KEMENTERIAN KESEHATAN REPUBLIK INDONESIA

BLUEPRINT OF DIGITAL HEALTH TRANSFORMATION STRATEGY 2024

Ministry of Health of the Republic of Indonesia

2021

Blueprint for Digital Health Transformation Strategy 2024

First published by Ministry of Health of the Republic of Indonesia. First printing 2021.

https://www.kemkes.go.id/

Citation suggestion:

Ministry of Health of the Republic of Indonesia. (2021). Blueprint for Digital Health Transformation Strategy 2024. Jakarta: Ministry of Health of the Republic of Indonesia.

Catalog

Digital Health Transformation Strategy Blueprint 2024.

Jakarta: Digital Transformation Office, Ministry of Health of the Republic of Indonesia 2021.

74 pg.; 21 x 29.7 cm.

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Supported by:

United Nations Development Programme (UNDP) dan Japan Government.

Partner:

United States Agency for International Development (USAID).

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LIST OF ABBREVIATIONS AND ACRONYMS

API	:	Application Programming Interface
Base Services	:	Basic data exchange functions that handle data needs according to related microservices function
BBPK	:	Center for Health Training
BIDW	:	Biobank Indonesia Data Warehouse
BIO	:	Codification of the biotechnology services business process architecture
BRIN	:	National Research and Innovation Agency
BPJS	:	Social Security Administration Agency
BPOM	:	Food and Drug Supervisory Agency
BKKBN	:	National Population and Family Planning Board
DHA	:	District Health Account
EA	:	Enterprise Architecture
EMR	:	Electronic Medical Record
e-PHR	:	Electronic Personal Health Record
FKTP	:	First Level Healthcare Facilities
FKRTL	:	Advanced Referral Healthcare Facility
FHIR	:	Fast Healthcare Interoperability Resources is the global standard of electronic health data exchange.
FRM	:	Codification of the business process architecture of Pharmacy and Medical Equipment and Household Health Supply services
IHR	:	International Health Regulation
IHS	:	Indonesia Health Services
INT	:	Codification of the internal management service business process architecture
RPJMN	:	National Medium-Term Development Plan
Microservices	:	A data exchange service that serves as a bridge to connectbetween users (community, providers, and stakeholders) and the IHS platform.

PEM	:	Codification of the health financing service business process architecture
PHA	:	Provincial Health Account
PKRT	:	Household Health Supplies
Provider	:	Service providers, health service provider facilities
PRM	:	Codification of the primary care business process architecture
RJK	:	Codification of the secondary care business process architecture
SDM	:	Codification of the HHR service business process architecture
HHR	:	Health Human Resource
SHA	:	System Health Account
STR	:	Registration Certificate

PREFACE

The COVID-19 pandemic presents various challenges, ranging from unequal access to health services to disproportionate health facilities and health workers to population ratio. One solution to deal with these challenges is to utilize digital information technology for testing, tracking, and treatment of COVID-19.

The Indonesian government strongly supports and encourages the use of digital technology for public health in the future. Digital transformation is an important agenda to encourage the realization of a Healthy Indonesia through the use of data and technology.

The breakthrough is a long-term strategy to deal with the COVID-19 pandemic and other health issues, and focuses on the health ecosystem, service efficiency, and data integration as the basis for decision and policy making. The growth of the digital health ecosystem is also expected to enhance Indonesia's readiness in facing pandemic and epidemic situations in the future.

The realization of the digital health transformation requires various parties, including the government, ministries/agencies, health workers, academics, private sector, communities, and volunteers to work

together for a more effective health response to address public health threats in the future and achieve equal distribution of health services throughout Indonesia.

The launch of the Digital Health Transformation Strategy Blueprint 2024 is expected to provide an overview to stakeholders and all health industry players regarding the direction and road map for Indonesia's digital health transformation in the upcoming years

Ir. Budi Gunadi Sadikin, CHFC, CLU
Minister of Health

EXECUTIVE SUMMARY

One of the current health issues in Indonesia is health data fragmentation, which is caused by the high number of health applications and the lack of regulation on standardization and data exchange. Based on a current mapping, there are more than 400 health applications developed by the central and local governments. This condition has resulted in health policies which are not based on comprehensive data and inefficient health services.

The COVID-19 pandemic and technological developments have prompted the Ministry of Health to immediately carry out a digital health transformation as a leap towards an advanced and equitable Indonesian health sector. The Ministry of Health has a vision to digitize the health sector covering prenatal care up to integrated health services for elderly patients. This vision is stated in the Regulation of the Minister of Health of the Republic of Indonesia (Permenkes RI) No. 21 of 2020 requiring health governance reform including the integration of information systems, research, and health development. The digital health transformation is targeted to produce human resources with the capacity to analyze health data. It aims to develop policies based on data in each health agency.

With regard to the above, the Ministry of Health has formulated a Blueprint for Digital Health Transformation Strategy 2024 to achieve a Healthy Indonesia in collaboration with all actors of the health industry under the Indonesia Health Services (IHS) Platform. The IHS platform is a digital health ecosystem platform that provides data connectivity, analysis, and services to support and integrate various health applications in Indonesia. The IHS platform is built on 6 main principles.

6 Main Principles Development Platform Indonesia Health Services

Service-Based Platform

The national health data is based on health service delivery, where the data is generated in line with the delivery of health services, and not through periodic reporting that is aggregated which tends to provide additional administrative burdens and does not provide an adequate level of data depth for further analysis.

Architecture Standardization and Specifications

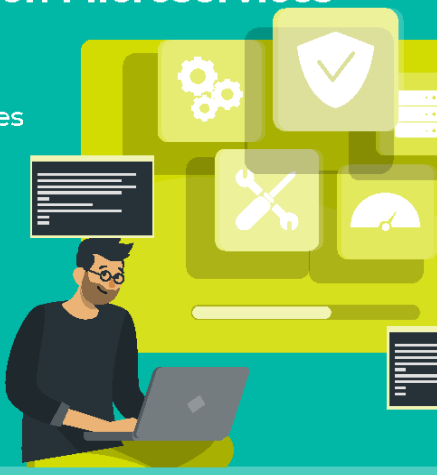
The IHS platform is an effort to standardize the architecture and specifications of data exchange between actors in the health industry. It is not intended to develop a single application.

Collaboration of Health Industry Actor Ecosystems

The IHS platform is not to replace the existing systems or applications, but it will be used by all actors in the health industry.

Open API Based on Microservices

The IHS platform provides data exchange services that can be used openly by all actors in the health industry.



Compliance through Integration

The IHS platform is a means for the Ministry of Health to monitor compliance with data requirements and minimum service standards for all actors in the health industry through integrated transaction activities.

Mutual Benefit through Ease of Service and Integrated Information

The IHS platform provides benefits benefits to all its members in the entire health ecosystem in the form of big data analytics and integrated information.

The focus on developing health data and health service applications and improving health technology ecosystem is expected to improve the data quality and policies to ensure an efficient delivery of health services. The Blueprint for Digital Health Transformation Strategy provides a solution for Indonesia to achieve a measurable and targeted digital transformation for the development of an integrated and sustainable health care system.

CHAPTER I
Situation and Challenges of Digital Health in Indonesia

1.1. Challenges

In the digital era, routine data integration is an essential component for digital transformation. President Joko Widodo said that integrated data and a simpler health service system are aspects that must be continuously improved to achieve a Healthy Indonesia.

The process of integrating health service data has many challenges. The number of health applications developed by the central government, sub-national governments, and the private sector poses a challenge towards the integration of health data systems. Applications that are supposed to facilitate and improve health services actually create new problems, such as fragmented data in various existing applications which have different standards that are not easily integrated and utilized. Based on the current mapping, there are more than 400 health applications developed by the central and local governments. This number is even higher if we include specific applications which are made by third parties and health institutions. Another health digitization problem is a lot of health data are still manually documented. Health data in several regions are still documented using paper and not integrated digitally.

The main challenges in developing national health data are that more than 80% of health care facilities in Indonesia are currently untouched by digital technology, fragmented data which are spread across hundreds of varying health sector applications, and lack of regulation in terms of standardization and data exchange.

Millions of Data and Hundreds of Apps

Indonesia's health data are scattered with highly diverse systems. Health care providers only receive partial information. Many aspects are not mapped from the existing data. An integrated data platform is needed to support health facilities to improve hospital services, especially for disease prediction.

Fragmented Data

Indonesian public health data are spread across thousands of health care providers. They use a variety of information systems. The system and application within the Ministry of Health are not integrated with the database of the Social Security Administration (BPJS), the Food and Drug Supervisory Agency (BPOM), and the National Population and Family Planning Agency (BKKBN).

Challenges:
Millions of Data & Hundreds of Applications
Policies are not based on data and services are inefficient

Medical records of 270 million population are still in paper form

Thousands of healthcare providers manage individual health data

Millions of prescriptions are based on individual information in paper form

Millions of claims are based on individual information in paper form

Hundreds of health applications are based on individual information

400+ Health applications have been mapped, and there are many more at the central and local levels

Inadequate Regulations

The health sector does not have adequate regulations on data protection, data standardization, and patient rights and privacy. Interoperability capabilities are needed to integrate all information systems and applications into a centralized database to make it easier for users, both patients and service providers.

In addition, health policies are not based on comprehensive data and health services have not been implemented efficiently. The issues need to be elaborated further based on the following categories: primary and secondary care, pharmacy and medical equipment, health security, health human resources, health financing, internal management, and biotechnology.

1.2. Issues related to Healthcare

1.2.1. Primary and Secondary Care

Primary care consists of Public Health Centres (Puskesmas), private clinics, and general practitioners, while secondary healthcare consists of all hospitals, both general hospitals and special hospitals. Primary and secondary healthcare serve around 272 million people throughout Indonesia. The use of information technology in the health sector has been used quite widely, from health planning to providing various health data at the individual and community levels (Regulation of the Minister of Health of the Republic of Indonesia No. 21 of 2020). However, with the various functions of the existing applications, there is a fragmentation of health information system in which the existing data are not interchangable.

In carrying out health services, the World Health Organization (WHO) states the importance of prioritizing the principle of continuum of care in health services, whereby health facilities carry out continuous monitoring of patient health (De Graft-Johnson et al. , 2006). Continuous and comprehensive patient observation can assist health workers in evaluating treatment that has been provided. A sound evaluation can facilitate communication between health facilities to provide referrals effectively and efficiently when needed.

However, incomplete, inconsistent and inaccurate data recording is the main factor affecting the quality of health services. On the other hand, a complete and standardized data recording can facilitate the preparation of evidence-based policies, improve competence of staff at healthcare facilities, and reduce the administrative workload of Puskesmas and hospitals which currently use more than 60 applications simultaneously to perform administrative reporting.

More specifically, the main issues in primary and secondary care may be summarized as follows:

Figure 2. Main Issues in Primary and Secondary Care

1.2.2. Pharmacy and Medical Equipment Services

The target of the Pharmacy and Medical Equipment Program based on the Decree of the Minister of Health No. HK.01.07/Menkes/422/2017 concerning the Strategic Plan of the Ministry of Health 2015-2019 is to improve access, self-reliance, and quality of pharmaceutical and medical equipment, with the following key performance indicators (Decree of the Minister of Health No HK. 01.07/ Menkes/422/2017):

1. Percentage of districts/municipalities with available essential drugs: 85%;
2. Percentage of medical equipment meeting the requirements: 95%;
3. Percentage of Puskesmas with available IDL vaccine (Complete Basic Immunization): 96.5%;
4. Percentage of raw materials for pharmaceutical preparations produced domestically: 100%;
5. Percentage of domestically produced medical equipment: 100%;

Apart from that, the resilience of the pharmaceutical supply and medical equipment is tested during the Covid-19 pandemic in Indonesia. The healthcare supply chain is in the spotlight. The spread of the virus has a very significant impact on the healthcare system. Healthcare institutions are facing increasing demand under unprecedented operational constraints. The main challenge in managing this crisis is the production and distribution of medical supplies. When personal protective equipment (PPE), ventilators, and medicines are needed, the procurement and distribution of these devices becomes a challenge. There have been shortages which exposed the fragility of the health care supply chain (Iyengar et al. , 2020).

The healthcare supply chain that is not well integrated has hindered healthcare facilities from responding quickly to the existing risk. This shows the importance of building a strong and responsive service supply chain.

More specifically, the main issues in the pharmaceutical and medical equipment sector are as follows:

1. Lack of standardization of company codes, products, and raw materials. This is the fundamental issue that hinders the development of an integrated platform due to the absence of a single key data feature for data aggregation and processing
2. Stock data for drugs, medical equipment, and household health supplies are stored separately in each producer, distributor, and health facility, and there is no standard data format.
3. Low accuracy of supply and demand mapping which causes high opportunity cost of stock out, as well as the circulation of illegal drugs and vaccines that is harmful to the public.
4. Redundant licensing process and compliance monitoring which requires the pharmaceutical and medical equipment industry to register and report to various different parties with the same substance.

> "Healthcare supply chain which not well-integrated will cause medical service facilities can't respond to a signal risk rapidly.

1.2.3. Health Security Services

The handling of the pandemic that is sporadic and with a traditional policy-making approach exposes the vulnerability of Indonesia's health resilience system. The quality of an emergency response is highly

dependent on the effectiveness of resource allocation in critical sectors and a coordinated response across sectors in the shortest possible time (Sasongkojati, 2020). Health security plays a very important role for a country. Global public health security is defined as the activities required, both proactive and reactive, to minimize the danger and impact of acute public health events that endanger people's health across geographical regions and international boundaries (World Health Organization, 2021). Building a responsive and effective health security system requires decision making based on robust and real time data. In accordance with Presidential Instruction No. 4 of 2019 concerning Capacity Building in Preventing, Detecting, and Responding to Disease Outbreaks, Global Pandemics, and Nuclear, Biological, and Chemical Emergencies, the Ministry of Health received instruction (Presidential Instruction No. 4 of 2019) to:

1. Enhance capabilities in preventing, detecting, and responding to disease outbreaks, global pandemics, and nuclear, biological, and chemical emergencies;
2. Improve technical coordination of the implementation of International Health Regulations (IHR) 2005 with a multi-sectoral approach;
3. Increase health surveillance capacity to identify events that have the potential to cause public health emergencies, including situations at the entry and exit gateways of the country, antimicrobial resistance, and food security;
4. Improve the coverage and quality of immunization;
5. Improve the prevention and control of zoonoses and antimicrobial resistance;
6. Increase capacity and strengthen laboratory networks to identify public health issues.

Health security is a shared responsibility between state and local governments as well as public and private partners, non-governmental organizations, academia, professional associations, communities, volunteers, families, and individuals (US National Health Security Strategy, 2021).

1.2.4. Health Human Resource Services

A well mapped health human resource is one of the the main variables of the national health security and the health system in general. The availability of health human resource is the basis for determining the performance of the national health security.

Moreover, complete HHR data is not available, and information regarding HHR is very minimal, both in terms of quantity and quality. At the national level, HHR planning is one of the strategic issues set out in Presidential Regulation No. 72 of 2012 on the 2012 National Health System. However, the implementation is still considered weak and the information system related to HHR is inadequate.

In addition, according to Regulation of Minister of Health (Permenkes) No. 33 of 2015, HHR planning is needed to identify the needs at each level of

Several main issues related to health security that haven't been solved yet are as follows:

1

Surveillance (detection) information systems that are not real time and integrated, hindering disease risk in each area from being mapped properly

2

Unresponsive health emergency detection and response capabilities

3

Absence of a monitoring system on the readiness of health facilities, laboratory networks, health human resources, medical equipment and drugs, and the need to improve local government regional readiness in dealing with health crises

4

Reliable health education sources are still not widely accessed

government, both in terms of quantity, type, quality, qualifications and distribution (AIPHSS, 2015). However, the results of the Health Manpower Research (Risnakes) show that not all healthcare facilities (fasyankes) perform HHR planning, only 79.8% of Puskesmas and 83.2% of hospitals have done so.

In Article 14 paragraph 2 of Law Number 36 of 2014 concerning Health Workers, HHR planning begins with the submission of proposals from health agencies, then recapitulated by districts/cities to be submitted to the central government through the provinces (AIPHSS, 2016). Unfortunately, in the field implementation, the bottom-up proposal mechanism has not been fully understood acrosss hierarchy up to the level of technical policy makers (Hendrayanti, 2008), (Beswick & Hill, 2010), (Rakhmawati & Rustiyanto, 2016), (Sumiarsih & Nurlinawati, 2019).

The main issues related to the effort to achieve national HHR resilience include:

1. Data acquisition and analysis is only based on comparison of various sources without direct data acquisition, causing low accuracy.
2. Lack of standardized data collection can cause double recording or misrecording.
3. Lack of standardized data collection can cause double recording or misrecording.
4. Information on the readiness of HHR reserves is not standardized and does not include complete information on the competence

and potential.

1.2.5. Health Financing Services

Health financing is one of the pillars in the implementation of the national health services that acts as an enabler in all health services. Transaction records, guarantee schemes, and strategic analysis are key elements to provide knowledge and understanding to improve the national health condition. To obtain a comprehensive understanding, an integrated operational system and good quality data are needed by the health financing stakeholders.

Data and information analysis of various transactions serves as a basis for decisions, policies, and strategic recommendations in the implementation of the national health services. The national health expenditures have a major influence in addressing the national health issues. In the European Union, nominal national health spending has a positive effect on Life Expectancy and reduces birth mortality rate by 0.64% per one percent increase in health spending (Onofrei et al., 2021). Health spending in each province in China also has a positive impact on reducing individual mortality (Hou et al. , 2020). Strategic analysis and sound policies related to health spending are the main factors influencing this positive impact.

Based on Law No. 39 of 2009 concerning Health, health financing aims to create sufficient, sustainable, fair, effective, efficient, and comprehensive financing, ensure equity, transparency and accountability with the main functions of mobilizing financing sources, allocating the national health budget, and utilizing the health budget (Law of the Republic of Indonesia No. 36 of 2009). These are performed related to the implementation of Individual Health Efforts (UKP), Community Health Efforts (UKM), and the governance of these efforts. The World Health Organization (WHO) itself establishes System Health Account (SHA) to support these functions by focusing on consumption, provision, and finance (WHO & Organization for Economic Cooperation and Development, 2011).

Self-financing (Out of Pocket) by the community is the main indicator in assessing the performance of the national health spending. This means that all national health expenditures and spendings are also aimed at reducing self-financing by the community. The national health insurance scheme will have a direct impact on this.

Data and analysis of the national health spending are the basis for providing a strategic direction and to execute spending. The expected objective is to perform all analysis based on standardized data which are adequate both in terms of quantity and quality. The National, Provincial, and District Health Accounts (NHA, PHA, and DHA) as part of the SHA serve as a basis for decision making on the national health spending.

Three main issues related to data input,

analysis, and standardization are as follows:

1. National health expenditure data are not detailed and do not accommodate all the needs of the national health expenditure analysis.
2. The analysis of NHA, PHA, and DHA is only available after two fiscal years and after the national health budget had been executed.
3. The national health insurance expenditure data of the government, national institutions, and private entities are not available in a complete and comprehensive form, causing inoptimal performance analysis.

1.2.6. Internal Management Services

The right internal management system can improve the efficiency of each activity and reporting that must be performed. In this guide, we will look at the internal management of the Ministry of Health and other agencies that are directly responsible to the Ministry of Health such as the Health Polytechnics, Health Training Centers, National Hospitals, and Lab Centers and other agencies that are not directly responsible to the Minister of Health, such as the Provincial Health Office and the District Health Office, which are responsible to the provincial and sub-national governments.

There are several objectives in developing this internal management system, namely, to integrate all existing applications into a single unit so that they can be used efficiently and effectively, as well as to facilitate data entry so that there is no redundant data.

With 19 main internal management modules, this system will simplify five main business processes, namely internal operations, tenders, planning and budgeting, implementation, and monitoring and evaluation.

1.2.7. Biotechnology Services

Health data in Indonesia still cannot be utilized optimally because the data is still scattered, the quantity and quality are low, and there is a sectoral ego. The data referred to here are pre-clinical, clinical, genomic data , and others. Genomic data include genomes of plants, animals, microorganisms, and humans. These data still cannot be collected, hindering mitigation of diseases and mutations and research developments. Each sector is still running on its own with no data center that can serve as the backbone for biotechnology-based innovation.

Indonesia's genomic surveillance capacity to detect new variants of SARS-CoV-2 is considered highly inadequate. Based on the total number of genomes registered in the GISAID database, Indonesia only ranks 7th out of 10 countries in Southeast Asia. This figure shows that the performance of the Biobank in Indonesia is still very low. Genomic surveillance takes a long time and can only be done in a specific laboratory at a high cost. This condition has a significant effect on health security in Indonesia.

The development of biotechnology in Indonesia has been going on for a long time, but tends to be slow due to several factors. The first factor is the lack of research funds in the field of biotechnology. Biotechnology research is needed to increase the quantity and quality of products as well as knowledge on biotechnology. Another factor is the lack of human resources, facilities, and government policies that hamper the marketing process of genetically engineered products.

Biotechnology has a positive role in agriculture, health, and the environment. In the agriculture sector, biotechnology helps reduce food crises, improve food quality, and increase the amount of agricultural production. In the field of health, biotechnology can diagnose genetic and non-genetic diseases and treat specific diseases. In the environmental field, biotechnology can improve the quality of a polluted environment through bioremediation, bioleaching, reducing plastic waste by producing bioplastics, and producing environmentally friendly biofertilizers.

In the design of the Biotechnology platform, the Ministry of Health can monitor registered companies, researchers, and the number of transactions. When this platform is launched, a massive communication is needed to maintain customer engagement. Public education will create the desired ecosystem to meet the needs.

To that end, the biotechnology service platform has the main objectives to:

- Enrich biotechnology products in Indonesia.
- Match researchers and industry.
- Provide data warehouse for biotechnology products.
- Create a Single Sign On platform system.
- Sharpen regulation on biotechnology.

CHAPTER II
Health Technology Transformation

2.1. Health Technology Transformation Priority

Regulation of the Minister of Health of the Republic of Indonesia (Permenkes RI) No. 21 of 2020 requires a health governance reform which includes the integration of information systems, research, and development. The digital health transformation process from the national to sub-national level is certainly not easy and needs to be carefully planned. This is designed in the health technology transformation roadmap.

The Health Technology Transformation Roadmap is divided into 3 main activities as shown in Figure 3.

The first part of the Health Technology Transformation is Health Data Integration and Development. It is divided into Health Data System Integration and Health Big Data Analytics System Development. This activity has the main output to improve the quality of health policies based on accurate, up-to-date and complete data.

The second part is the Integration and Development of Health Service Applications. This activity has 3 program activities, namely developing Integrated Health Applications, improving Health Human Resource (HHR) with health informatics skills, and establishing a centralized helpdesk at the Ministry of Health. This output is related to the efficiency of health services in every line (First Level Health Faciity/FKTP and Advanced Referral Health Facility/FKRTL).

The third part is Health Technology Ecosystem Development. In this activity, the Ministry of Health has 3 main programs, namely Telemedicine Technology Expansion, Development of Health Technology Innovation Product Ecosystems and Health Biotechnology Research Integration. Its output is to create collaborations and an ecosystem of digital health innovations between governments, universities, industry, and the general public.

Priority Activity Diagram

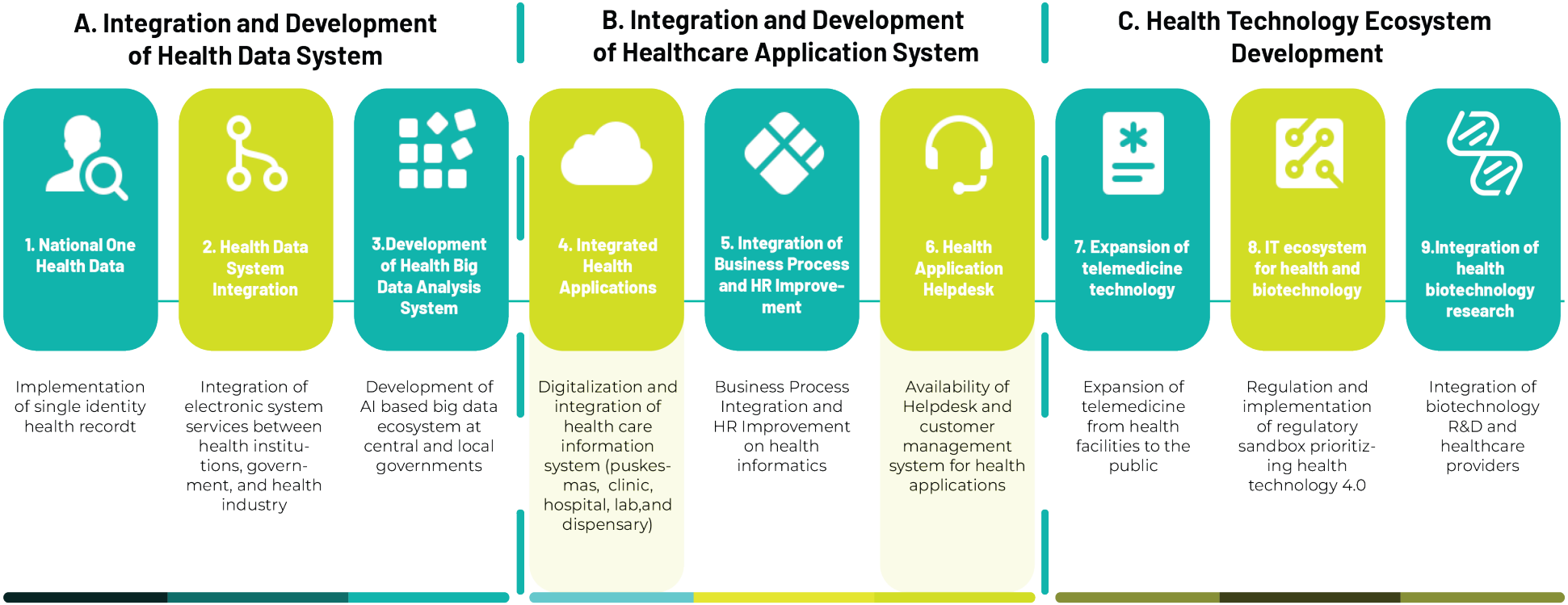


Figure 3. Priority Activity Diagram

Health Technology Transformation Roadmap

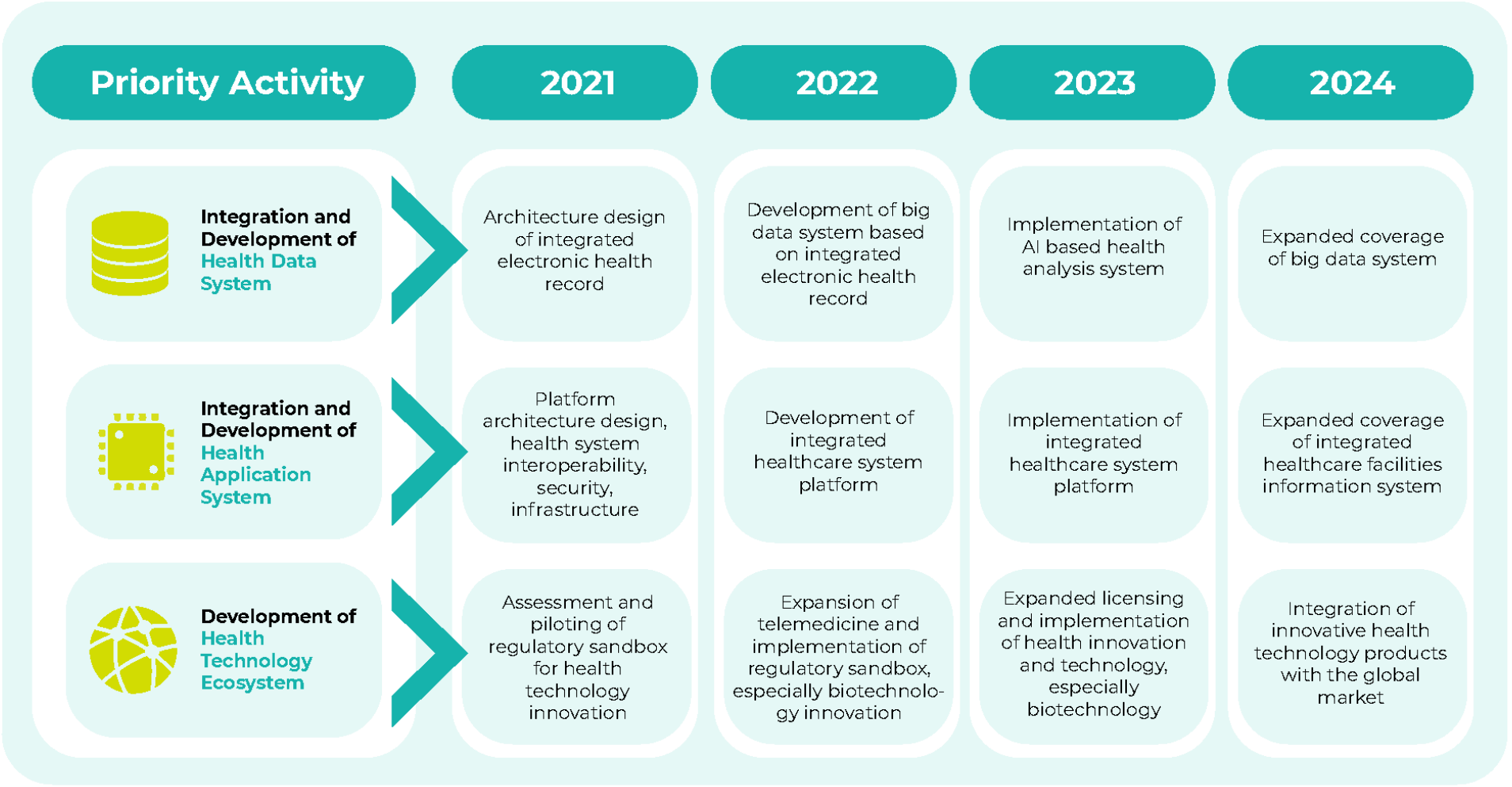


Figure 4. Health Technology Transformation Roadmap

Year 2021: Health Data System Integration & Development Activities focusing on Architecture Design of Individual-based One Health Data Governance (Integrated EHR)

The development target focuses on architectural design with the goal that each individual has integrated health data. The data requires integration with the health application system which focuses on the platform architecture design, health system interoperability, security and infrastructure. The next activity is Health Technology Ecosystem Development as an ecosystem assessment and regulatory sandbox trial in health technology innovation.

Year 2022: Development of Integrated Big Data System

Big data system development includes individual-based health systems covering pandemics, healthy families, and stunting. This will focus on the number of health data systems that are already integrated with the central database. The Health Application System Integration & Development activity will be developed into an integrated health facility system platform.

Year 2023: Implementation of Health Analysis System

In 2023, it is expected that there will be an increase in individual data variables from 2022, namely an increase in integrated data systems. This is realized by implementing an artificial intelligence -based health analysis system . This implementation is marked by the expansion of licensing and implementation of biotechnology innovation technology products at health facilities, improvement of telemedicine services at First Line Healthcare Facilities (FKTP), and a policy on digital health.

Year 2024: Expansion of Indonesia's Digital Health Transformation

Activities carried out in the previous years are expected to expand integrated health governance in Indonesia, expanding the integration of health service applications, and the Indonesian health innovation ecosystem. Activities in 2024 will be a continuation of activities in 2023 which will be carried out in several regions of Indonesia. In 2024, all regions in Indonesia are expected to have an integrated individual-based health data management. Similarly, it is expected that 100% of health care facilities will have an integrated system. In 2024, the focus is more on expanding the target in the previous year, namely well-run digital transformation system integrating individual-based data, health application systems in health facilities, adequate health human resources with digital literacy, high number of biotechnology products applied in health facilities and the expansion of telemedicine services at FKTP.

2.2.Health Data Integration and Development

Health Data Integration and Development consist of three program activities. The first is the National Health Data System. This program is an implementation of the National

Individual-Based Health System or Integrated Electronic Medical and Health Record. The second is the Integration of Health Data Systems in the form of integration of electronic system services between health agencies within the central government, local governments, and also the health industry. The third program is Health Big Data Analysis System Development. The program will build a health big data ecosystem based on artificial intelligence analysis, both at the central and local levels. This activity has a main output of improving the quality of health policies based on accurate, up-to-date and complete data.

Several studies have shown several issues due to an unintegrated health data system, including under-reporting and uncompleteness. This will affect the quality of the data that has been collected. Health decisions that are not based on quality data will have a negative impact on public health.

The implementation of activities according to the health technology transformation roadmap will begin in 2021. This year, the architecture design of an Integrated Electronic Health Record will be developed. In 2022, the development of an Integrated EHR-based big data system will be continued. Then, the implementation of an artificial intelligence-based health big data analysis system will begin in 2023. It will continue in 2024 and is expected to expand the coverage.

Integration and development of health data is needed to improve the quality of health policies based on data analysis. This program will target stakeholder components starting from the level of the health department and national institutions (eg BPJS), health providers/ facilities, up to the health industry.

2.3. Health Application Integration and Development

The Health Technology Information System continues to develop, so the development of health applications is also needed to optimize health services and management at various levels of health services. The targets of these activities are Puskesmas, clinics, health centers, hospitals, laboratories, pharmacies, and the health office. The expected output is the optimization of health services and management at the level of Puskesmas, clinics, hospitals, laboratories, and pharmacies with the support of efficient and integrated applications.

The integration of health applications will focus on the integration and digitization of health emergency response services, primary services, pharmacy services, referral health services, health financing, health human resource management, covid-19 vaccination, internal management of the Ministry of Health, and Ministry of Health infrastructure. These highly varied services require a platform that includes all nine health services.

2.4. Health Technology Ecosystem Strengthening

From year to year, the number of digital technology developers in the health sector is increasing. Most of these developers have collaborated with the government and are officially registered at the Ministry of Communications and Information Technology as Electronic System and Transaction Operators. However, until now, none of the digital technology developers in the health sector is under the auspices of the Ministry of Health. So far, the legal basis of the developers are only the Cooperation Agreement. Therefore, a new approach is needed in drafting regulations that are able to catch up with the rapid development of digital technology in the health sector

Telemedicine Technology Expansion

The expansion of health technology in the health sector is not as rapid as in other sectors such as e-commerce and banking, but the Indonesian health sector is gradually picking up speed. One of the technologies that was rapidly adopted is telemedicine technology, which is widely developed by private innovators in the form of digital start-up companies. The Covid-19 pandemic has significantly increased the use of telemedicine. The use of telemedicine is related to the government's target of achieving Universal Health Coverage (UHC) for at least 95% of the population or as many as 257.5 million people by 2020. This telemedicine technology is also a solution to the limited health infrastructure and human resources which cause limited access to health services for the public.

Innovative Health Technology Product Ecosystem Development

The development of innovative health technology product ecosystem, implementation of the regulatory sandbox and incubation of Health Technology 4.0 are the government's responsibilities to identify opportunities or develop new regulations to encourage the public to participate in creating or even supporting each of these innovations. The regulatory sandbox is important because it can accommodate several functions, including: (1) testing a regulation based on real conditions that occur more quickly and accurately, (2) bridging the needs between digital health industry developers and health regulators, (3) providing guarantees to investors who want to invest in start-up companies related to the health sector.

Health Biotechnology Research Integration

The development of innovative health technology product ecosystem, implementation of the regulatory sandbox and incubation of Health Technology 4.0 are the government's responsibilities to identify opportunities or develop new regulations to encourage the public to participate in creating or even supporting each of these innovations. The regulatory sandbox is important because it can accommodate several functions, including: (1) testing a regulation based on real conditions that occur more quickly and accurately, (2) bridging the needs between digital health industry developers and health regulators, (3) providing guarantees to investors who want to invest in start-up companies related to the health sector.

2.5. Digital Transformation Governance

Effective leadership and governance enhances transparency and credibility, provides guidance, and ensures that the national digital health vision is well planned. Effective management ensures that processes are carried out in a structured and timely manner with appropriate stakeholder consultation. The organizational structure of the Health Technology Transformation management is formed by establishing a Digital Transformation Management Team which consists of Operations Team, Technology Team, Product Development Team, and Data Management Team. In addition, there are eight Sub-Working Groups (Tribe), namely: the Primary Care Tribe, the Secondary Care Tribe, the Pharmacy Resilience Tribe, the Health Resilience Tribe, the Health Financing Tribe, the Health HR Tribe, the Internal Management Tribe, and the Biotechnology Tribe.

Role of the Digital Transformation Office in Realizing Digital Transformation

The Special Team for Digital Health Transformation (DTO) of the Ministry of Health has several major responsibilities in realizing digital health transformation, including planning and managing the vision development process, collecting various information, analyzing and compiling a national Digital Health vision, conducting research and stakeholder consultation, as well as harmonizing and centralizing the development of information technology related to the digital transformation.

DTO also performs a thorough integration of the digital transformation process within the government. The integration carried out is in terms of policy governance, technical integration, and integration of human resources. This integration results in a fast and adaptive digital transformation, especially in responding to the main needs of the health sector during the pandemic. The DTO of the Ministry of Health has received various recognitions, both formally and informally (positive public sentiment on social media).

Role of Work Units in Digital Transformation

DTO, Pusdatin and work units collaborate with each other in realizing digital transformation. The relevant Work Units plan, provide direction and substance for product and service research. Collaboration between the work units with Pusdatin and DTO is the key to the success of this process. Subsequently, the Pusdatin and DTO teams will carry out application development centrally. The relevant work units then perform a trial application with DTO and Pusdatin. Furthermore, the work units will undertake field implementation while continuing to evaluate the application. DTO and Pusdatin will support the implementation by monitoring and evaluating (Figure 5).

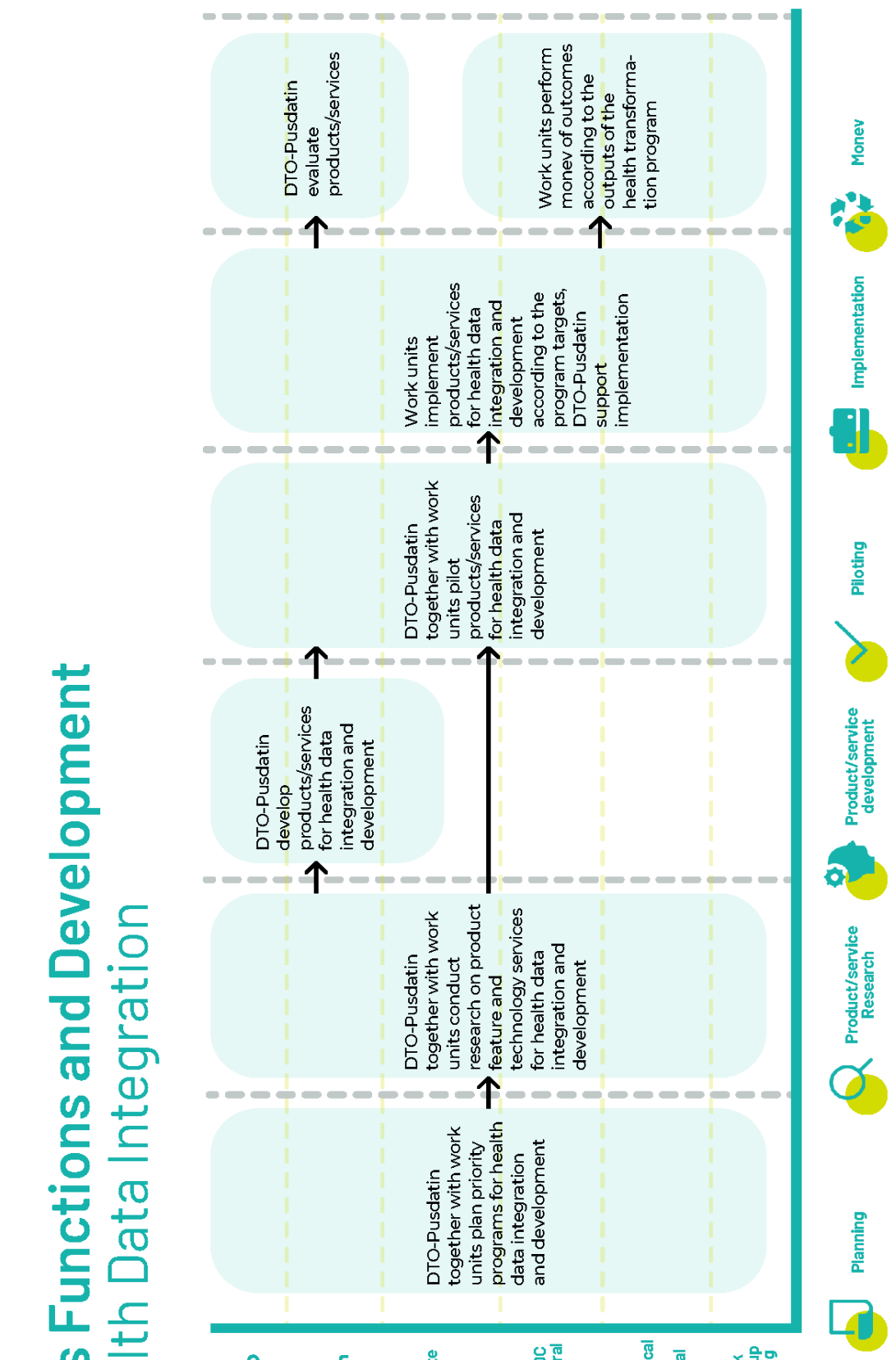


Figure 5. Flow Across Functions and Development of Health Data Integration

CHAPTER III
Health Technology Enterprise Architecture

3.1. Urgency of the Platform Approach and Enterprise Architecture

Figure 6. Urgency of the Platform Approach

The in-house development approach, in which the Ministry of Health fully assumes the role of developer and provides national implementation support, is not a feasible option because it requires considerable human resources. Meanwhile, currently the health industry players (health technology startups, hospital operators, clinics, pharmacies, and so on) have their respective applications with various platforms and data structures. As a result, the national health data are spread across the service providers.

The Ministry of Health must create technological transformation and digitalization to overcome the digital gap by adopting a platform-based approach (also referred to as PaaS, " Platform-as-a service"). The Ministry of Health must develop a platform that connects the entire ecosystem of health industry players to create a reliable national health data. The platform will link various application platforms and will not replace the existing application functions or merge all application functions into a single application.

The platform provides standardized specifications and mechanisms for: business processes, data, technical aspects and security. Applications in the platform must meet business process specifications, data exchange mechanisms (based on HL7 FHIR and HTTPS REST API), and security specifications (authentication, and encryption). As a result, this platform will realize national health data

collaboration with all health industry players, without being dependent on specific programming platforms.

Enterprise Architecture is the platform blueprint for business process, data and application standards. It is the basis for all health industry players to align their application platforms so that they can be integrated into one platform.

3.2. Platform Development Principles

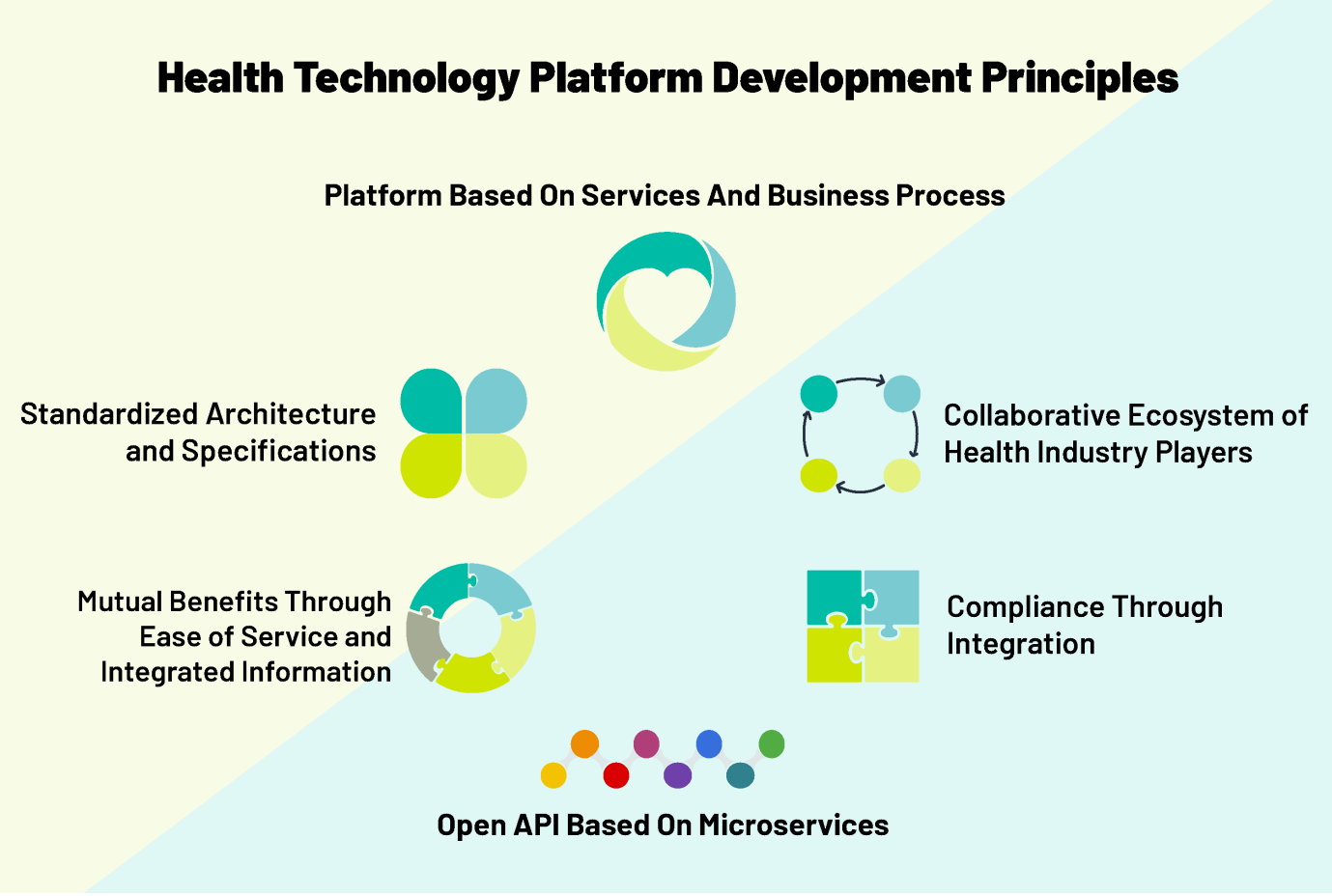


Figure 7. Platform Development Principles

The principles of the national health data platform development are as follows:

1. Service -Based Platform
2. Architecture Standardization and Specifications
3. Collaborative Healthcare Ecosystem
4. Open API Based on Microservices
5. Compliance through Integration
6. Mutual Benefits through Ease of Service and Integrated Information

3.2.1. Principle 1: Service-Based Platform

The national health data must be based on health service delivery at healthcare facilities and other supporting facilities. Data will be

generated along with health service delivery. The data is not developed through periodic reporting that is aggregated which tends to add to the administrative burden and does not provide an adequate level of data depth for further analysis.

3.2.2. Principle 2: Architecture Standardization and Specifications

The platform-based approach follows the principle of "standardization of specifications, not standardization of applications". It does not build a single application that is used uniformly throughout Indonesia. Instead, it builds an architecture standards and specifications that can then be used by various health industry players. The standard is a technical reference that allows different platforms to exchange data.

3.2.3. Principle 3: Collaborative Healthcare Ecosystem

The platform-based approach is based on the spirit of collaboration with the entire ecosystem of health industry players to provide health services throughout Indonesia. Therefore, this platform is not to replace the existing systems or applications, but it will be used by all actors in the health industry.

3.2.4. Principle 4: Open API Based on Microservices

To realize the spirit of collaboration between health industry players according to the 3rd principle above, the platform will be implemented through an Open API based on microservices. Open API is technically a reusable services concept where the platform will provide data exchange services that can be used by service providers. Health industry players can be as creative as possible in the development of health service technology, but some of its functionality can be facilitated by data exchange services provided by the platform. The existence of this service has a positive impact in terms of faster time to market and providing better services for industry players.

3.2.5. Principle 5: Compliance through Integration

The platform-based approach is a means for the Ministry of Health to control, monitor and evaluate the performance of the health industry players. By joining the health industry players on the platform, the Ministry of Health can monitor compliance with data requirements and fulfillment of service standards through transaction activities that flow on the platform.

3.2.6. Principle 6: Mutual Benefits through Ease of Service and Integrated Information

All health industry players are required to join the platform, but it is mutually beneficial for all parties. The platform not only requires the integration of business processes, but also provides benefits, both in the form of integrated data and processed data such as analytics, forecasts, and others.

3.3. Platform Indonesia Health Services

Figure 8. Diagram of the IHS (Indonesia Health Services) Platform

The general public acquire health information through the Citizen Health App, which is an application that stores complete personal health data (Personal Health Record). Other user groups are represented by " Partner Systems ", namely applications or platforms that are currently used by the health industry, such as Hospital MIS, Puskesmas MIS, Laboratory applications, and others.

The Citizen Health App and Partner Systems are both connected at the heart of the health technology platform, namely the IHS (Indonesia Health Services) Platform. The IHS platform is a digital health ecosystem from the Ministry of Health. IHS was built to make it easier for health industry players to integrate with a single health data system and ensure all health transactions can be recorded and utilized properly. It does not only benefit the industry players, but also the general public. They can check their own health transactions or their families' so they can get health education content curated by trusted parties through the Citizen Health App.

The development and operation of the IHS Platform and Citizen Health App is under the management of the Ministry of Health, which can also be connected to Partner Systems or existing applications managed by other parties.

The Citizen Health App platform is developed to solve three major issues. The first problem is that personal health data is not integrated and has low interoperability. This causes redundancy for the health administration when accessing various health services. The second problem is that the public can not monitor their personal health history. This is because medical records are scattered in various health services. Finally, the health services that people currently receive are not based on an individual approach. For example, health education is not provided individually and is often mistargeted.

Figure 9. Citizen Health Platfrom

The above issues may be addressed by the Citizen Health platform which is based on a single source of truth, with integrated and interoperable electronic Personal Health Record (e-PHR). The Citizen Health platform is an effective and efficient health service platform. It is an integrated platform that stores complete personal health data for all citizens. Users can access their personal health reports and obtain personalized recommendations to maintain optimal health. The security of user data on the platform is also guaranteed by the Ministry of Health.

3.4. Platform Architecture Design

3.4.1. Business Architecture

Business architecture is one part of the enterprise architecture that can map efficiently and effectively from a business and technology point of view. There are several methods for business architecture development. First is to map all the applications within the Ministry of Health and group them based on their respective functions and services. This is to identify existing applications that overlap or have the same service function. The purpose of this platform is to create an innovation, simplification, or a combination of various functions.

The second method is in-depth interview. This method is carried out by inviting experts on each service. This method creates a new formulation of issues that occur in each service. Based on these issues, potential efficiency will be formulated, one of which is regarding the simplification of basic services. In addition, this method also generates expectations from the experts on the existing services to create a breakthrough or new innovation.

The last method is the legal approach. The business architecture is created based on the applicable laws and regulations of the Minister of Health. One example is the Regulation of Minister of Health No. 4 of 2019 concerning Technical Standards for Fulfilling Basic Service Quality and Minimum Service Standards in the Health Sector. The regulation regarding the primary care process serves as a basis to provide services for pregnant women, the elderly, and children under five years of age. It is the basis for formulating the business process of maternity services from arrival to completion. Therefore, the regulation is the reference for developing business processes for each service.

These methods are used as the basis for all services. The goal is to be able to map each business process from each directorate or service. This is because the current approach is not only based on the application, but also based on the service. The previous business process mapping in each service may be used to identify the relationship between the business processes.

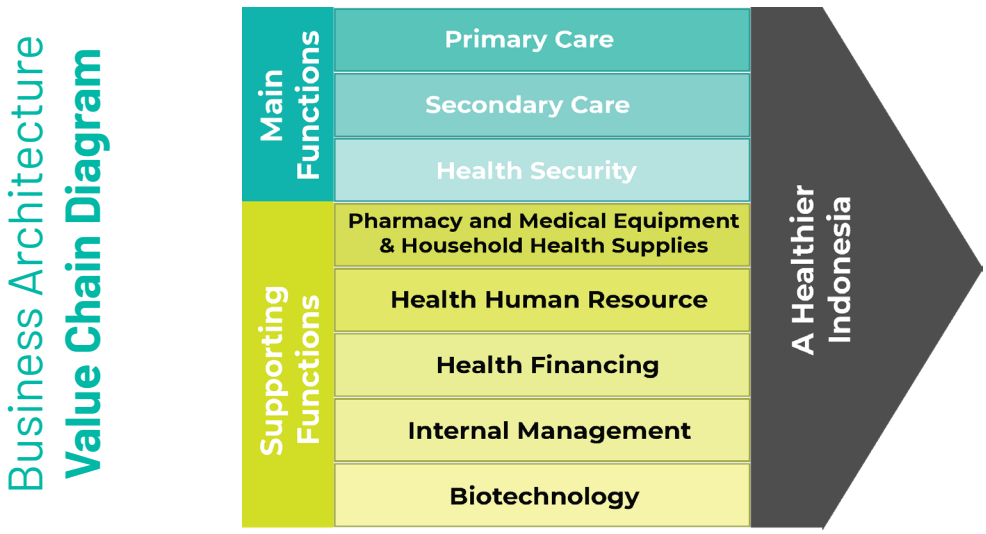


Figure 10. Business Architecture Value Chain Diagram

The Citizen Health and Indonesia Health Services platforms created will be mapped based on 8 services in the Ministry of Health. Based on the value chain diagram above, the platform is made up of the main functions consisting of Primary Care, Secondary Care, and Health Resilience and the supporting functions consisting of Pharmacy & Household Health Supplies, Health HR, Health Financing, Internal Management and Biotechnology.

The services under the main functions are selected based on the business processes from both platforms to create value or benefits for the users, while the services in the support functions are selected based on the business processes that can help achieve the objectives of each business process in the main function (Figure 11).

Business Architechture

Functional Decomposition Diagram

Functions		Business Process			
Main Functions	Primary Care	Individual health effort	Public health effort	Health Facility Management	Analisys dan Mapping
	Secondary Care	Individual health effort		Health Facility Management	Analisys and Mapping
	Health Security	Early warning system	Epidemiology Investigation	Governance	Health education/ promotion
Supporting Functions	Pharmacy and Medical Equipment & Household Health Supplies	Inventory Management	Supply demand Mapping	Licensing and compliance monitoring	Drug use and services
	HHR	HHR profile management	HHR distribution and management	HHR distribution and management	
	Health Financing	Health Account Analysis	Analysis of Health Insurance Fund and JKN	Health insurance participation	Complaint Mechanism
	Internal Management	Internal Operation	Planning and budgeting	Monev	
	Biotechnology	Biotech Development		Biobank Development	

Figure 11. Business Architecture Functional Decomposition Diagram

3.4.2. Data Architecture

The data architecture strives for data standardization that enables application integration and data interoperability. As a result , the data generated by unique and different information systems at the organizational level can be integrated and utilized at the district/city, national, and global levels.

These data integration and interoperability issues have been identified globally. Until now, efforts to solve the problem have been carried out by creating a standard framework that allows data consistency and interoperability. Two popular frameworks implemented in healthcare environments are Fast Healthcare Interoperability Resources (FHIR) and OpenEHR. Both are open standards that strive for standards and data interoperability as a goal, however, the two standards are designed to solve slightly different problems.

FHIR is optimized to solve data exchange problems by providing an easy and simple REST API. The basis of FHIR is the use of resources that can be used for various purposes. Generally, these resources are used for the exchange of clinical information such as meetings (Encounter), treatment plans (CarePlan), and order of diagnosis. In its implementation, FHIR users can build a database according to their needs using a combination (bundle) with more than 100 available resources.

On the other hand, OpenEHR is optimized to provide a data platform with a focus on data consistency as the primary focus, with API and data exchange as the secondary focus. In contrast to resource-based FHIR, OpenEHR uses more than 300 archetypes to provide a complete set of data elements. This of course makes OpenEHR have a higher level of difficulty to use than FHIR.

This health data architecture adopts the FHIR health data interoperability framework. This framework was chosen for several reasons. First, the current single health data platform has a priority on how the data contained in multiple health care information systems can be exchanged. FHIR's design that focuses on REST API for data exchange is the best choice for this purpose. Second, the one health data platform is not to replace the existing information system so the data interoperability framework must be adapted to the needs of each user. In this case, the use of resource-based FHIR is considered simpler and easier to customize than OpenEHR for data exchange purposes. Third, FHIR has a wider user community than OpenEHR, so data communication can be carried out between members of a wider community as well. Malaysia, the Philippines, Australia, and the United States are several countries that have used FHIR.

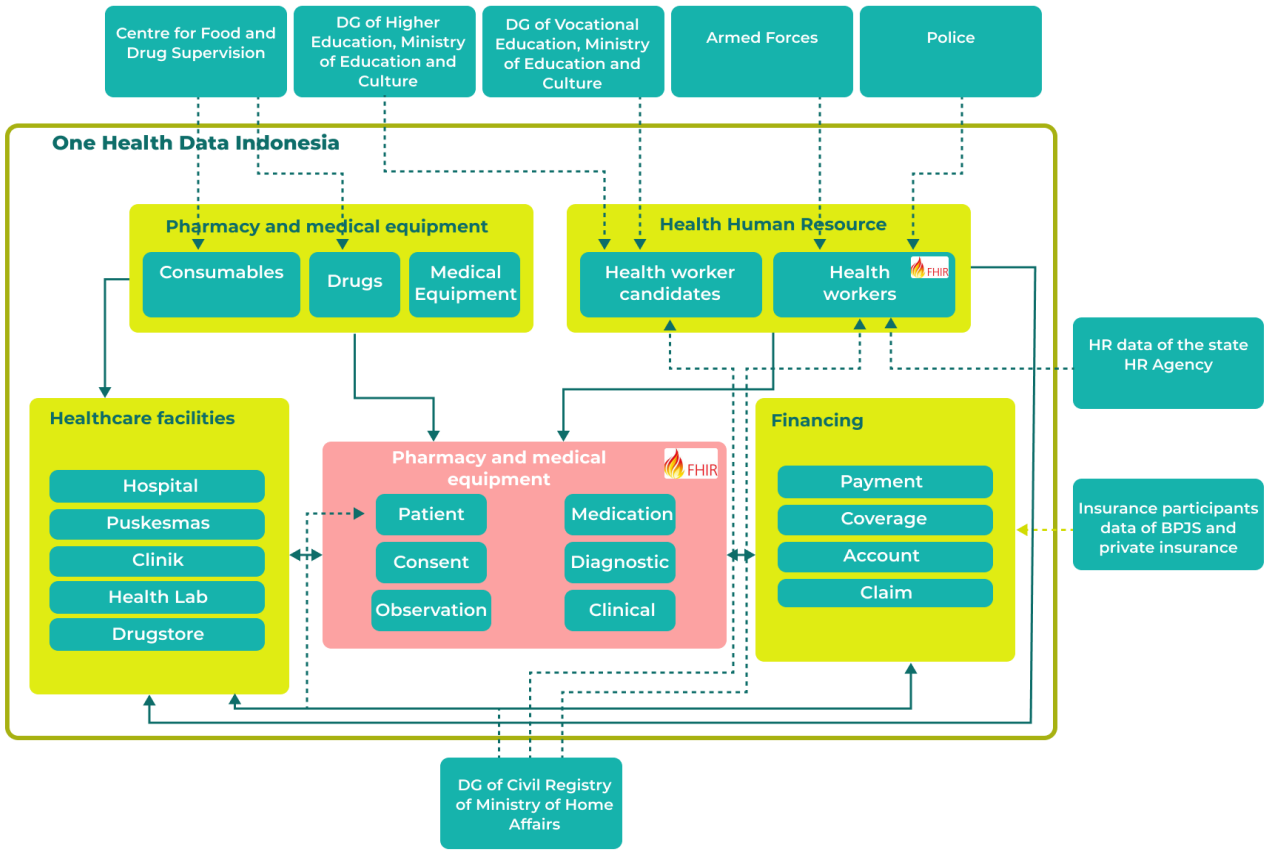


Figure 12. Data Architecture Logic Diagram

The One Health Data architecture starts from the transaction process that occurs through two main platforms, namely the Citizen Health App and Partner Systems . On the user or patient side, the Citizen Health App platform will provide electronic personal health record data for both patients and other people who are still in the same patient's family. The main purpose of the One Health Data architecture is to collect data on all medical activities into a centralized Electronic Medical Record database (red island) with other data islands as supporting databases (yellow islands). Electronic Medical Records contain records of health service activities such as examinations, medical procedures, and clinical procedures. Meanwhile, the supporting data serves to support the context of the main service information. The data island of Health Facilities provides supporting information regarding health service provider organizations such as hospitals, public health centers, clinics, labs, and others. The pharmacy and medical device data island provides information on drugs or medical devices needed in healthcare activities. The data island of health human resources records information on health workers who perform health service activities. Then, the financing island contains data that explains the costs incurred and charged for the medical treatment performed. This medical record data will be protected in a data protection and security framework called Data Ownership and Stewardship. Consent will be a layer in every data exchange transaction, in addition to metadata and the data itself.

On the Partner Systems side, the existing health service facility management system (eg Hospital Management Information System, Puskesmas Information System) is the main aggregator to obtain a single medical record data. Medical record data contains patient data, patient data sharing consent data, medical observation data, drug administration data, medical diagnosis data, and clinical action data. This medical record data is complemented by data on health care facilities that explain where the medical action took place, data on health human resources that explains who is carrying out the medical action, and financing data that explains the amount of payment for medical actions carried out by BPJS and private insurance.

After a single Electronic Medical Record has been collected, data analysis can then be performed. Examples of big data analytics that can be done include exploration of hospitals in Indonesia that treat the most patients, predictions of the spread of outbreaks on the island of Java, and classification of clinical actions based on the area of origin. In addition to structured data in the form of tables, analysis for unstructured data can also be carried out, for example text mining analysis to find out the frequency of occurrence of words in certain disease prescriptions, or predictions using image processing to determine the location of tumors using observational medical record data from the CT scan image.

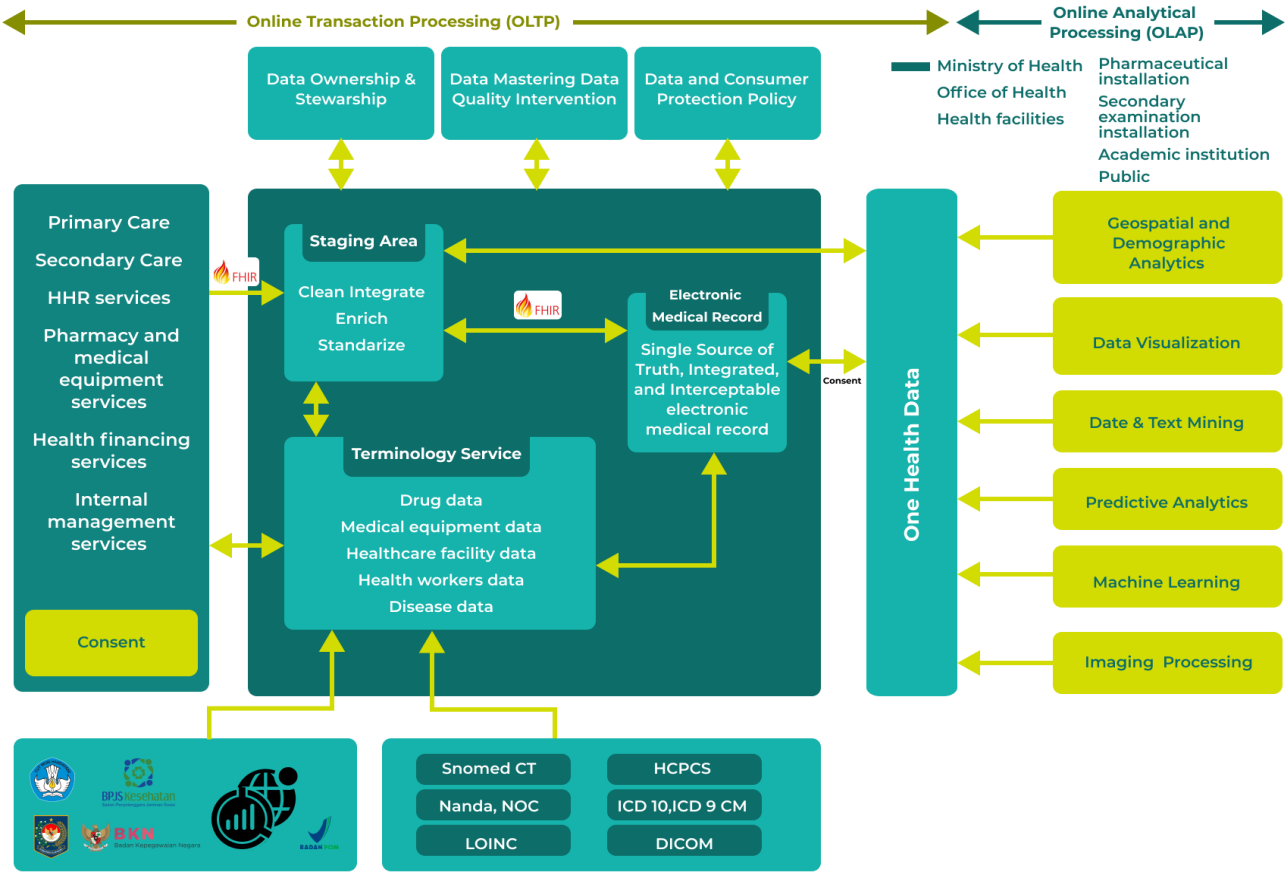
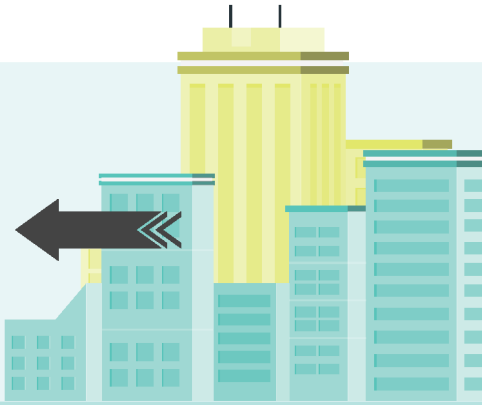


Figure 13. Data Architecture Conceptual Diagram

Core Structure Indonesia Health Services Platform

Citizen Health App

Partner Platform



Service Registry

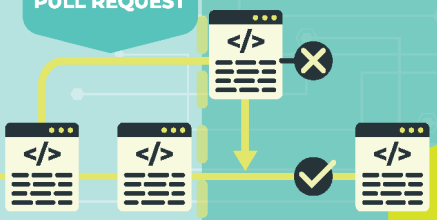
API Gateway

OAuth Service

Microservices

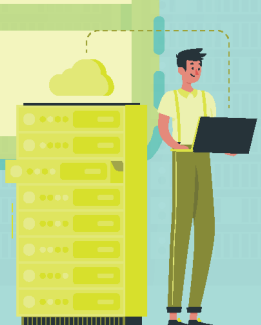
Base Service

Advanced Services



One Health Data

Electronic Medical Record	Healthcare facility
Financing	Health human resource
Pharmacy and Medical Equipment	Data Mart



3.4.3. Application Architecture

The IHS platform exists and is built as a solution to the latent problems related to integration and many applications as previously described. IHS is not an application but a platform or ecosystem where all applications and everyone can be connected or incorporated in the same environment based on scalable, integrated, advanced and secure microservices as shown in the figure above.

The development of the IHS Platform is carried out through a modular approach, where each service has its own function and environment. Each module has a database and logic (base service) that is used in the system to serve the needs of the end-user and utilizes data that has been integrated and standardized. Data users are connected through API to API communication or through the citizen health app which is specifically taylored for individual users.

The core business processes consist of:

1. **Microservices: a business process that functions as a bridge to connect users (communities, providers, and stakeholders) with the IHS platform.**
2. **Base Services: a business process that functions to handle data needs and the treatment needed so that users can receive output in accordance with the microservices functions used.**

Integrated and standardized data will also be supported by advanced analytics ranging from text mining to forecasting by utilizing state of the art big data analytics to improve health services in Indonesia provided by related parties, through data mart that are updated in real time.

Therefore, the existence of the IHS Platform is expected to improve health services in Indonesia. The general public can individually check their medical records through the Citizen Health application at any time. Meanwhile, service providers can also contribute at any time or periodically to the IHS environment and take advantage of the data contained in the One Health Data Indonesia system.

The IHS platform is composed of microservices modules based on the services provided and the main needs of the service recipients. The services are shown in the figure 15.

The first type of service is primary and secondary care. The modules in this service group serve to meet the needs of the main health care providers, namely Puskesmas and hospitals. The services range from immunizations up to the availability of beds in hospitals. This module is needed because many applications have been created and used by primary care providers or Puskesmas. So is the case with hospitals, where many hospitals have or use their own systems to carry out their functions.

The second type of service is pharmacy and medical equipment services. The services provided here range from distribution management to production licensing. These

services are expected to improve the pharmaceutical industry by providing easy access to data. The third type of service is financing services. The modules and services under this category range from capitation absorption data up to service costing integration.

The next two modules are also important, namely Health HR Services and Internal Management services. HHR services generally contain services related to health workers, both domestic and foreign. Under IHS for HHR function, services are provided to recruit health workers. To complement HHR services, IHS also provides modules for Internal Management services that can be used to help facilitate the management of health services.

The sixth type of service is Biotechnology Services. This service is also important to be included in IHS because it is an ecosystem where anyone can be involved in data use. The use of data for research and scientific development is provided by services such as access to Biobank and Research and Innovation Hub.

The seventh type of service is health resilience services which are also provided in IHS. The services range from the availability of ambulances up to education and health promotion which will also be used in the last or eighth service, namely the Personal Health Record Service. This last service function provides complete individual health record. There will be applications that may be accessed separately by the public in the future. As this is a service-based function, every service provider can also have access to the modules and services in it.

All of these microservices can be mixed and matched to be accessed by Health Service Providers (such as: Hospitals, Public Health Centers, Clinics, Pharmacies, Laboratories) as well as related stakeholders (such as: Ministry of Health, health offices, insurance) according to standard business process specifications that have been set. For example: Hospitals can access all microservices of Primary and Secondary Services and Pharmacy and Medical Equipment Services, while Clinics can access some of these microservices.

Primary and Secondary Care

- Immunization
- Secondary Medical Examination Results
- Service Records
- Bed Availability Management
- Drug Stock Management
- Secondary Care Management
- Surveillance Report
- Monev Report
- Hajj Services
- Secondary Medical Examination Order
- Environmental Observation
- Logistics Management
- Program Planning Management
- Health Facilities and Infrastructures Management
- Generated Report
- Health Worker Services
- Patient Services
- Primary Care Report
- Maternal And Child Health
- Health Of Children Under Five
- Biotechnlogy
- Referral Service
- Drug Prescription
- Disease Prevention Services
- Juvenile Health
- Pre-Marital Health
- Elderly Health
- Follow Up Services
- Nutrition Extension Services
- Health Education And Promotion
- Reproductive Age Health

Pharmacy and Medical Equipment Services

- Product Evaluation
- Generated Report
- Consumable Management
- Distribution Management
- Import Management
- Medical Equipment Sufficiency Management
- Medical Equipment Stock Management
- Drug Stock Management
- Health Facilities And Infrastructures Management
- Medical Equipment Maintenance
- Waste Management
- Logistics Management
- Monev
- Pharmacy Licensing Application
- Drug Quality Assurance
- Drug Prescription
- Import Licensing
- Medical Equipment Production Licensing
- Consumable Production Licensing
- Drug Production Licensing
- Drug Sufficiency Management
- Production Licensing
- Drug Production Management

Financing Services

- Capitation Absorption Data
- Facility Budget Proposal
- Billing Integration
- Revenue Analysis
- Local Government Budget Reporting
- Health Insurance Participants Data Integrity
- Administrative And Financial Management
- Aggregated Claim Amount Distribution
- State Budget Absorption Report
- Service Recapitulation Management
- Operational Expenditure
- Expenditure Analysis
- Financing Sources
- Aggregated Capitation Fund Distribution
- Health Insurance Fund Distribution
- Insurance Absorption Analysis
- Operational Cost Proposal
- Complaint Analysis
- Service Costing Integration

HHR Services

- Job Status
- Professional Organization Services
- Healthcare Facilities HHR
- Doctor Internship
- Private HHR
- Job Status
- Professional Organization
- Armed Forces/Police HHR
- Recruitment
- Training
- Civil Servant HHR Recruitment
- Student HHR
- Data Collection Of Indonesian HHR Abroad
- Diploma Equalization
- Non-Civil Servant HHR Recruitment
- Competency Test
- Specialist Doctor Empowerment
- Professional Equalization
- HHR Need Request
- HHR Aggregation
- Adjustment Of Foreign HHR
- Practice Permit
- Registration
- Transfer
- Scholarship

Health Security Services

- Ambulance
- Health Education And Promotion
- Surveillance
- Lab Management
- Blood Stock Management
- Health Worker Services
- Blood Transfusion

Biotechnology

- Biotechnology
- Sample Data Access
- Biobank Registration
- Product Proposal
- Sample Data Product Registration
- Single Sign On Registration
- VETO Registration
- Sample Proposal Playground
- Research Innovation Hub
- Topic

Internal Management

- Absorption
- Salary
- Asset Management
- Work Program
- Tender
- Budget
- Job Position
- Organization
- Publication And Communication
- Work Unit
- Assistance Services
- Reimbursement
- Leave
- Insurance Claim
- Official Travel
- Vendor Recruitment
- Evaluation
- Individual Report
- Correspondence
- HR
- Archive
- Polling
- HR Management

MyHealthRecord

- Medical Claim
- Health Security Surveillance
- Drug Service & Use
- Emergency Management
- Electronic Medical Record Readiness
- Health Education And Promotion Content
- Geography
- Identity
- Health Quarantine
- Demography
- Blood Management
- Suspect Management
- Testing Management
- Tracing Management
- Case Monitoring
- Payment
- Telemedicine
- Early Warning System
- Sociology
- Medication
- Quarantine
- Clinical Report
- Premium Payment Notification
- Financing Complaint
- Health Insurance Profile
- Health Insurance History
- Patient Admission
- Billing/Claim
- Consent Condition
- Observation
- Patient Services
- Patient Registration
- Patient Appointment
- Service Request
- Medical Resume
- Service Diagnostic

Figure 15. Modules Based on Health Services

3.5. Service Cluster Platform Solutions

The previously described issues and challenges in each healthcare cluster, supported by an IHS Platform-based solution, will be transformed into a comprehensive and inclusive digital health service.

3.5.1. Primary and Secondary Carer

Primary and secondary healthcare may be realized effectively, efficiently, and sustainably by establishing Indonesia Health Services (IHS) as a standardized and comprehensive data aggregator platform with a focus on the following solutions:

Primary Healthcare Solutions

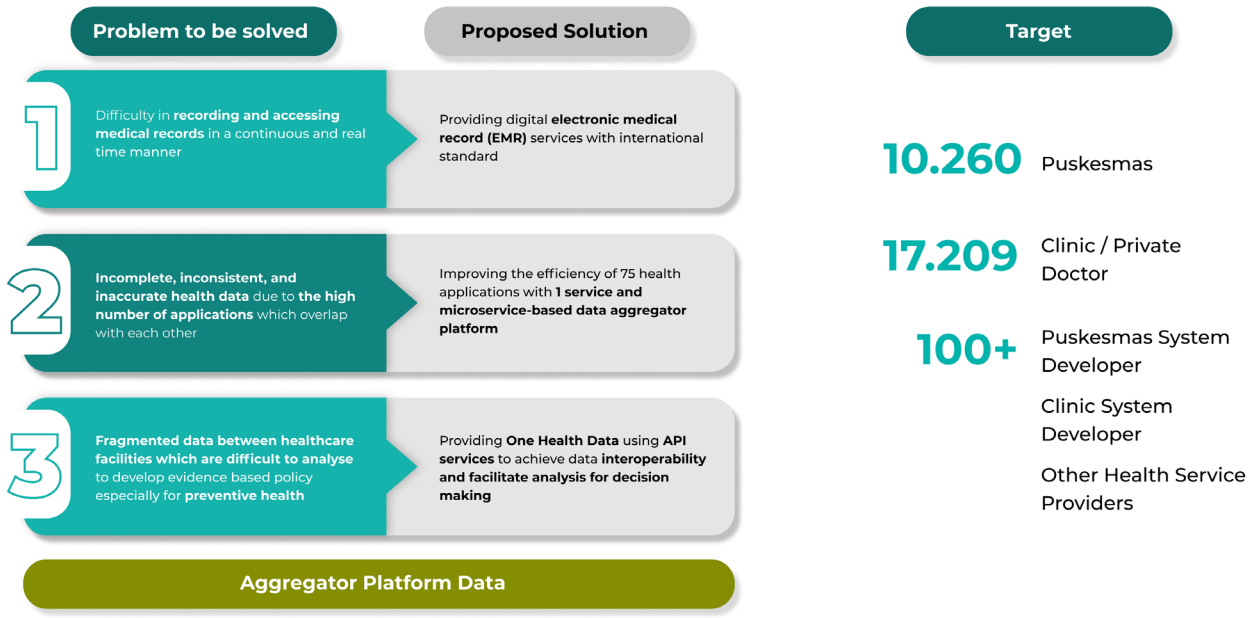


Figure 16. Primary Healthcare Solutions

1. Provision of Electronic Medical Record (EMR) services or digital medical record data recording using international data standardization (FHIR, ICD10, LOINC, SNOMED-CT, DICOM, intervention standards, diagnoses, and nursing outcomes, drug data standards).
2. The provision of One Health Data service as a national health data warehouse with an API gateway to enable health data interoperability.
3. Provide accurate health data as a basis for strategic policy-making analysis for stakeholders in the health ecosystem.
4. Integration of applications from various health service providers in one platform based on microservices.

Secondary Healthcare Solutions

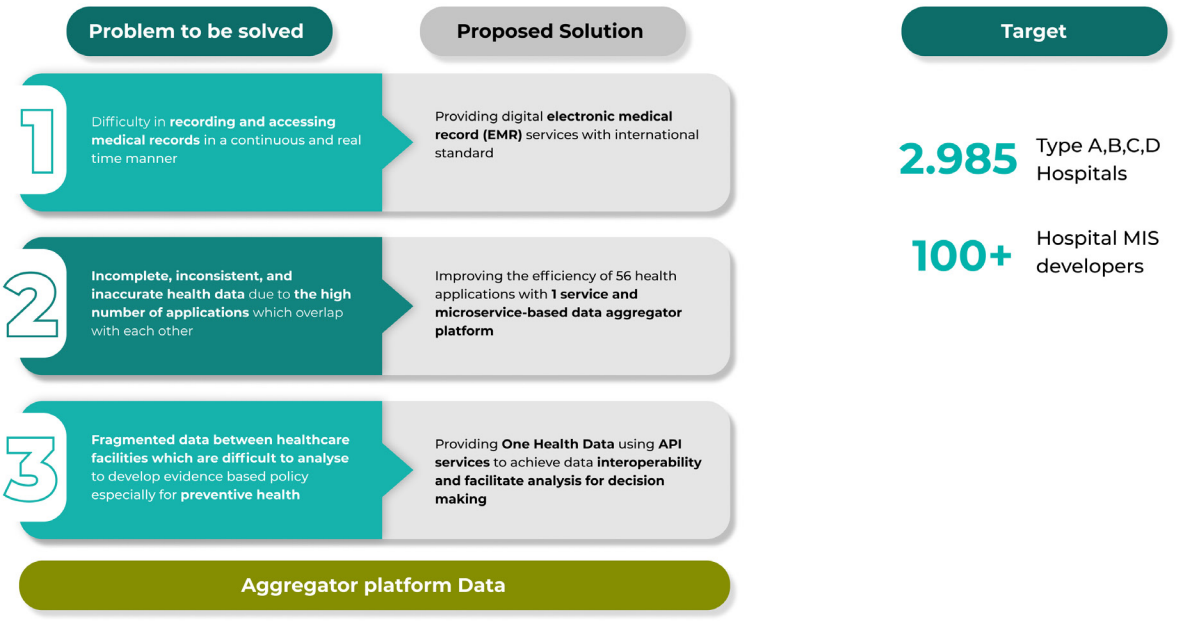


Figure 17. Secondary Healthcare Solutions

The primary and secondary care platforms include 8 primary healthcare modules and 1 service analytics module. In primary care, there are three additional main modules related to public health efforts. These modules consist of microservices and are supported by base services as a standard reference for data exchange. The main module will be used to support the core process, while the analytical module will be used to simplify reporting process of health facilities.

The primary care function has three additional modules on public health, family health, and environmental health. The three modules support promotive and preventive functions which are the main tasks of primary health care facilities - with activities such as health education & promotion, family health, nutrition services, immunization, environmental health, disease prevention and control, and hajj services.

With this approach, 75 existing primary care applications can be managed with only 25 microservices, while 56 existing secondary care applications can be managed with only 19 microservices. This means that with this system, managing primary and secondary care operations only requires 4 to 10 applications that are integrated with each other through the One Health Data platform. The design of this solution will provide convenience for both the public as patients, as well as health workers as managers and service providers in health facilities.

Platforms that support health data interoperability are expected to serve patients continuously and quickly, and ease the administrative workload of health workers.

Telemedicine Service Flow from Home

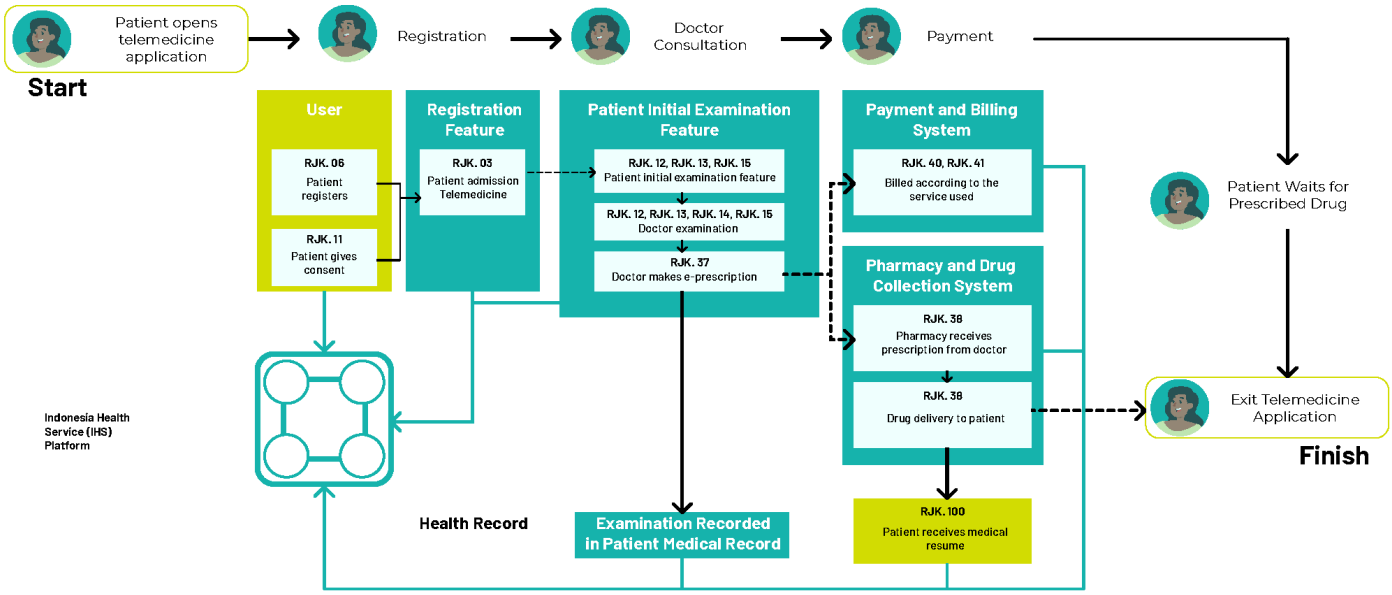


Figure 18. Illustration of Telemedicine Service Flow from Home

Figure 18 shows an example of a use case in a secondary care. Patients who wish to have an online consultation via telemedicine must register in the related application in advance to book medical consultation services as needed. The patient will be asked to go through an initial assessment prior to a doctor's examination according to the complaint. The doctor then establishes the patient's diagnosis and prescribes medication if necessary. Patients can redeem the prescription on the same application and the online courier will immediately deliver the drug from the nearest pharmacy installation to the patient's home. After that, the patient receives a bill in accordance with the services that have been obtained.

Patients will get a medical resume of the results of the examination along with prescription notes and doctor's recommendations. All activity data is linked to the patient's medical record and entered into the Indonesia Health Services (IHS) platform.

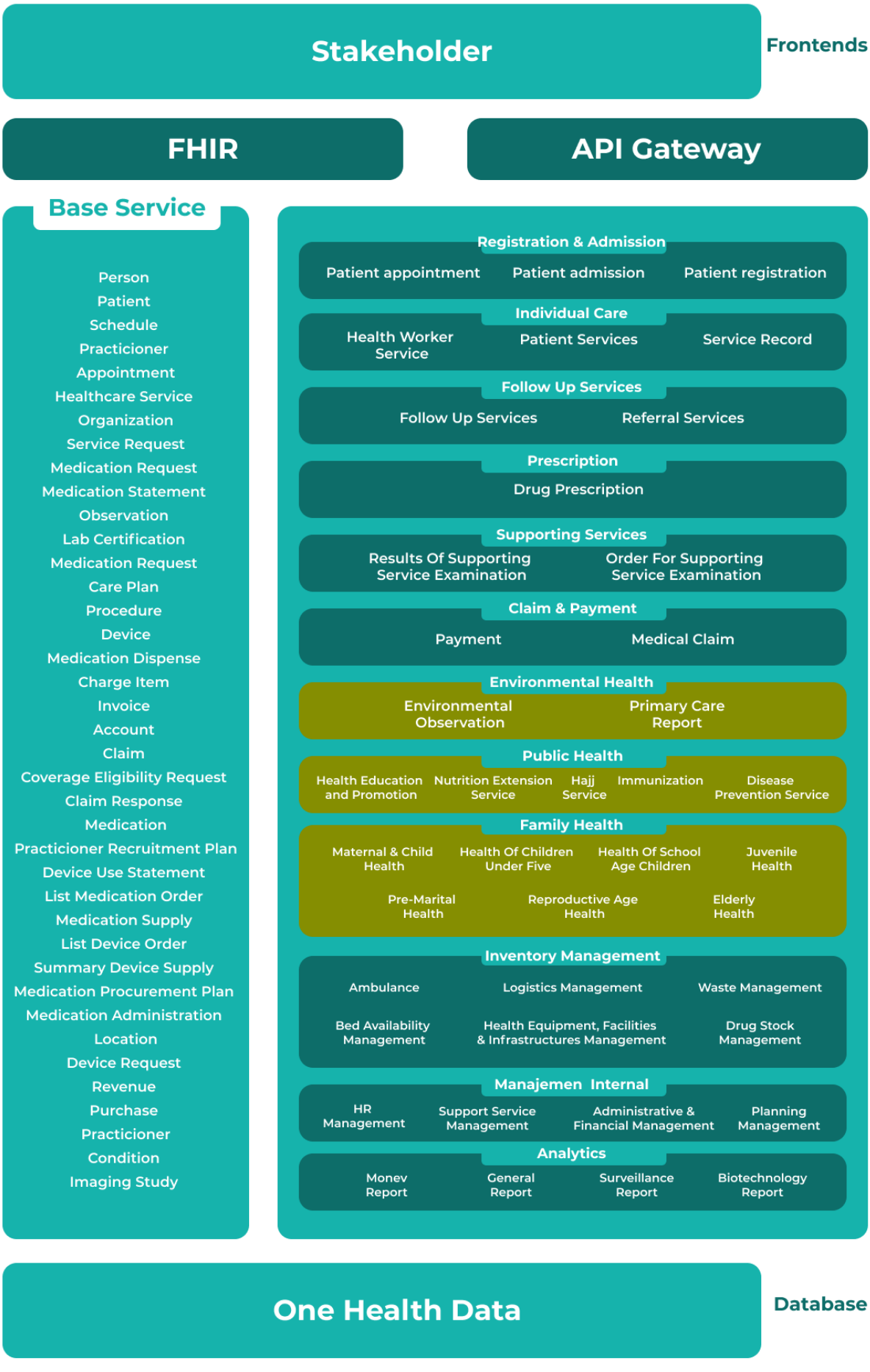


Figure 19. Architecture Diagram of Primary Care Application

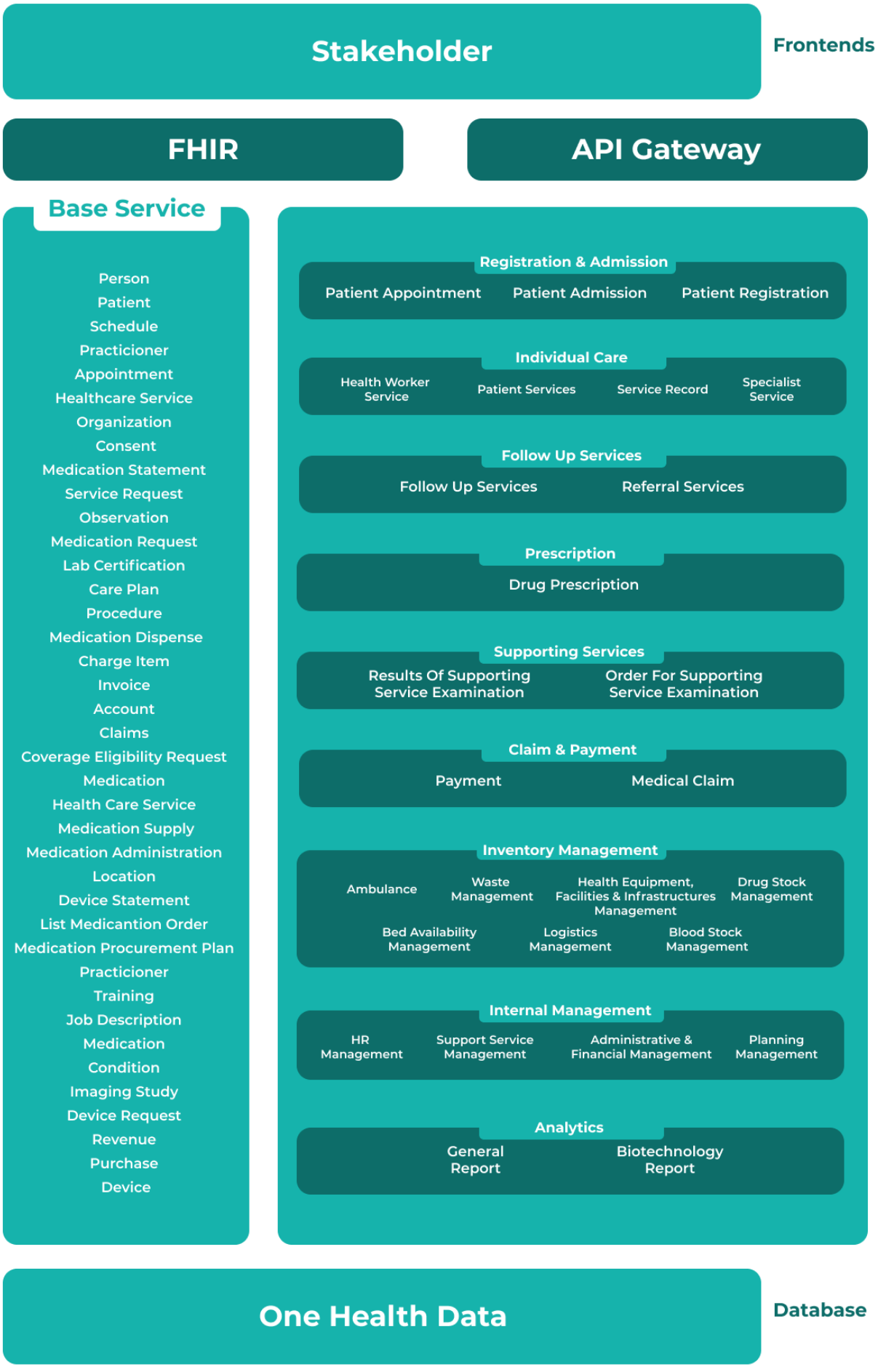


Figure 20. Architecture Diagram of Secondary Care Application

3.5.2. Pharmacy and Medical Equipment Services

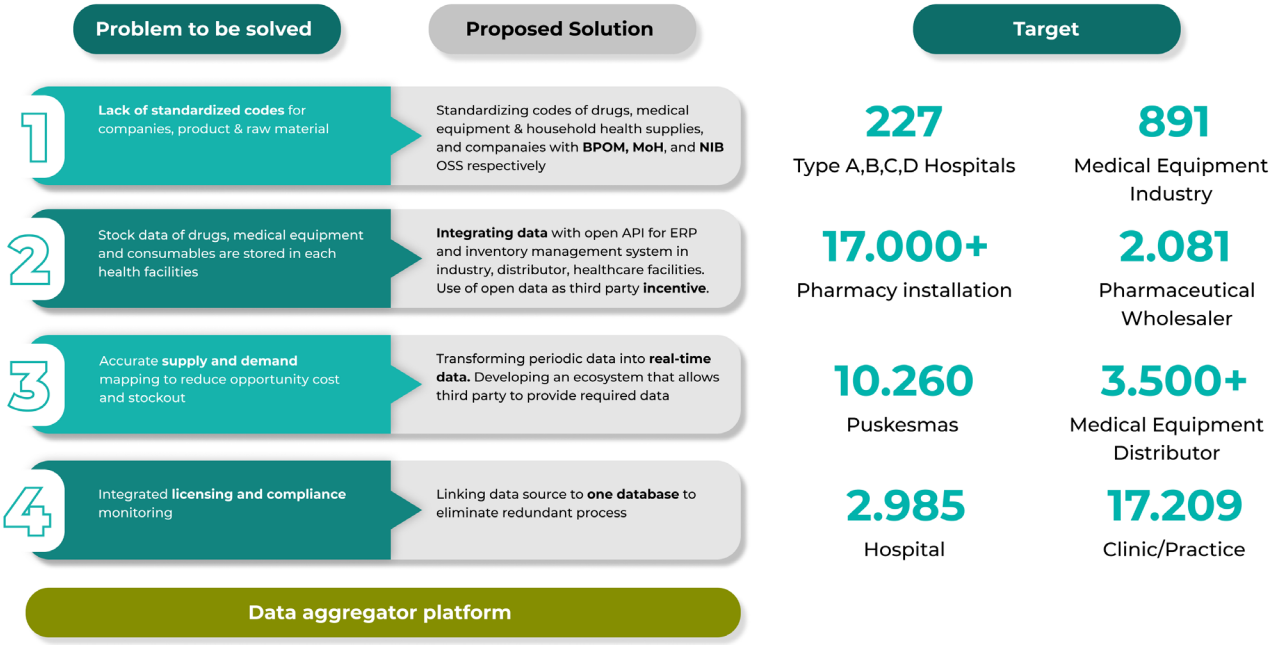


Figure 21. Pharmacy and Medical Equipment Solution

To achieve a resilient pharmacy & medical equipment services in Indonesia, an integrated end-to-end supply chain management system is needed. The following solutions should be prioritized:

1. Standardization of drug codes with BPOM standards, medical device & household health supply codes with standards from the Ministry of Health, and company codes with NIB standards from OSS (Online Single Submission).
2. Data integration is available through an open API with FHIR standards connected to ERP (Enterprise Resource Planning) & inventory management systems of manufacturers, distributors, and health facilities. Open API will reduce resistance from other agencies because it does not require large costs and efforts. To stimulate the adoption of open APIs, incentives are needed for third parties in the form of open access data.
3. Transformation of the manual recording system into a digital one with a connected system to ensure a more accurate monitoring of drug distribution and reduce the risk of illegal drug circulation in society. Developing an ecosystem that allows third party logistics providers in the pharmacy & medical equipment industry to provide the data needed in accordance with the regulated data standards.
4. Connectivity of data from multiple sources into a single pharmacy & medical equipment industry database to eliminate redundant processes. Integrating the existing systems with a single health data standard.

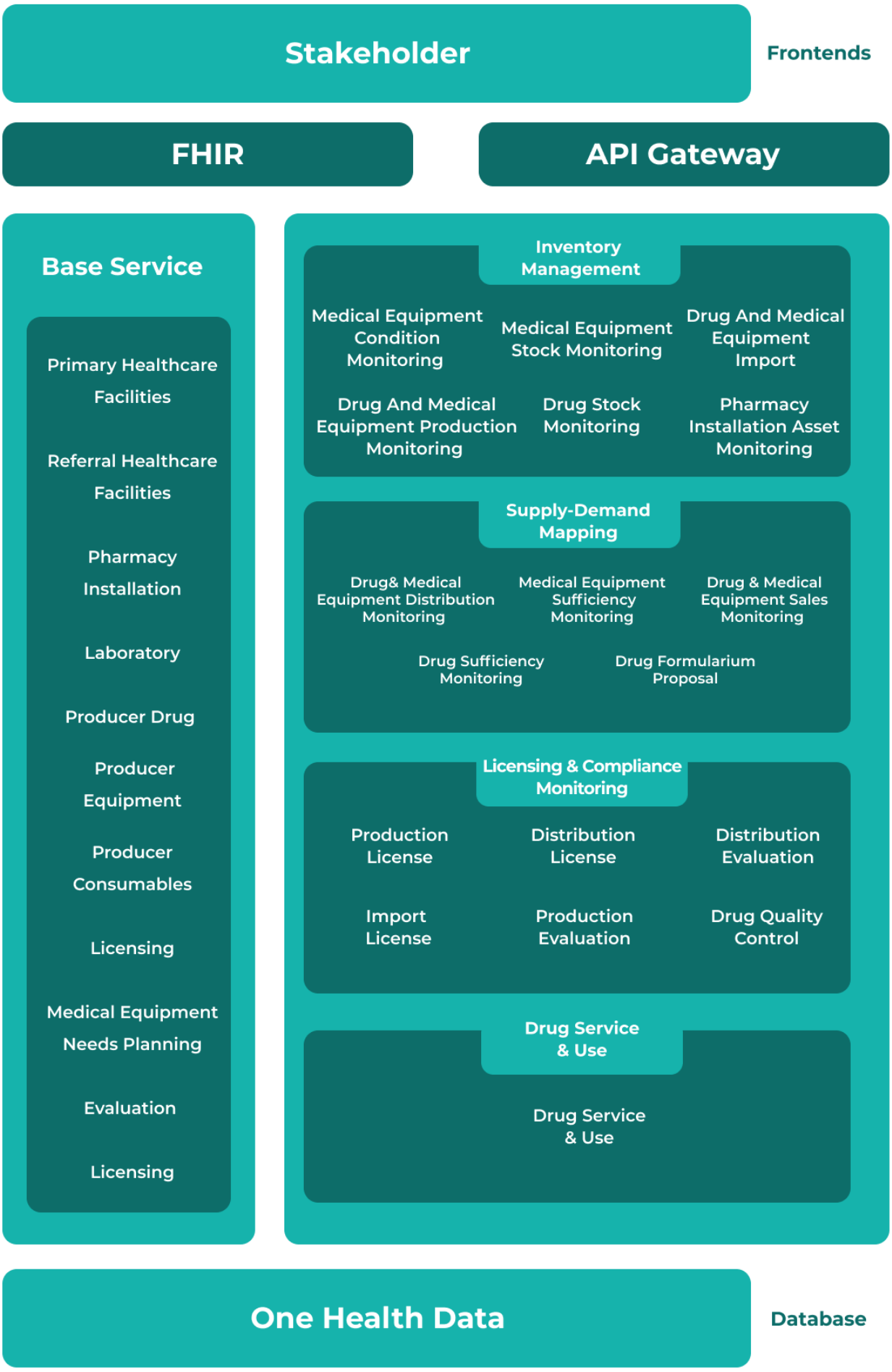


Figure 22. Architecture Diagram of Pharmacy and Medical Equipment Services

The Pharmacy and Medical Equipment service platform will cover four major services, namely inventory management, supply-demand mapping, licensing and compliance monitoring, as well as drug service and use. Each main service has a service under it which is managed by the respective directorates at the Directorate General of Pharmacy & Medical Equipment (Dirjen Farmalkes). Each main service will produce microservices & modules which will be facilitated in an aggregator platform to aggregate data from various data touchpoint (producers, distributors, health facilities, etc.). The data that has been aggregated can be used for strategic decision making and minimize congestion in the supply chain of medicines & medical equipment. Apart from being used by regulators and policy makers, the aggregated data can also be used by partners and actors in the pharmacy & medical equipment industry to forecast supply and demand more accurately to minimize stockout.

Apart from being used by regulators and policy makers, the aggregated data can also be used by partners and actors in the pharmaceutical & medical equipment industry to forecast demand from the demand side and supply stock from the supply side more accurately to minimize the probability of stockout.

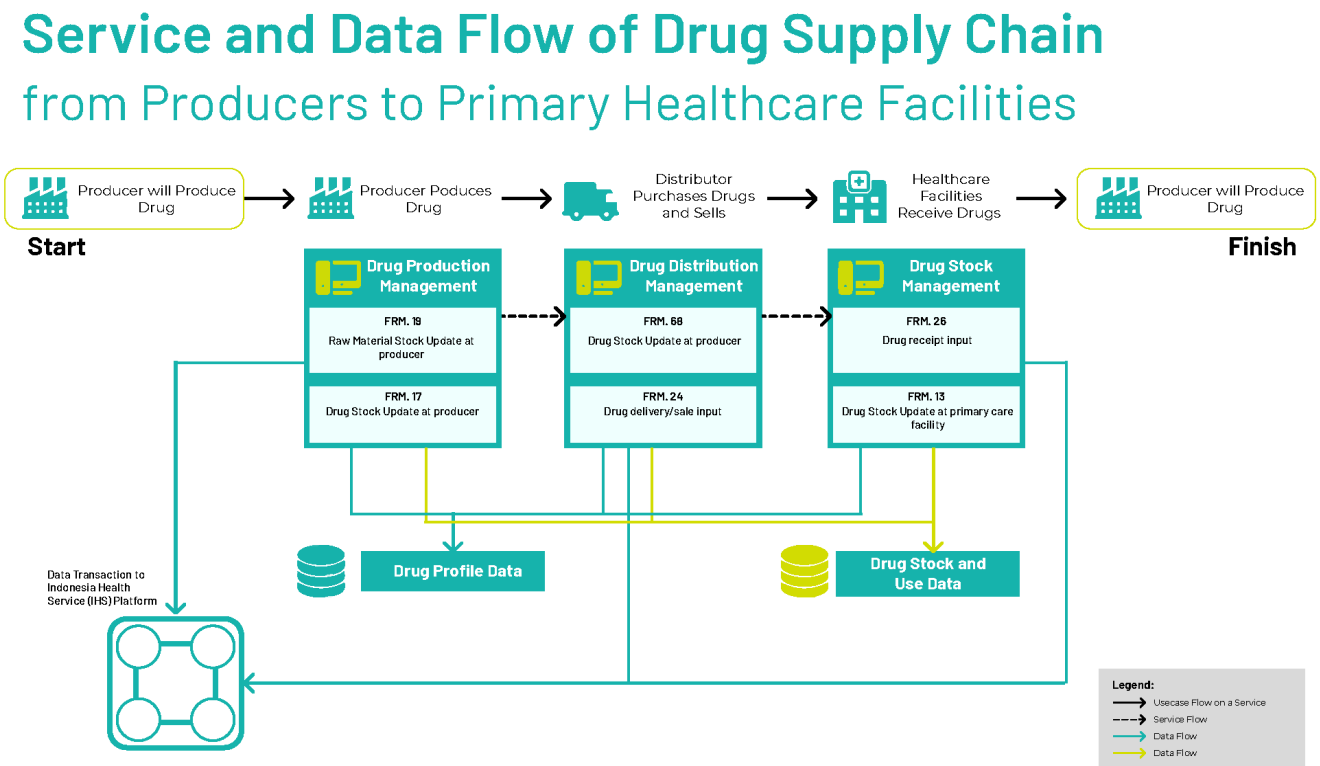


Figure 23. Illustration of Service Flow & Drug Supply Chain Data from Producers to Primary Health Care Facilities

Figure 23 is an illustration of Pharmacy and Medical Equipment services, namely the flow of drugs from the producer to primary health facilities and to the patients. Manufacturers will produce drugs when the raw materials ordered have arrived at the manufacturer's warehouse. After the drug is produced, the manufacturer will update the drug stock. Drugs that are eligible to be sold will be delivered by producers to distributors. When the drug is received, the distributor will update the drug stock. After the medicine is ordered, it is sent to the health facility. When the drug has been dispatched out of the warehouse, the distributor will input the delivery/sale of the drug. The healthcare facility will input the receipt of drugs when the drug is received. When there are patients who need the drugs, they will be sold to the patients and the health facility will update the drug stock.

3.5.3. Health Security Services

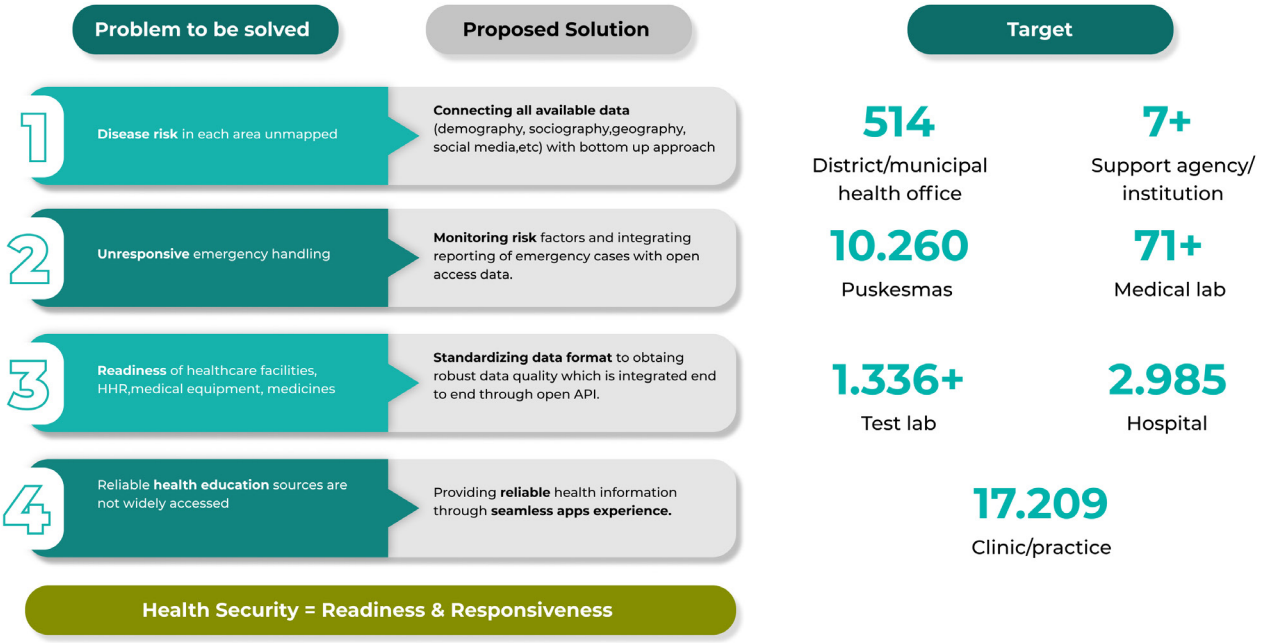


Figure 24. Health Security Solutions

Figure 25. Architecture Diagram of Health Security Services

To achieve a holistic and responsive health security system, the following solutions must be prioritized

1. Aggregation and utilization of all available data (demography, sociography, geography, social media, etc.) with a bottom-up approach, then processing them with advance analytics to obtain an accurate mapping of disease risk from specific areas to enable agencies & stakeholders to take take effective preventive action.
2. Monitoring of risks of health crises by developing a real-time early warning system and integrating emergency case reporting with open access data.
3. Standardization of data formats to obtain robust data quality that is integrated end-to-end through Open API. Data supply is obtained from the lowest level of health facilities and aggregated to obtain accurate data analysis to support strategic decision making.
4. Reliable and easily accessible sources of information and health promotion through a seamless apps experience.

To achieve Health Security, the government through the Ministry of Health cooperates with various relevant parties across directorates general, ministries, and institutions. One single platform needed to ensure an integrated and effective coordination. The health security platform will be developed with several main services that produce microservices & modules that will be facilitated in an aggregator platform to aggregate data from various data touchpoints (health facilities, laboratories, pharmacy, individual diagnosis, data testing , tracing, tracking and treatment, etc.). Data integration allows predictions of health crises and outbreaks to enable the relevant stakeholders to quickly and accurately prepare budgets, human resources, and logistics and minimize losses/severity cost.

Figure 26 is an illustration of health security service, namely vaccine certificate and PCR or swab test verification. Patients who will travel must prepare a travel permit in advance. First, patients need to provide identity data to register for vaccination and will receive a schedule. According to the schedule, patients will be given vaccinations, starting with screening of the patient's health and ending with monitoring AEFI. Next, the Health Human Resources input the patient's vaccination data. Patients can view vaccine results and certificates for travel needs on the PeduliLindung customer platform. When a patient performs a PCR or antigen swab test, the healthcare facility will input the patient's test results which will be recorded in a database with the patient's identity. For check-in purposes, the patient can show a vaccine certificate and negative PCR or antigen test results available on the PeduliLindung customer platform to the relevant officer.

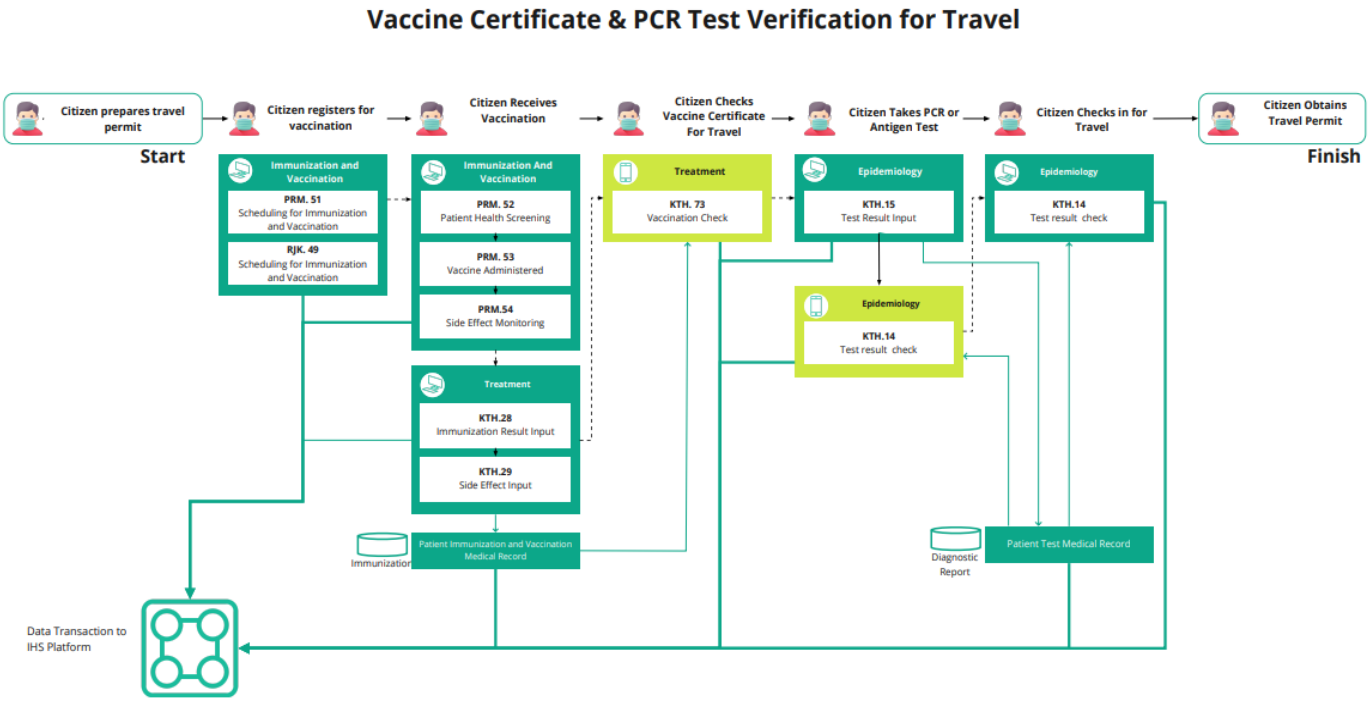


Figure 26. Illustration of Service Flow for Vaccine Certificate & PCR Test Verification

3.5.4. Health Human Resource Services

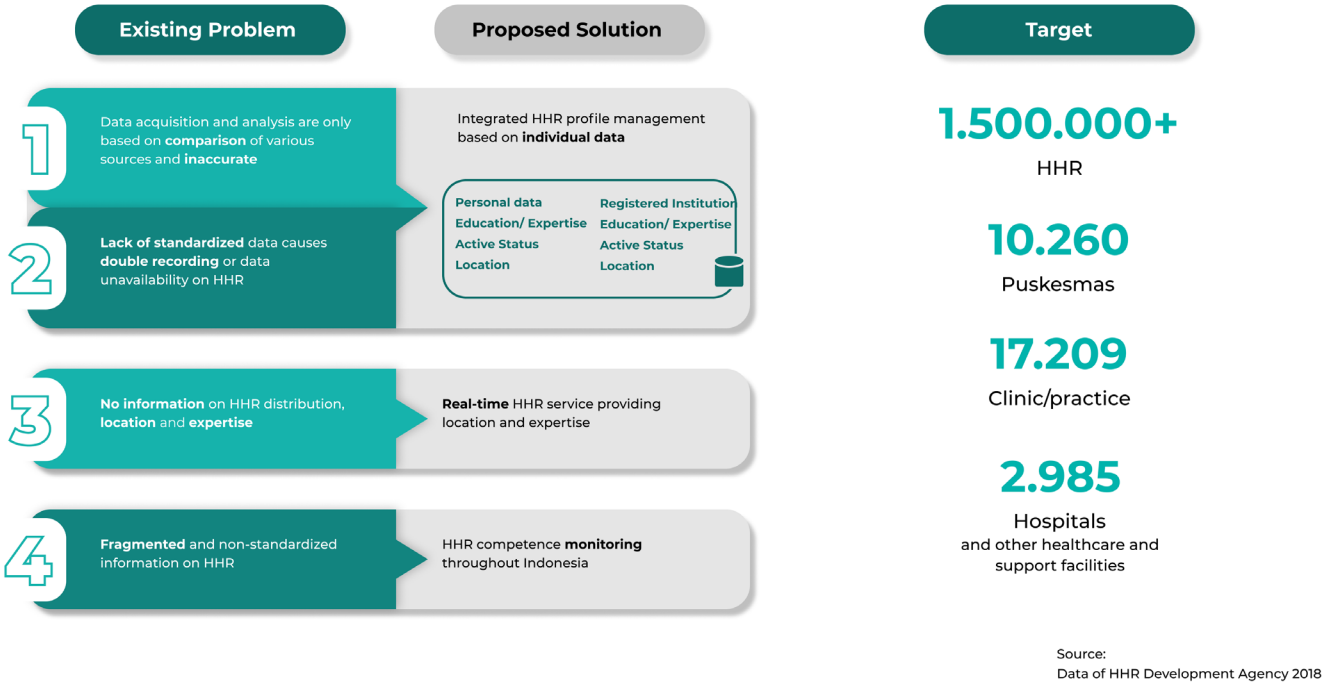


Figure 27. Health HR Service Solutions

To deal with various issues in fulfilling HHR, it is necessary to plan and execute follow-up actions that cover the entire problem so that the solution is right on target and provides answers to these problems. The solutions are categorized under the following services.

1. Integrated HHR profile management based on individual data.
   Each stakeholder, in this case a health education institution, can input student profile data which will provide an overview of the number of HHR candidates in the future. In addition, there is a big data information system that can also be accessed directly by HHR.
2. HHR distribution analysis based on integrated real time data.
   Through big data, the information system will allow the Ministry of Health to analyze HHR distribution and identify HHR imbalances or deficiencies in an area and/or specific health facilities. With big data, it is possible to identify the distribution of all HHRs in Indonesia, complete with the number, expertise, and competence, allowing a faster response time to meet HHR needs in the event of an outbreak.
3. Supervision and training with a centralized curriculum that can be accessed directly by HHR.
   The Ministry of Health is expected to provide a platform for all professional organizations or third parties to improve HHR competencies and skills, including for Competency Tests, Registration Certificate (STR), Practice Permits (SIP), training, and scholarship. In this case, the Ministry of Health can serve as a centralized source of information regarding the services provided by each stakeholder

In general, the main process in the platform is the data analysis based on the management of individual HHR data. The retrieved data come from the One Health Data Indonesia database which stores all HHR individual data. The data generated and processed are expected to pass through the API services gateway in accordance with FHIR standard.

Figure 28. Architecture Diagram of Health HR Service Application

3.5.5. Health Financing Services

Figure 29. Health Financing Service Solutions

To meet the need for data and information on the national health financing and expenditures, analysis need to be performed in accordance with the actual needs. The solutions consist of the following four elements.

Processing of information, data, and analysis of all national health financing activities. It is necessary to develop a basis for data processing, information, and expenditure analysis for all health activities nationally, both on a macro (Supply Side Financing) and micro (Demand Side Financing) scale.

Standardization of data directly from health facilities for updates of service tariff and capitation. A platform that provides comprehensive digital data collection facility is needed. The data entered will be standardized to automatically eliminate data that do not meet the system's criteria. The output of the analysis can be in the form of new capitation standards and tariffs to be applied on a national scale.

One health financing platform for all sources. The integration of the latest data with systems that are already in operation so that all data are collected on the same platform. This is very important to ensure that all analysis will be centralized and based on the latest validated data.

Administration of profile data of all users of health insurance and independent funds. Through this platform, administrative activities can be centrally accommodated and provide additional benefits to individuals as direct users of health insurance.

The financing service application is

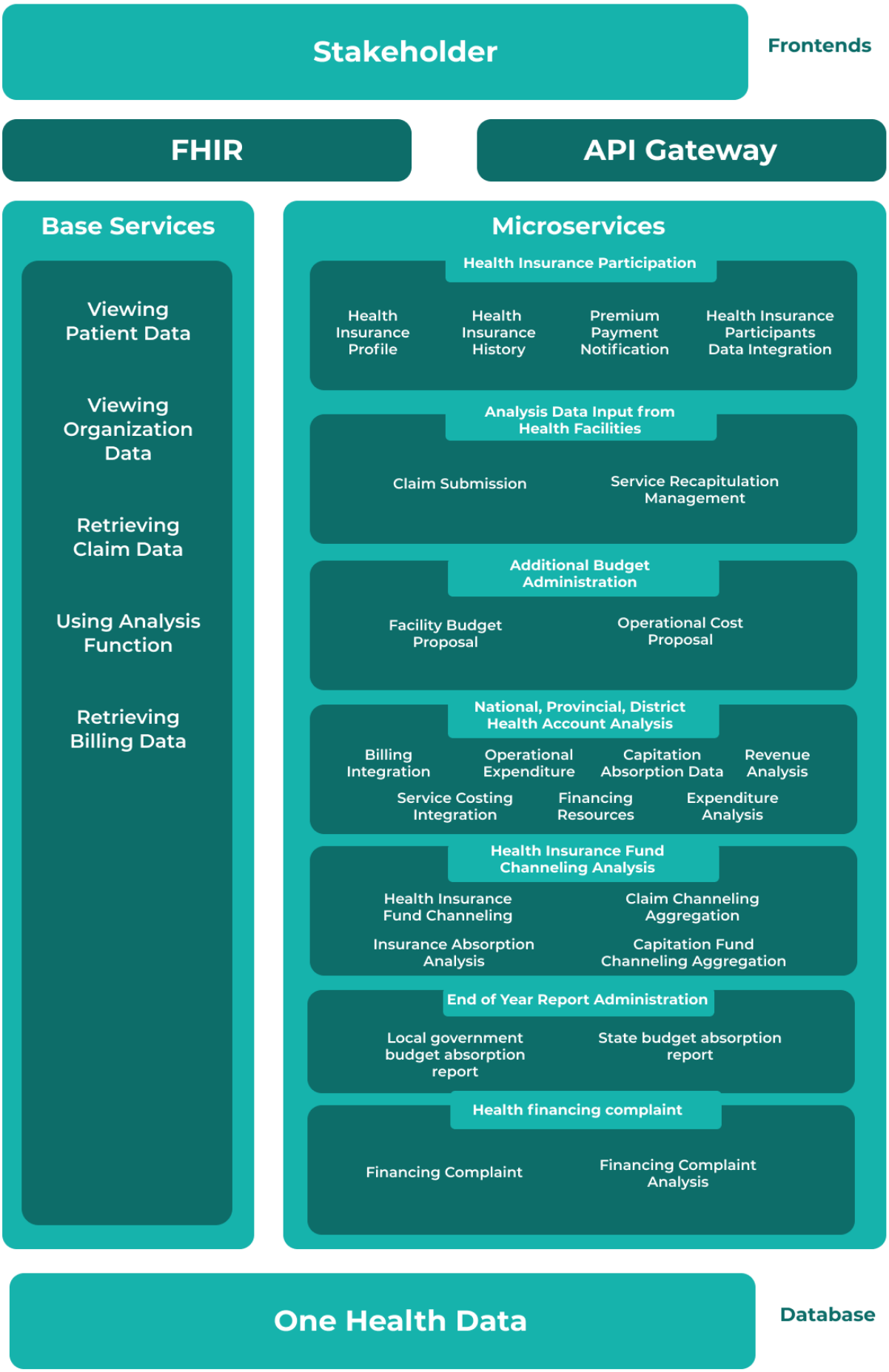


Figure 30. Architecture Diagram of Health Financing Service Application

divided into seven service modules on health insurance participation, analysis from health facilities, additional budgeting administration, national, provincial, and district health account analysis, health insurance fund distribution, year-end administrative report, and health financing complaint (Figure 30).

3.5.6. Internal Management Service

Figure 31. Internal Management Service Solutions

There are various issues related to internal management at the Ministry of Health. The first issue is the high number of applications used internally, for example the e-Renggar application for Planning and Budgeting services, e-Monev for Monitoring and Evaluation, e-Office for personnel and other applications, causing inefficient data input. The second problem is that the data in each internal application is still not integrated. To overcome this problem, the Ministry of Health wants to develop a service architecture that can be used by all employees at the Ministry, Health Polytechnic (Poltekkes), Center for Health Training (BBPK), National Hospitals and Lab Centers. In the future, this modular system can be used to unify a database that is harmonious and aligned with the relevant health agencies at the provincial and local levels.

The Internal Management application platform has 5 main modules, namely Internal Operations, Auctions, Planning and Budgeting, Implementation and Monitoring and Evaluation. In addition, each module has its own base service which is based on the business processes of each service.

Figure 32. Architecture Diagram of Internal Management Service Application

3.5.7. Biotechnology Services

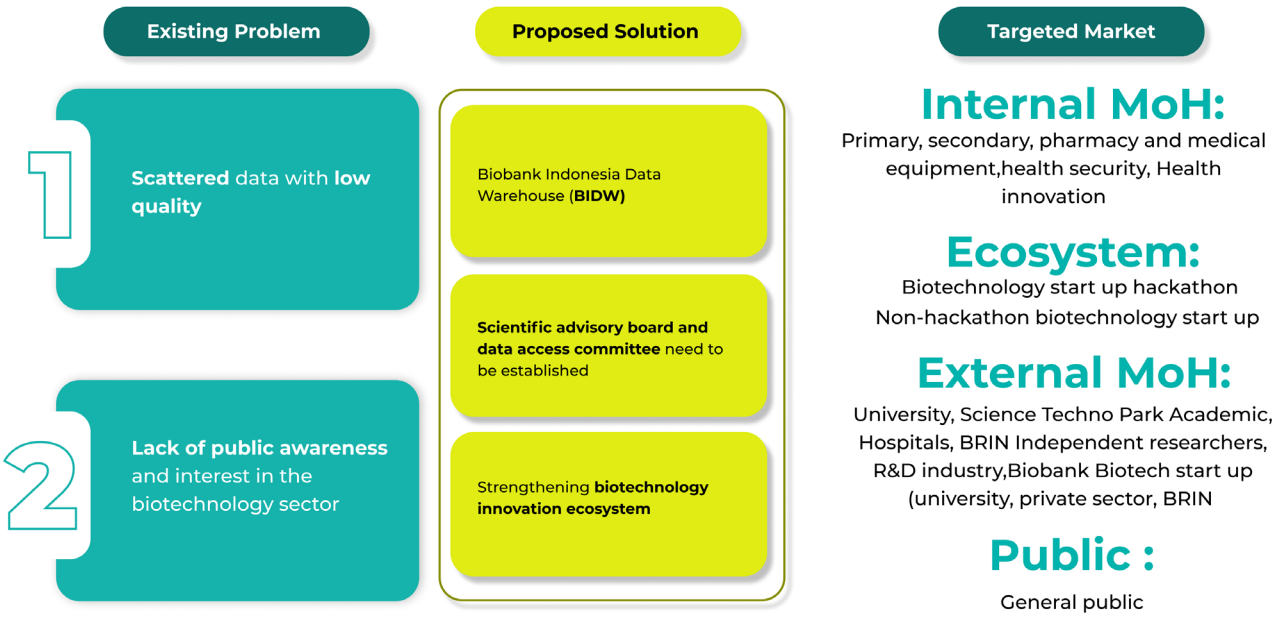


Figure 33. Health Biotechnology Service Solutions

3.5.7.1. Biobank

Biobank Indonesia Data Warehouse (BIDW) is a data gathering & sharing system to support the centralization of pre-clinical, clinical, genomic, and CMC data that aims to provide real time data. This data gathering process will involve Ministry of Health (internal), the biotechnology-based health innovation ecosystem, and Ministry of Health (external). The parties involved in the data sharing process are the same as those in the data gathering process, with the addition of the general public who may access some general information.

Ministry of Health (Internal) includes primary and secondary care, and activities related to pharmacy and medical equipment and health security. The biotechnology-based health innovation ecosystem includes startup that has passed the hackathon stage developed for the Ministry of Health's biotechnology service. The startup is a biotechnology-based entity that can produce products in the form of consumables, wearables, or services, that is able to perform data gathering at BIDW. As for external parties, the research and innovation sector includes BRIN, Science Techno Park, Universities, Academic Hospitals, Independent Researchers, R&D Industries, Biotechnology Startups, and Biobanks (Universities, Private, BRIN).

The data gathering process will be carried out by the Scientific Advisory Board with the requirements of 52 data sets from the Minimum Information About Biobank Data Sharing (MIABIS) standard (Norlin et al., 2012) with complete documents in the form of Bio Standard and Biosecurity . Then the data sharing process will be carried out by the Data Access Committee based on Cybersecurity/IT with seven steps for submitting data access.

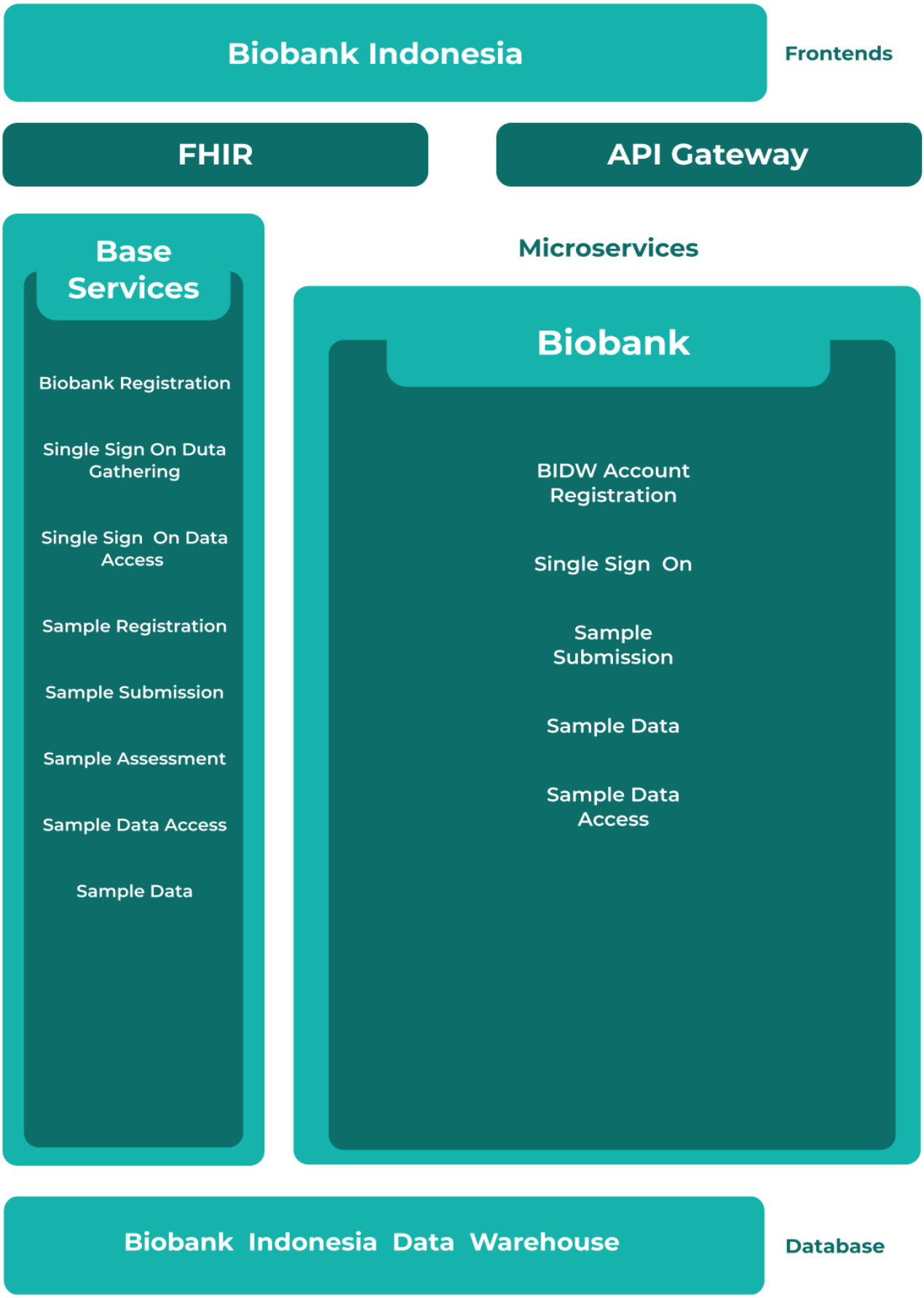


Figure 34. Architecture Diagram of Biobank Service Application

3.5.7.2. Biotechnology-Based Health Innovation Ecosystem

The development of biotechnology in Indonesia has been going on for a long time, but tends to be slow due to several main factors. The first factor is the lack of research funds in the field of biotechnology. Biotechnology research is needed to increase the quantity and quality of products as well as knowledge about biotechnology. Another factor is the lack of human resources, facilities, and government policies that lenghten the marketing process of genetically engineered products.

Biotechnology has a positive role for agriculture, health, and the environment. In the agriculture sector, biotechnology helps reduce food crises, improves food quality and increases the amount of agricultural production. In the field of health, biotechnology can diagnose genetic and non-genetic diseases and treat certain diseases. In the environmental field, biotechnology can improve the quality of polluted environments through bioremediation, bioleaching, reduction of plastic waste by producing bioplastics and producing environmentally friendly biofertilizers.

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To that end, the Biotechnology Services platform has the main objectives to:

1. Enrich biotechnology product in Indonesia.
2. Match researchers and industry.
3. Provide a data warehouse for biotechnology products.
4. Provide a data warehouse for biotechnology products.
5. Sharpen regulation of biotechnology.

In the design of the biotechnology platform, the provider from the Ministry of Health can monitor registered companies, researchers, and the number of transactions. When this platform is launched, massive communication is needed to maintain customer engagement. Through public education, an ecosystem is created that can meet these needs.

Biotechnology services have two main problems that need to be addressed, namely:

1. The data is still scattered, the quantity and quality of the data is low, as well as sectoral egos.

To overcome this problem, the Ministry of Health wants to build a Biobank Indonesia Data Warehouse. It is necessary to form a Scientific Advisory Board to regulate the collection system and a Data Access Committee to regulate the data usage system.

2. Low public awareness of the importance of the biotechnology sector and efforts to integrate Biobank nationally. To overcome this problem, the Ministry of Health wants to strengthen the Biotechnology-based Health Innovation Ecosystem, including the Collaborative Sandbox in the form of a discussion room, the Startup Hackathon as an innovation maker in consumable, wearable, and services base products, and the the Startup Hub & Capital Providers to bring together innovators and capital providers.

The Biotechnology Application has four main services, namely, Biobank Indonesia Data Warehouse, Collaborative Sandbox, Hackathon Biotechnology, and Start-Up & Capital Providers Hub. Each service has its own modules. The Start-Up and Capital Providers Hub has the VTTO Registration and Product Registration modules. The Biotech Hackathon service consists of the Playground, Research and Innovation Hub , and Product Submission modules. The Collaborative Sandbox service only has a Topic Sandbox module, and the Biobank service consists of the Biobank Registration, Single Sign-On, Sample Submission, Sample Data, and Sample Data Access modules.

All modules in Biotechnology Services will be separated into two services with reference to their respective databases. The Biobank Indonesia Data Warehouse will have its own database and a biotechnology-based health ecosystem will become a single database with user and provider platforms.

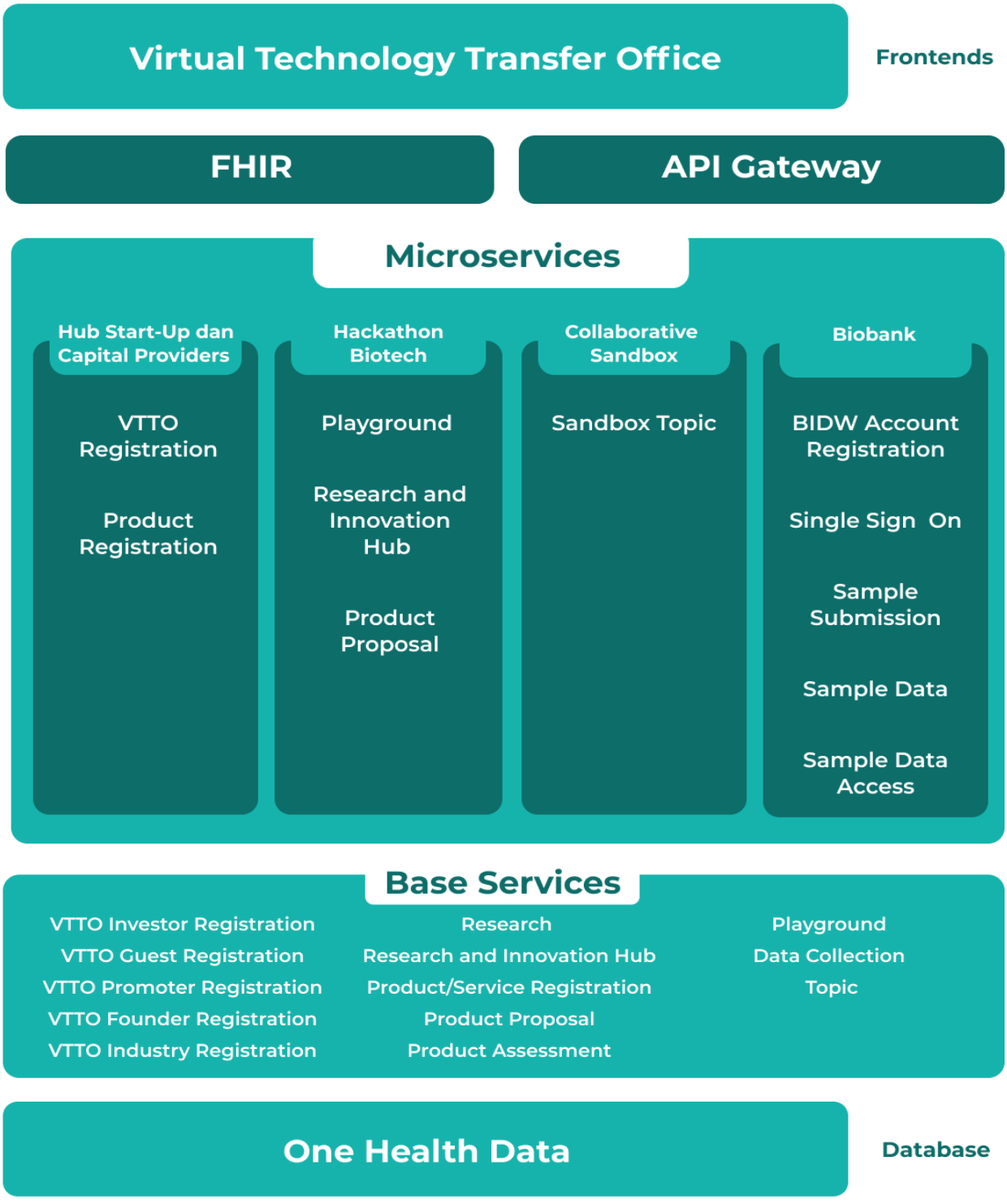

Figure 35. Architecture Diagram of Biotechnology Service Application

Biotechnology application through two main services: biotechnology innovation ecosystem and Biobank Indonesia Data Warehouse.

Microservices

Lingking and synchronizing data of stakeholders/ providers with one health data and vice versa.

Base Services

Groups of logic/interaction to meet user demand.

Advance Services

Service platform outside core business process to meet analysis needs, both in aggregate and raw forms.

CONCLUSION

The integration of eight health services creates a big challenge in the effort to carry out a digital health transformation strategy planned for 2024. One of the biggest challenges that arise is the presence of many health service applications that cause health data to be scattered without a standardized format. This situation poses a threat to the national health security due to the lack of preparedness of information and actualization of follow-up actions. For example, information on the readiness of hospital beds, medicines and medical equipment, as well as health workers throughout Indonesia is not based on real time data and is inaccurate, thus causing decisions and policies that are not well targeted.

The Ministry of Health as the main actor in achieving the vision for a Healthy Indonesia cannot work alone, but must be supported by all actors of the health industry. The implementation of a digital health transformation strategy must also be based on data and an integrated health service system.

The digital health transformation strategy will focus on developing health data and service applications, and improving the sustainable health technology ecosystem. These are expected to improve the quality of data and policies to increase the efficiency of health services. Through this mapping, all health services can be integrated to achieve optimal effectiveness and interoperability in primary and secondary care, pharmacy and medical equipment, national health security, health human resources, health financing, internal management to innovation in the biotechnology ecosystem.

The implementation of the digital health transformation strategy is carried out using a platform-based approach based on breakthroughs in building national health data, namely service and business process-based platforms, standardization of architecture and specifications, collaboration of ecosystems for health industry players, open APIs based on microservices, and compliance through integration of mutual benefits through ease of service and integrated information. The digital health transformation strategy has outputs in the form of the Indonesia Health Services (IHS) Platform and the Citizen Health App. The IHS platform is built as a solution to latent problems related to the integration of various applications. Citizen Health App is a platform that stores complete personal health records.

The digital health transformation strategy changes the direction of health services to be simpler and easier to use by the public, increasing efficiency because health data can be accessed easily and have good quality. With a targeted and measurable implementation based on existing mapping, the transformation of digital health technology will create a higher quality health service system to ensure a better economic growth. Therefore, the Blueprint for the Digital Health Transformation Strategy is here to answer the problems, potentials, and challenges of Indonesia's digital transformation to produce comprehensive, implementable, and measurable solutions in the development of sustainable health services.

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