessary. However, all of the people who concern the idea were disconnected, and there is no systematic effort to organize (Erik Schulte, personal communication, September 29, 2020). Therefore, the principles' idea began to be discussed in 2014 at the "Jointly Designing a Data Fairport" workshop in Lorentz (Wilkinson et al., 2016). There were some hackathon events and meetings to formulating, reformulating, having debates about FAIR principles, then the principle was published in 2016 as a commentary in Nature Scientific Data (Erik Schulte, personal communication, September 29, 2020).

Surprisingly, the FAIR principles has received its most interest from higher-level organizations rather than the researcher. This situation happened due to the implementation of FAIR depends on what kind of circumstance the group met. The people who fund science and structure large scale projects feel responsible for ensuring the funding will use appropriately due to research data sometimes disappeared in several years (Erik Schulte, personal communication, September 29, 2020).

As a principle that came from the Indonesian government, Satu Data Indonesia can use FAIR as a role model of implementation. Satu Data Indonesia should not see as a standard and can be applied in every ministry, agency, and local government based on the circumstance. Therefore, Satu Data Indonesia may gain attention from the external government and open an option to involve outside political entrepreneurs in any data management to apply its principle.

8.4 Conclusion

Three streams of Satu Data Indonesia and FAIR depict that these two principles can be merged and come together to open the possibility of the Satu Data Indonesia policy extension by FAIR. Both Satu Data Indonesia and FAIR shared a similar data management problem when the current system did not optimize data synergy. The only difference is the initiative of Satu Data Indonesia came from the government that makes the scope of the

problem are ministries, agencies, and local government. In the policy stream, three out of four principles of Satu Data Indonesia can achieve by using all of the FAIR principles. Moreover, the FAIR principles will not only help Satu Data Indonesia to accomplish its goal but also make an improvement by applying the principle to data and metadata. All of the political entrepreneurs of Satu Data Indonesia came from internal government, while FAIR came from various stakeholders. Moreover, the most exciting stakeholder of FAIR is higher-level organizations due to their funding optimization in science.

Satu Data Indonesia could strengthen its principle by use FAIR as guidance in developing a data standard or use a platform that applied the FAIR principles in the data source. Both options will ensure the Indonesian government's data met Satu Data Indonesia and FAIR principles. Moreover, Satu Data Indonesia can follow how FAIR is implemented in a group or organization. As a principle, Satu Data Indonesia should promote a principle that can be applied based on the circumstances.

9 Suitable FAIR Model to extend Satu Data Indonesia's Principle in Fighting Pandemic

Although Satu Data Indonesia and FAIR are harmonious and could use FAIR as a guidance or a role model, the suitable model for fighting a pandemic is still unknown. This chapter investigates how FAIR principles implemented in COVID-19 data management in Africa, followed by a model construction based on the implementation which suitable for Satu Data Indonesia principles. The observation when doing the internship in VODAN Africa and interview with Executive Coordinator of VODAN Africa are the primary source to understand how FAIR principles applies data management COVID-19 in Africa.

9.1 VODAN Africa

Despite the FAIR principles implemented in various subjects and globally adopted, developing countries experience significant difficulties in implementing a new technology compared to developed countries due to education and economic situation. A country that implements the FAIR principles in the COVID-19 system with a similar condition to Indonesia will be a good role model to develop the COVID-19 plan that uses the FAIR principles but still respects the country regulation. VODAN Africa is an excellent example

of FAIR implementation in a country that has not applied FAIR in the COVID-19 system. Although another COVID-19 system is used in some African countries, the FAIR principles technology still aligns with the current system. This condition quite similar to the Indonesia condition where the Ministry of Health builds the centralized system to provides data for COVID-19 stakeholders. In addition, several parallels between Indonesia and the Sub-Saharan economy were shown by the World Economic Forum's Global Competitiveness Index 2017-2018. Both have the same barriers to their development: low education and lack of readiness for technology(Wicaksono, 2018). Thus, if FAIR principles can be implemented in Sub-Saharan Africa through VODAN Africa, Indonesia may learn from VODAN Africa to extend Satu Data Indonesia's principle by FAIR.

Africa has been excluded for several years on the data science most of the time; it makes health care workers, doctors, the nurses, the labs' scientists, everyone involved in an epidemic cannot have access the right kind of data. As a result, if data scientists and machine learning engineers want to get the dataset, they should go into other parts of the country (Fransisca Oladipo, personal communication, September 3, 2020). This situation considered crucial to solving as Africa could actively participate in fighting an epidemic.

VODAN Africa is the implementation of VODAN in Africa by Universities and Hospitals in Uganda, Ethiopia, Nigeria, Kenya, Tunisia and Zimbabwe; as well as Professors and graduate students from the University of Leiden supported by the GO FAIR Foundation. There are two kinds of stakeholders involved in VODAN Africa: African and European partners, all of them are consist of universities, students, researchers, government agencies, and NGO. The project is sponsored by the Philips Foundation to provide global access to the vital data required from Africa and the rest of the world to tackle and control the COVID-19 pandemic. (*About VODAN Africa*, 2020). The main objective of VODAN Africa is to build COVID-19 FAIR Data Point (FDP) in African countries and want to make Africa as a huge data source on the COVID-19 pandemic with respect to law and regulatory framework of data privacy in each country members (Fransisca Oladipo, personal communication, September 3, 2020).

The first phase of VODAN Africa was focused on building FDP, and it started by Metadata for Machines (M4M) Workshops, a systematic and scalable approach to the creation of machine-actionable metadata by GO-FAIR. This workshop is a fast-track event where

policy and domain experts can build new or make informed choices regarding the reuse of current existing metadata schema. There were 22 M4M VODAN Africa webinars from July 2020 to September 2020 that also includes the installation of the FDP in different locations.

9.1.1 FAIR Implementation in VODAN Africa

The mission behind FAIR is essentially automated many functions of the principle with not much human intervention due to data volume and complexity. M4M workshop has the purpose of finding a way how a machine can assist human in implementing FAIR principles. As explained earlier in chapter five, the metadata requirement is in every principle that makes metadata content will be guide machine when performing FAIR principles means there is no FAIR data without machine-actionable metadata.

Figure 10. FAIR principles

Another essential concept in FAIR is in the last principle (R1.3) that states meta(data) meet domain-relevant community standards. This principle refers to FAIR needs to be adopted or customize based on domain-relevant and community standards. Figure 10 presents two different colors on FAIR principles: blue color means the principle related to domain-specific content and the red color means the principle related to technical infrastructure, in

this project, is the development of FAIR data point. The domain-relevant and community standards could be the VODAN specific metadata-requirement or based on the member customization. The figure below illustrates the high-level architecture of the FAIR data point.

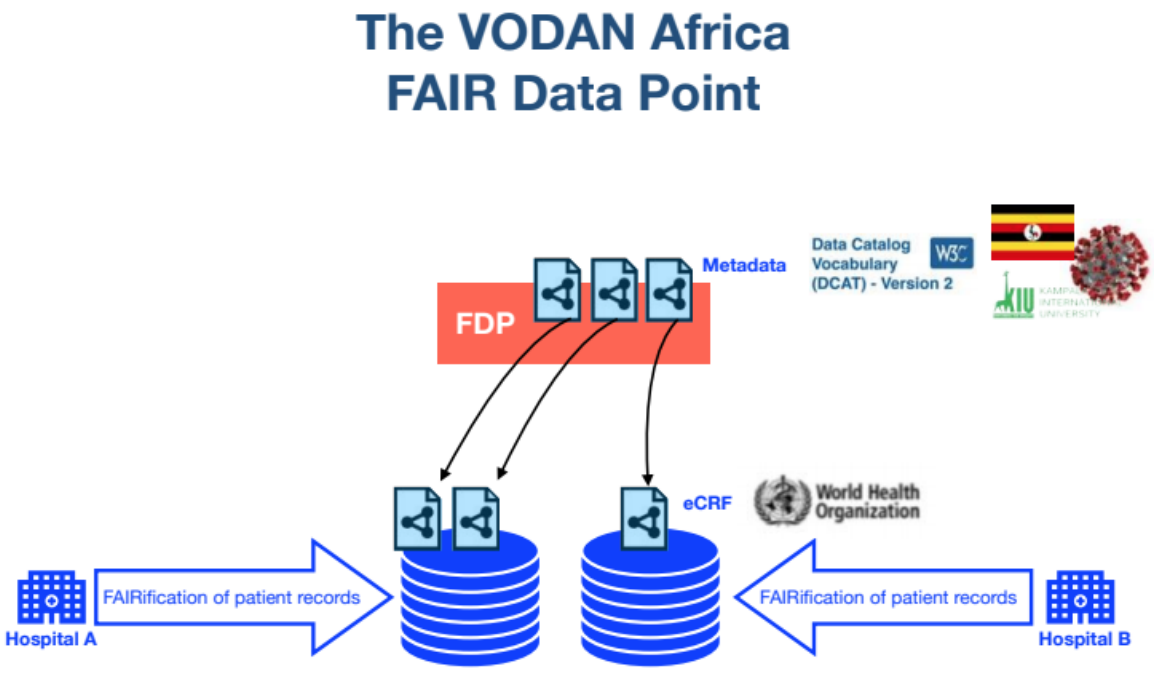

Figure 11. High Level Architecture of FAIR Data Point

As shown in Figure 11, the red part represents FDP, and the blue part represents data and metadata that should provide for FDP. Metadata should be constructed by the stakeholder to load content in FDP. A Case Report Form (CRF) of COVID-19 from WHO already transform through a FAIRification process into Resource Description Framework (RDF) schema, A model standardized by The World Wide Web Consortium(W3C) for data publishing and web sharing, that makes a real patient data can be input in this form. However, not all of the hospital has COVID-19 data with RDF format; it could be in another digital format or only paper. Thus, it is necessary to do a FAIRification process for the local hospital's data without interfering information flow process.

FAIR Data Point is a software that enables data owners to view FAIR metadata and data.FDPs make datasets and their fine-grained metadata discoverable and accessible by

machines. The datasets can be external or internal to the FAIR Data Point (Dutch TechCentre For Life Science, n.d.). FDP location depends on the circumstance of the project, for example, the FDP could be installed for COVID-19 data by Ministry of Health as the authority in health governance and regulatory framework or University that involved in the related research. A FAIR Data Point is consisting of one or more catalogue, in a catalogue containing one or more dataset, and one dataset containing one or more data distribution. All of the FAIR Data Point content following data catalogue vocabulary by W3C. With the installation of FDP, the data collection can be accomplished by virtual visits rather than waiting to be disseminated to the central location.

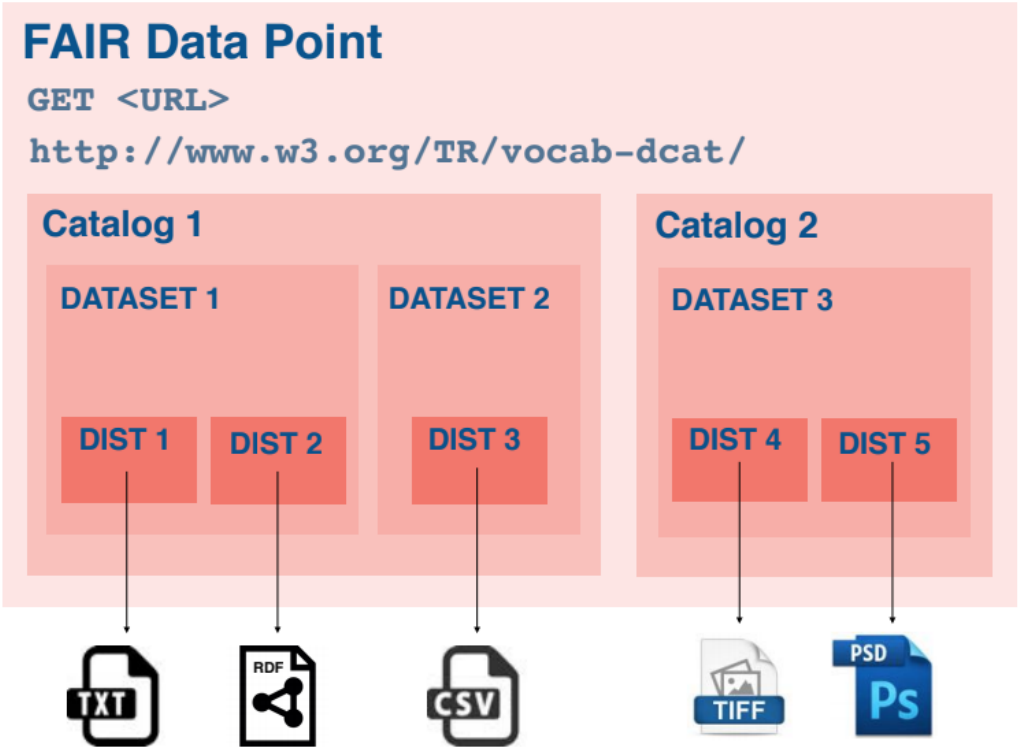

Figure 12. Overview of FAIR Data Point Content

Development of FDP and transforming CRF from WHO in the system helped by VODAN in a Box, a set of tools to enable the collection of virus outbreak data and the publishing of metadata describing these datasets. (VODAN Team Revision, 2020). VODAN in a Box can be seen as an installation package that can be installed by the user in any circumstances such as in a cloud, server, or in a local machine. According to the documentation of VODAN in a Box, this package composed of:

- Data Stewardship Wizard (DSW) - to capture and store data based on WHO's COVID-19 CRF (VODAN Team Revision, 2020) ;
- FAIR Data Point - to publish metadata about the COVID-19 CRF dataset and other pandemic-related content (VODAN Team Revision, 2020);
- WHO COVID-19 Rapid Version CRF Semantic Data Model - this semantic data model has been embedded in DSW to provide semantically-rich RDF export to the data entered with the DSW (VODAN Team Revision, 2020).

AllegroGraph, a closed source triplestore designed to store, retrieve and manage document-oriented RDF-triples, is also installed as VODAN in a box and is a standard format for linked data (Claburn, 2007).

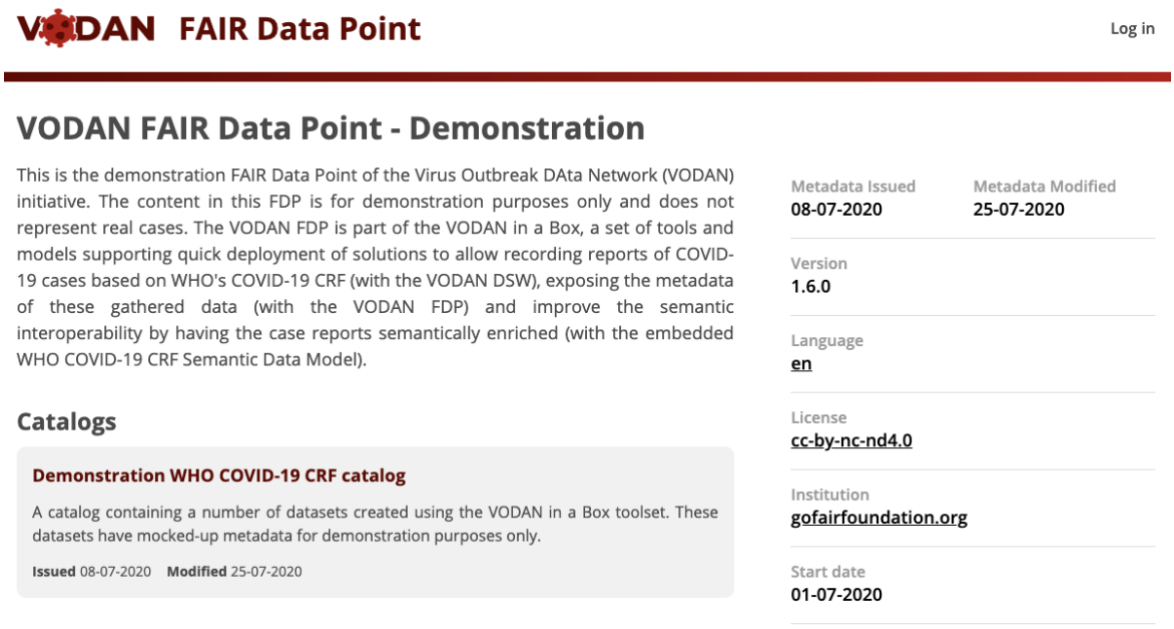

Figure 13. VODAN FAIR Data Point

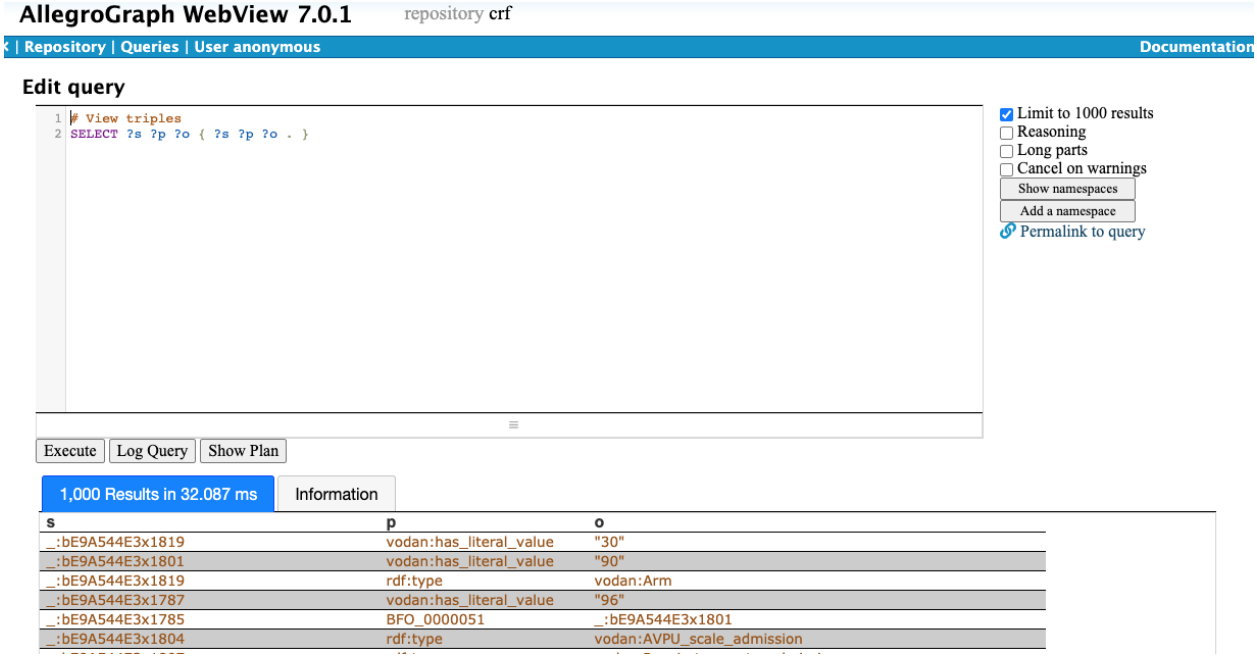

Figure 14. AllegroGraph WebView

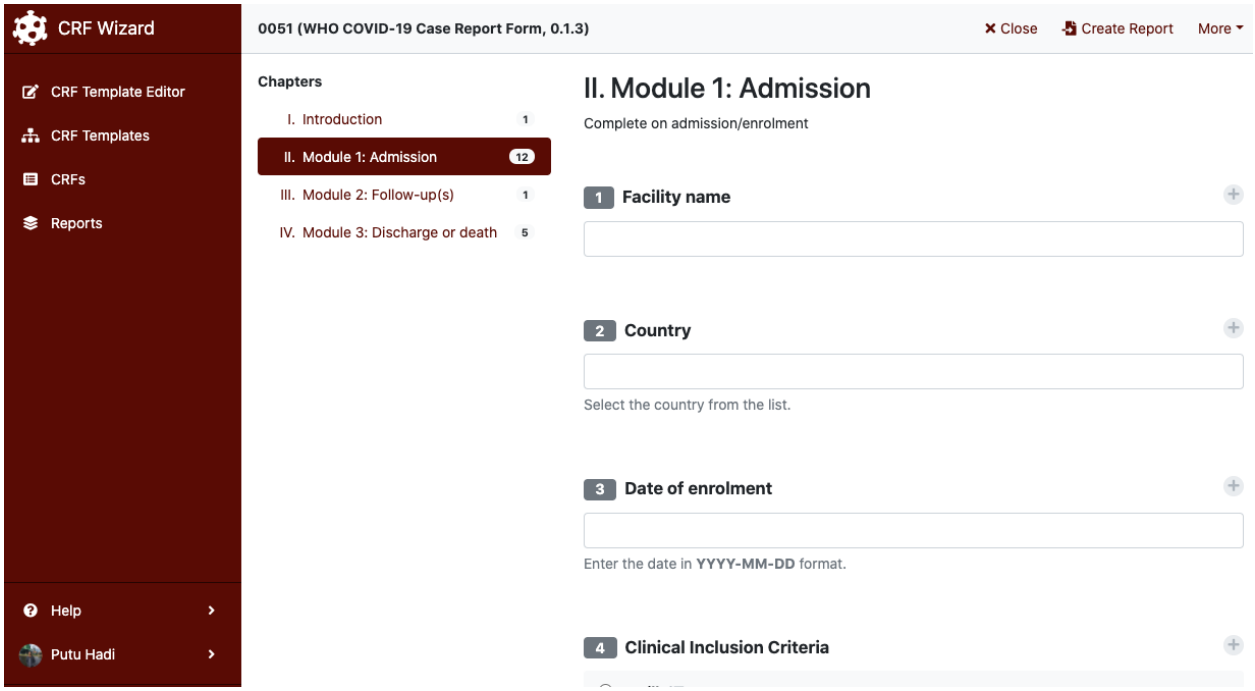

Figure 15. CRF Wizard of VODAN

9.1.2 FAIR Implementation Result and Challenge

With GO-FAIR guidance in the M4M workshop, seven active FDP was deployed within six months in the VODAN Africa initiative. The seven FDP installed in Uganda (1),

Nigeria (2), Kenya (1), Tunisia (1), and Ethiopia (2). A machine-based querying testing was held on the 29th of September, 2020, demonstrated by Erik Flikkenschild, the Information Manager Research at Leiden University Medical Center (LUMC) and Mariam Basajja, the Technical Coordinator, VODAN Africa and a PhD student at Leiden University (Oswige, 2020). The demonstration shows how a machine could access the data by a query from an FDP to the other FDP. The demonstration presents data access from LUMC FDP to Uganda FDP or vice versa. The successful data access also proves that the algorithm could visit the data without moving data from the point of origin.

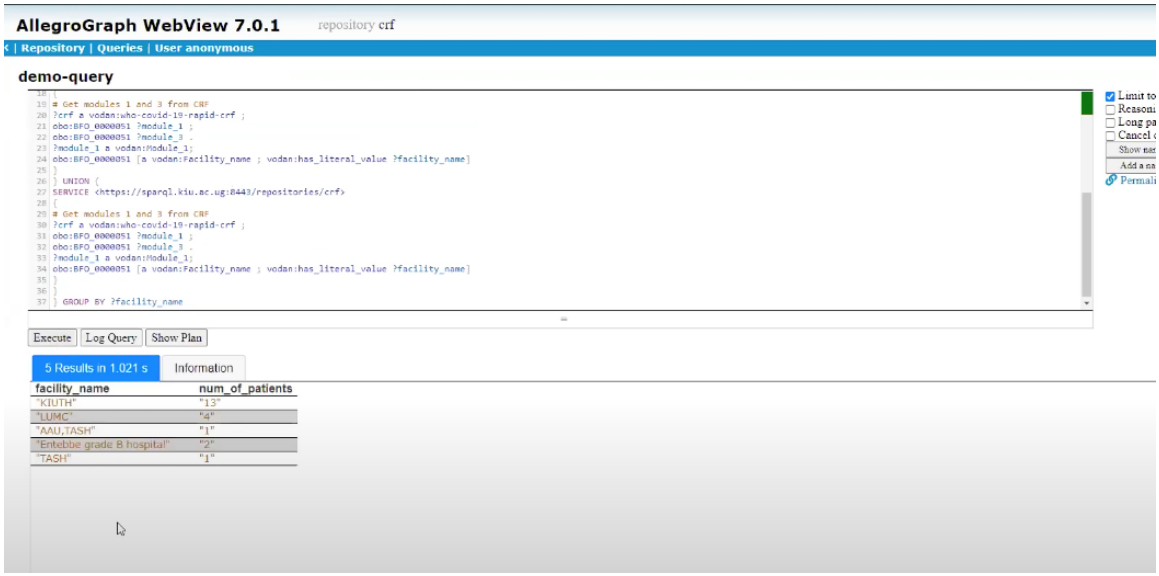

Figure 16. AllegroGraph WebView

However, several challenges arise in the development of FDP in the project.

- The members experience difficulties in FDP installation. One of Nigeria members suggests a video tutorial on FDP deployment since it is quite technical, and not all of the members could follow the guidance. Moreover, the docker was not working in a particular Windows operating system. Most of the members use Windows operating system, which confused them when developing FDP with the Ubuntu operating system.
- District Health Information Software 2 (DHIS2), open-source, a web-based software platform for data collection, management, and analysis commonly used in Africa. The FDP system could cause overlapped with DHIS2 in COVID-19 data management. However, the DHIS2 system facilitates open data but does not fulfil

the FAIR principles requirement. Therefore, FDP instalment in most countries is still relevant until it can be checked whether DHIS2 met the FAIR principles.

- eCRF assists data storing in RDF format, but the FAIRification process for local hospital's data still unclear. The next challenge of VODAN Africa is to transform the current hospital's data to meet the FAIR data principle requirement. Therefore, the condition requires the next phase to investigate the organization flow within the local hospital and make the data met the metadata requirement.

9.2 A Model to Implement FAIR in Satu Data Indonesia for COVID-19 Data Management

As shown in chapter 8, three elements : problem stream, policy stream, and the political stream of FAIR and Satu Data Indonesia can be merged to open the policy window to extend the Satu Data Indonesia principles. Satu Data Indonesia could follow how the FAIR principles works in various circumstance and also use the FAIR principles to make the data met Satu Data Indonesia requirement. Observation result in the VODAN Africa project presents how FAIR principles perform in COVID-19 data management and could be a suitable model for Satu Data Indonesia.

Whereas only Indonesian government act as the single policy entrepreneur in implementing Satu Data Indonesia for COVID-19 data management, VODAN Africa project involves several kinds of policy entrepreneur such as academia, private, government, and NGO to open an opportunity using FAIR in the data management. As explained in chapter 8, the origin of Satu Data Indonesia came within the data difference problem within ministries and agencies. Therefore, the Indonesian government constructs and publishes a policy called Satu Data Indonesia that is expected to integrate all of the local and central government data. As a result, the Indonesian government views the Satu Data Indonesia principles as a government principle without involving outside actors to perform FAIR in government activities. This condition can be seen in COVID-19 data management, where the system build by the Ministry of Health and outside actor only seen as a data user. The better way is not to restrict the Satu Data Indonesia as a government product and treat it as a principle like FAIR did where the principle will be developed based on a particular circumstance in any organization. Even though the government's principle, it still can involve the policy entrepreneur from the outside government when performing its principle for data management. In COVID-19 data management, the

external actor such as academic and private, could work together to build a data management system based on the Satu Data Indonesia principles.

The current COVID-19 data management system shows the Indonesian government centralize the COVID-19 in a data warehouse built by Ministry of Health and expect data steward in hospital, local government, and labs will input the data through a single system. However, COVID-19 data difference between central and local government still highlighted by the Indonesian researcher due to incapability of the current system to shows the real situation (Syambudi, 2020). This condition depicts Satu Data Indonesia was not able to found the best form to use in the pandemic data management in order to increase data transparency and integration.

The implementation of FAIR in the technology architecture of VODAN Africa may help the Satu Data Indonesia principles to build a suitable model that can perform better in COVID-19 data management. The FAIR Data Point allows the algorithm to visit the point to gained data by providing datasets and their metadata discoverable and accessible by machines. It could answer the COVID-19 data difference between central and local governments by distributing the installation of FDP in every region. The Indonesian government could work with academic and local government to create FDP in every region rather than centralize data dissemination in one location. Thus, the central government can run an algorithm to visit the data in every FDP that will guarantee no data difference problem will happen.

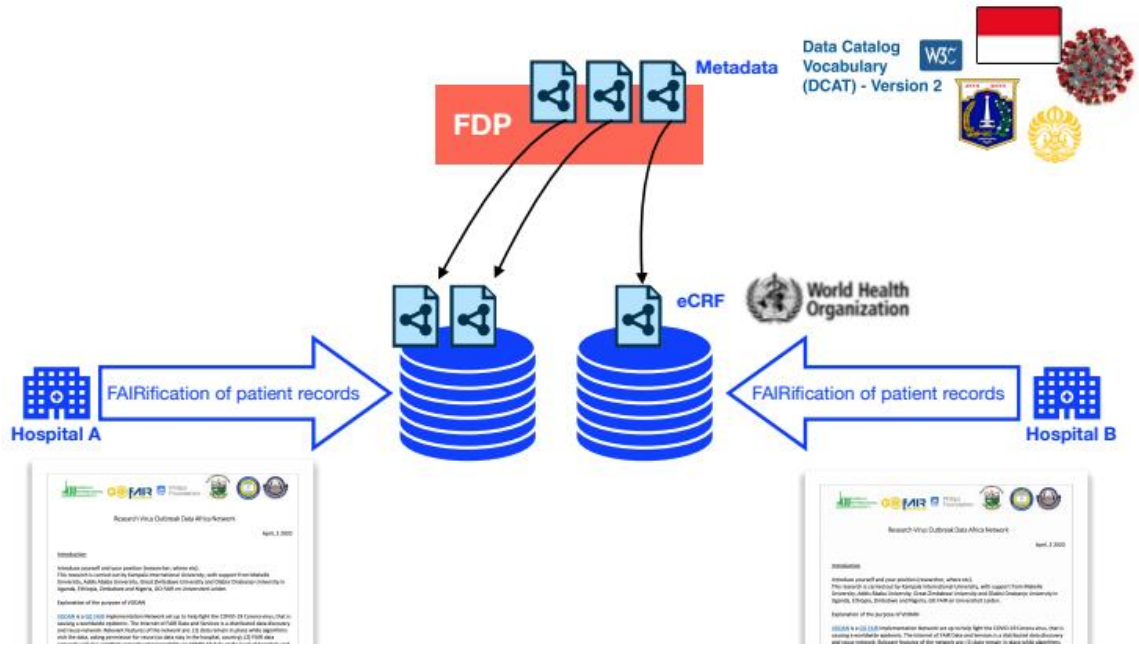

Figure 17. High Level Architecture of FAIR Data Point in Indonesia

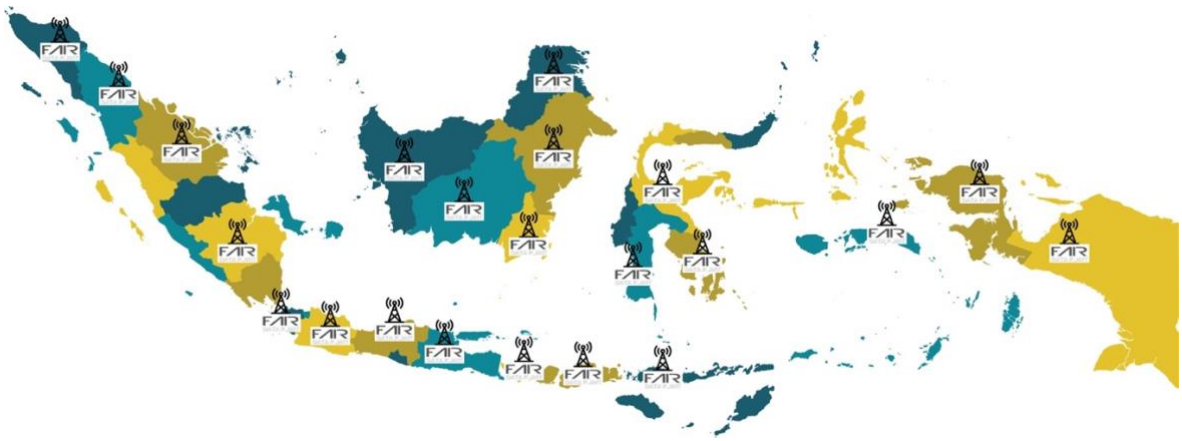

Figure 18. Illustration of alternative Data Management by FAIR Data Point in Every Region

Although the centralized system still uses for COVID-19 data management, the installation of FDP is still align with the Satu Data Indonesia principles. Implementing the FAIR principles in COVID-19 data management also fulfils the Satu Data Indonesia principles due to both principles are harmonious and FAIR principles still in line with health governance and regulatory documents. However, the effort to transform COVID-19 data that is still not meet metadata requirement and use other than RDF format needs to be done by the Indonesian government.

9.3 Demonstration of Local FDP For COVID-19 Data Management

In practice, an actual FDP will be installed on the domain expert; for example, in the COVID-19 data management in Indonesia, FDP can be installed in the Ministry of Health due to the ministry responsibility in COVID-19 data or could be in each local hospital/government that manage by Ministry of Health. However, to install an FDP in the government server is impracticable at this time. The connection between Satu Data Indonesia and FAIR should be informed to the Indonesian government; therefore, a window policy to extend Satu Data Indonesia principles by FAIR can be open by following FAIR principles guidance and applying FDP. Considering the situation to install FDP in the Indonesian government server is not possible, a local FDP will be installed on a computer that is not connected to the network and aimed to simulate the FAIR implementation. An installation of FDP requires a docker engine and docker-compose. The step of the installation follows a guide from the VODAN documentation website (docs.vodan.fairdatapoint.org).

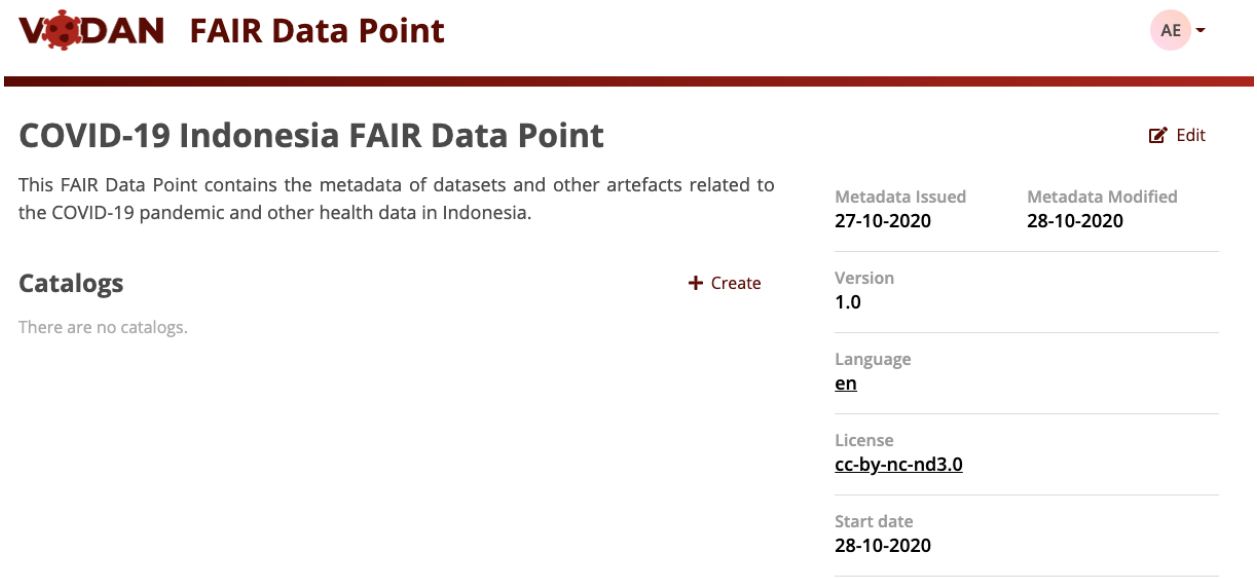

Figure 19. Indonesian Local FDP

Figure 18 shows a FAIR data point installed in a local machine. As shown previously, FDP consists of catalog, dataset, and distribution. The admin of FDP can create a catalogue with "Create" menu. In this FAIR Data Point, the Indonesian government could distribute their COVID-19 dataset. However, A FAIRification process should be done to make the data can be read both by human and machine. For a simulation purpose, COVID-19 case data

in Magelang in CSV format downloaded from Satu Data Indonesia portal and uploaded in the local FDP.

Figure 20. Catalog Data

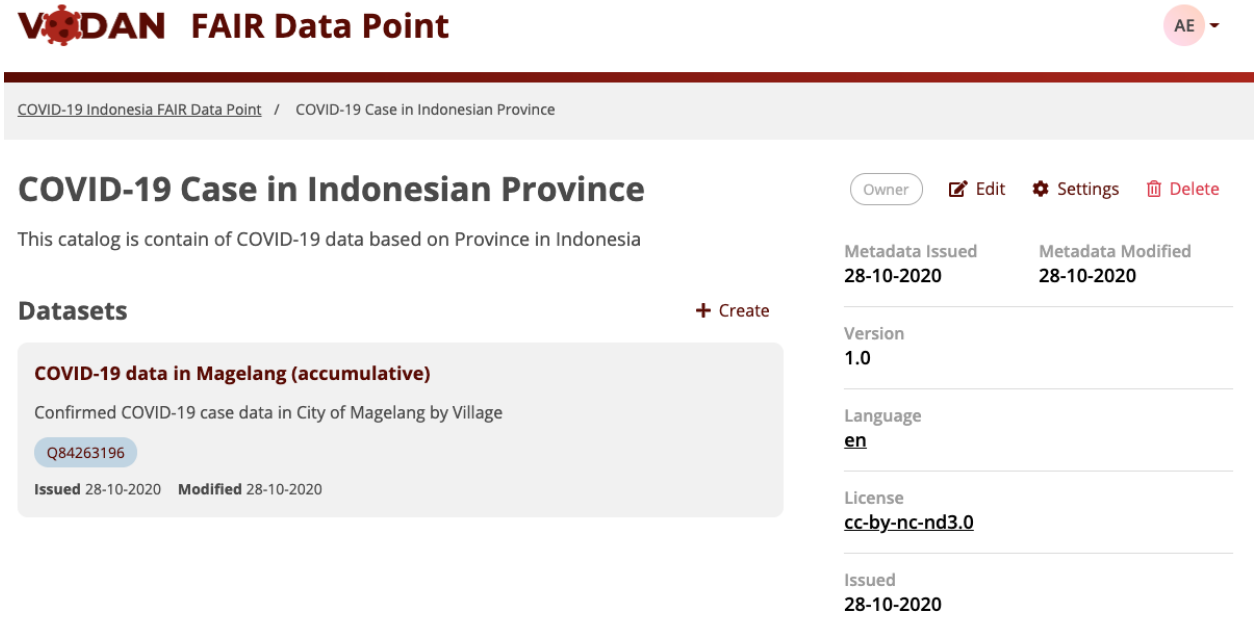

Figure 21. Datasets

Figure 22. Data Distributions

Figure 23. Data Distributions

A CRF wizard to capture and store data also deployed in the local machine. Current deployment uses eCRF template from WHO; however, it is possible to edit the current template or import template in order to custom field. All data from the eCRF input will be stored in a triplestore and graph database; therefore, it can be query by using SPARQL. With this architecture, the Indonesian government could query the data and prevent data differences even though several FDP developed in every region.

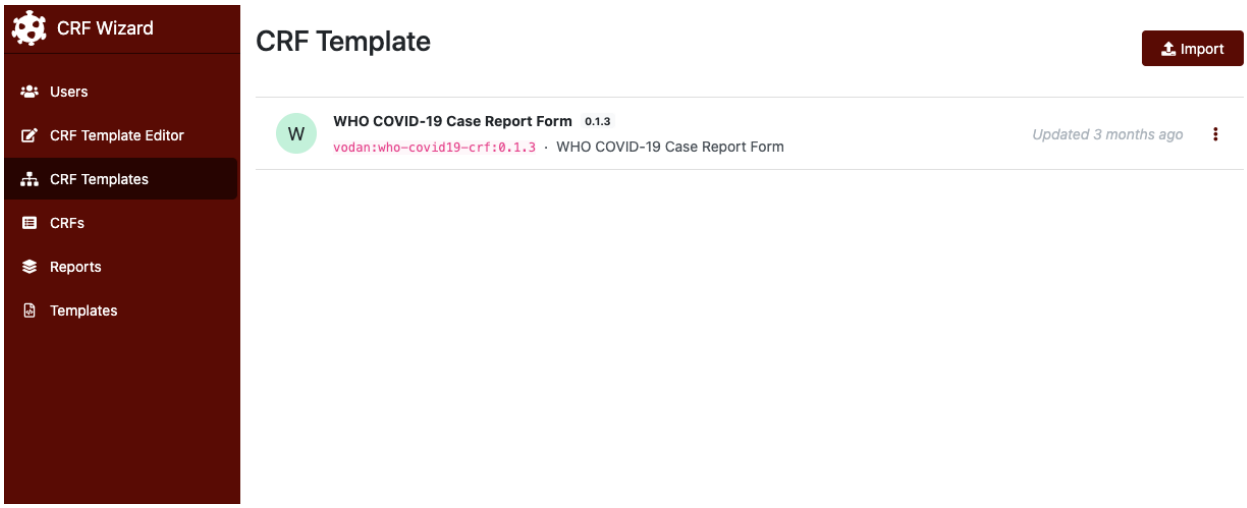

Figure 24. eCRF Template

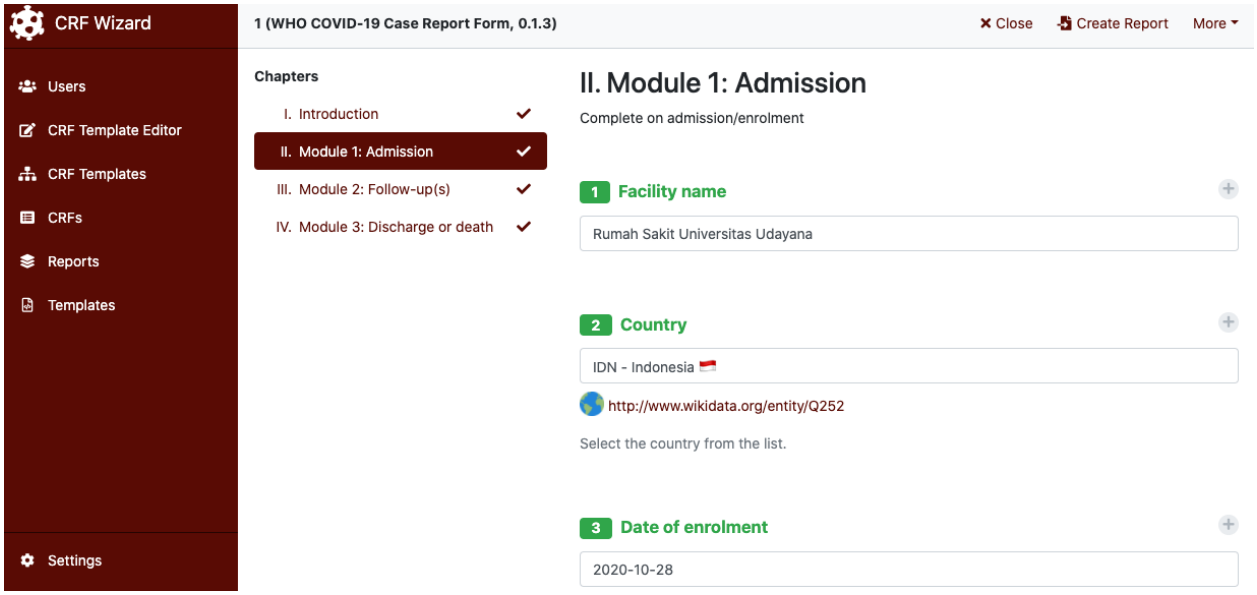

Figure 25. Data Admission

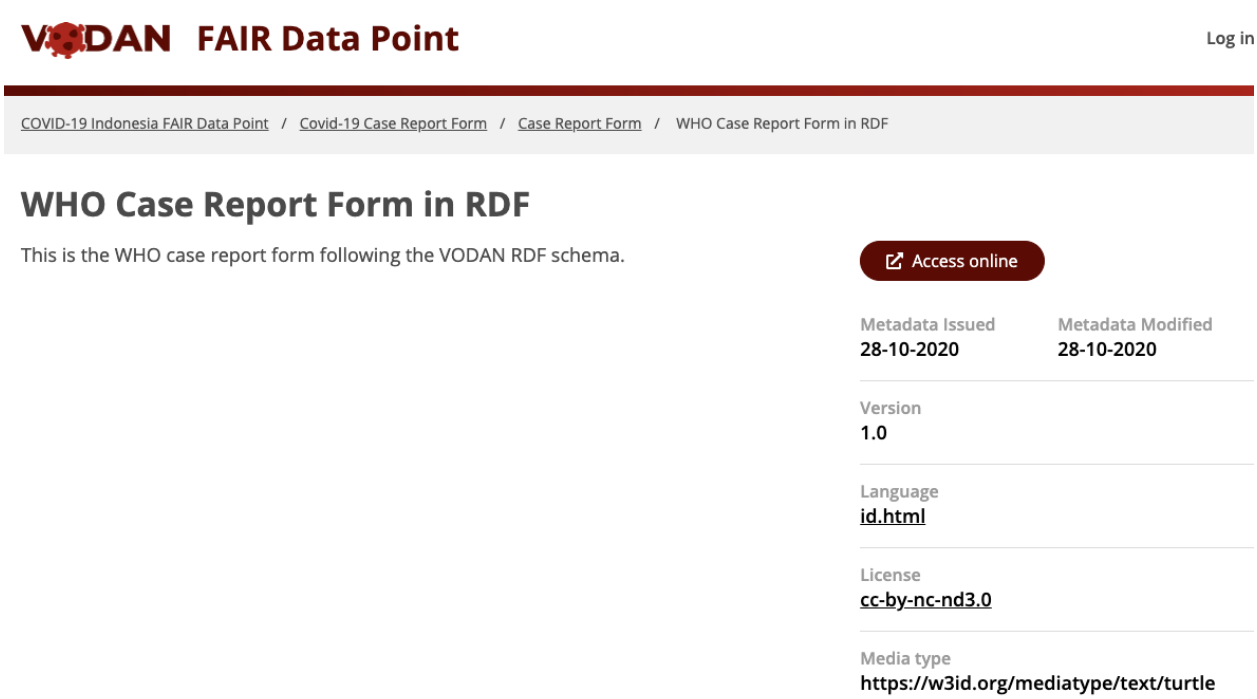

Figure 26. Triplestore Access from FDP

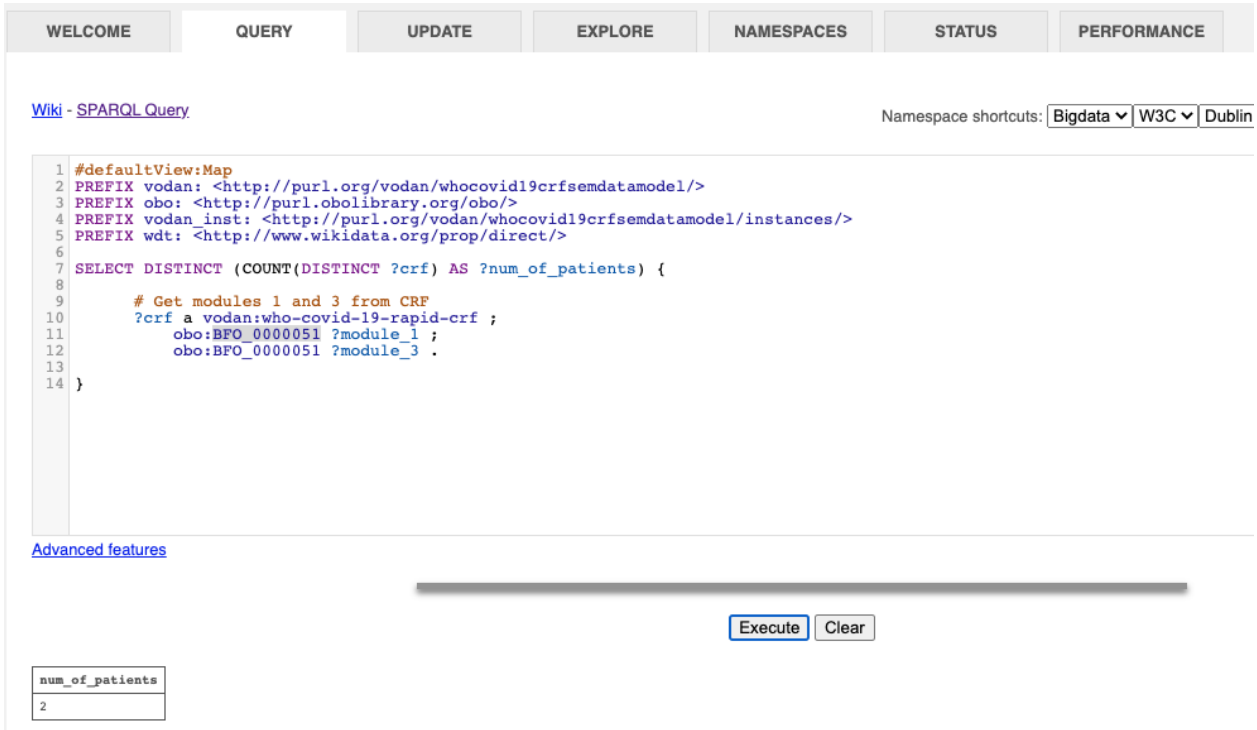

Figure 27. Query example for number of patient

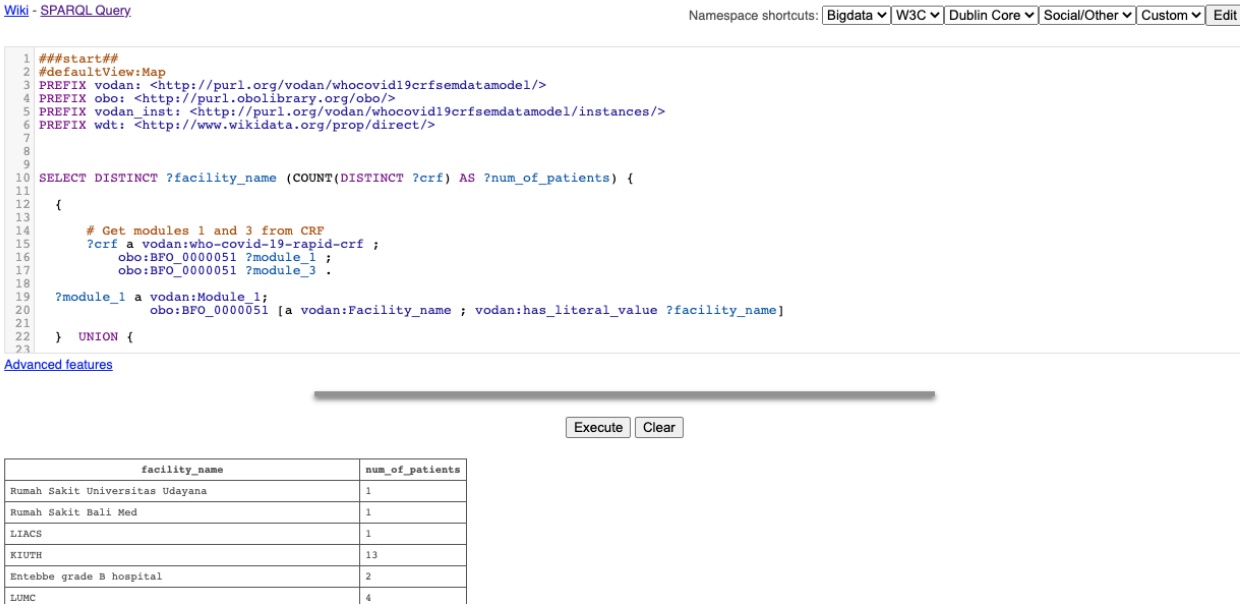

Figure 28. Query from local FDP to other FDP

9.4 Conclusion

VODAN Africa project is an excellent example of FAIR implementation in health data management, which still respected to data privacy law in African members. This project aims to make Africa a huge data source on the COVID-19 pandemic and make Africa actively participate in fighting an epidemic. The VODAN Africa project applied the FAIR principles by installing FAIR Data Point loaded with the stakeholder's metadata content and did FAIRification for COVID-19 data. The FAIR data point in countries member facilitates algorithm to visits data without moving data from the origin point.

A suitable FAIR implementation model to extend Satu Data Indonesia's principle in fighting a pandemic can follow how VODAN Africa develops data management by using the FAIR principles. Despite the origin of the Satu Data Indonesia principles is within the Indonesian government, the principle should follow how FAIR can be implemented in any circumstances depend on the organization. With this view, the principle's promotion in a particular situation, such as a pandemic, can involve external policy entrepreneurs. Moreover, applying the FDP and FAIRification process of COVID-19 data management aligns with the Indonesian government's purpose to provide data transparency. The data difference between central and local government could be eliminated by FDP distribution rather than use data centralization.

10. Discussion and Conclusion

10.1 Relevance of The Results to Satu Data Indonesia

This thesis aims to provide a better understanding of Satu Data Indonesia and extend the principle by FAIR to improve Satu Data Indonesia when implementing in COVID-19 data management. The case study of Satu Data Indonesia provides an insight into its principle by using Kingdon Agenda-Setting to identify the current situation of data management and identified three streams that can come together to create the policy window in using FAIR to extend Satu Data Indonesia's principle.

Comparison of Satu Data Indonesia and FAIR with coding analysis found these two principles harmonious due to their similarity in the objective and principles. The only difference is that both principles came from the different origins of the problem environment. Satu Data Indonesia initiated by the Indonesian government due to the government's data management problem that makes the principle scope is Indonesian government data. On the other hand, FAIR starts the idea from scholarly data publication, which makes the principle applicable in any circumstances. All of the FAIR principles can answer the goal of Satu Data Indonesia's principles. According to these analyses, it can be concluded that if data management following the FAIR principles, it also meets the Satu Data Indonesia requirement. These results also provide an example of FAIR implementation in government, which will be a useful input for FAIR adoption by the government in the future.

Further document analysis showed that Indonesia's health governance and regulatory framework gained a 75% FAIR equivalency score that opens the possibility of FAIR elements to use in the Indonesian health system through Satu Data Indonesia. This high score may be explained by the awareness of data integration that was started in 2014 in a discussion within ministries and agencies that produce a blueprint of Satu Data Indonesia. Moreover, interoperability emerges as the principle that is frequently mentioned in the documents.

All Indonesian government interviewees identified the root of data differences within ministries and agencies is the sectoral ego. A common view amongst interviewees was that the Satu Data Indonesia policy would force ministries and agencies to use Satu Data

Indonesia's principle in producing data that expected will enhance data interoperability among them. The interviewee from the Ministry of Health confirmed the Satu Data Indonesia principles applies in the COVID-19 data management by developing a central data warehouse to provide data API for the stakeholder. Despite the interviewee stating the COVID-19 data is transparent, the Ministry of Health's link did not contain datasets. Another important finding was that all of the policy entrepreneurs involved in implementing Satu Data Indonesia in the data management came from a single actor: the Indonesian government.

This thesis provides the first comprehensive assessment of the connection between Satu Data Indonesia and FAIR principles. As an initiator in Satu Data Indonesia, the Indonesian government shows an effort to bring together the three policy streams due to the same actor involvement in each stream. The comparison of three elements: problem stream, policy stream, and political stream between the two principles show that all streams can be merged and come together to open the possibility of using FAIR elements for the Satu Data Indonesia policy extension. An implication of this result is the possibility that Satu Data Indonesia could model data management by using FAIR elements.

The interview result indicated that the public is showing concern with the data transparency in the Indonesian government, but they are viewed only as a data user. Based on the observation in VODAN Africa project, the suitable model for using FAIR elements in Satu Data Indonesia is not to restrict its principle to work with internal policy entrepreneur. Another important finding is using FAIR elements by applying the FDP, and FAIRification process in COVID-19 data management still align with Satu Data Indonesia and might solve the data difference between local and central government due to the capability of the architecture to make data distributed but still integrated by capability of algorithm visit.

10.2 Reliability and Validity

Use interviews as a data collection method allowed the interviewee to give their perspective regarding Satu Data Indonesia's connection with FAIR and the implementation in COVID-19 data management; however, there were some defects that may potentially prevent the achievement of the objective. First, some interviewee tried to provide a

favorable answer during the interview even though the researcher reminded them that there were no right or wrong answer. Secondly, some interviewees did not elaborate on their perspective on Satu Data Indonesia principles and assumed it is clearly stated in the policy document. Observing the principle implementation in the Ministry of Health may have increased the validity of the results. However, the interviewee was asked during the interviewee to clarify unclear responses by questioning "What do you mean by this" or "Can you tell me more about this" and always confirm their answer by summarizing and asked "Can I conclude that" or "Do you mean that". The researcher also joins two webinars from the Ministry of Health regarding Satu Data Indonesia implementation in COVID-19 data management in order to make valid interpretations.

10.3 Challenges for future research

This thesis provided new information about Satu Data Indonesia's improvement by using FAIR elements and a new perspective of how FAIR works in the government circumstance; however, more research is required in this area to validate and expand on the discoveries of Satu Data Indonesia principles. More research is required on the detailed practice of the Satu Data Indonesia principles within ministries and agencies. It would also be interesting to investigate the level of FAIRness of the current data management system that applied Satu Data Indonesia by the Indonesian government. One of the challenges for future research is to explore the effectiveness of FAIR data point compared to the current system and set a FAIRification process for the current hospital data, that can support the FAIR Data Point Architecture.

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