Kingdom of Bhutan
Ministry of Health, Government Technology Agency

Project for Strengthening Government Capacity for Using Digital Technology and Data in Bhutan

Progress Report
(Detailed Planning Phase)

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Japan International Cooperation Agency (JICA)

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Project for Strengthening Government Capacity for Using Digital Technology and Data in Bhutan
Progress Report (Detailed Planning Phase)
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Acronyms

Abbreviation	Description
ABIN	Apollo Bhutan Institute of Nursing
ADHA	Australian Digital Health Agency
API	Application Programming Interface
BMHC	Bhutan Medical and Health Council
CBS	Centre for Bhutan Studies
CHU	Community Child Health Units
CID	Citizen ID
CNAM	Caisse Nationale de l'Assurance Maladie
DEHS	Digitally Enabled Health Services
DHIS2	District Health Information System ver2.0
DNA	Deoxyribonucleic Acid
DX	Digital Transformation
EBPM	Evidence-Based Preventive Medicine
ePIS	Electronic Patient Information System
ER	Emergency Room
EU	European Union
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GNH	Gross National Happiness
GP	General Practitioner
HAs	Health Assistants
HIPAA	Health Insurance Portability and Accountability Act of 1996
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information Systems
ICM	Information Communications and Media
ICT	Information Communication and Technology
ID	Identity
IPD	Inpatient Department
IoT	Internet of Things
IT	Information Technology
JCC	Joint Coordinating Committee
JDWNRH	Jigme Dorji Wangchuk National Referral Hospital
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
KGI	Key Goal Indicator
KGUMSB	Khesar Gyalpo University of Medical Sciences of Bhutan
KPI	Key Performance Indicator
LAN	Local Area Network
MCH	Maternal and Child Health
MoH	Ministry of Health
MM	Minutes of Meetings
NCD	Non-Communicable Diseases
NDI	National Digital ID
NHS	National Health Service
NPO	Non-Profit Organization

NSB	National Statistics Bureau
OPD	Outpatient Department
ORC	Outreach Clinic
OVI	Objectively Verifiable Indications
PDM	Project Design Matrix
PEN	WHO Package of Essential Noncommunicable
PHC	Primary Health Center
PHR	Personal Health Records
PII	Personally Identifiable Information
PO	Plan of Operations
PoC	Proof of Concept
PPP	Public Private Partnership
RCDC	Royal Centre for Disease Control
RD	Record of Discussions
SCCI	Service with Care and Compassion Initiative
SIM	Subscriber Identity Module
SNS	Social Networking Service
SOP	Standard Operating Procedure
STATA	Statistics and Data
THC	Thromde Health Centre
TICL	Tashi InfoComm Limited
TWAN	Thimphu Wide Area Network
UK	United Kingdom
USA	United State of America
USD	US Dollar
VCT	Voluntary Counseling Testing
VPS	Virtual Private Server
WHO	World Health Organization
WLAN	Wireless Local Area Network

1 Purpose of the Project

1-1. Project Background

- Bhutan is a country with an internationally well-known development index called the Gross National Happiness (GNH) index and has developed mainly in hydropower projects and agriculture utilizing geographical and climatic conditions, while maintaining people's sense of well-being and traditional culture. On the other hand, an increase in the unemployment rate of the younger generation (15-24 years old) (the unemployment rate for the younger generation increased from 15.7% in 2018 to 20.9% in 2021) with a remarkable distancing from agriculture and the brain drain of the younger generation have become social issues, and the creation of economic opportunities that generate productive and profitable jobs is strongly desired.
- As one of the clues to the solution, there are great expectations for the utilization of digital technology and data. For example, in the 12th Five-Year Plan, which went into effect in 2019, a large budget was allocated to the "National Digital Flagship Project (Digital Drukyul Flagship Program)" after the water sector, which was the traditional core industry. According to the plan, for Bhutan, where conditions are disadvantageous in terms of geographical and population size, digital technology is an essential element for improving the quality of life and revitalizing economic activities. In fact, 97% of households own mobile phones (of which 64.6% are smartphones), and the required IT conditions are being developed.
- Against this background, JICA, through a prior survey, held repeated discussions with the Bhutanese government regarding the possibility of use digital technologies and data in the field of health care, which is one of the nine elements comprising GNH. Specifically, by developing an environment that encourages the integrated management and utilization of medical and health data, in addition to improving the quality of medical care through accurate treatment based on evidence, the government indicated its intention to realize the promotion of private-sector medical-related industries and the creation of employment opportunities through such data sharing.
- Considering this, the Government of Bhutan requested this project with the purpose of solving health issues such as prevention of Non-Communicable Diseases (NCDs), which have been on the rise in recent years, reducing healthcare costs, and promoting innovation in health-related services to lead to new economic opportunities. The project also aims to link these to the improvement of GNH through the development of an environment that encourages integrated management of health data and data utilization. This project aims to improve and expand the quality and industrial development of health services based on the concept of a data utilization infrastructure, thereby contributing to the improvement of the Gross National Happiness, by examining the accumulation of an environment that encourages the integrated management of health and health data into the data infrastructure and the utilization of data, and services that utilize it from the government and the private sector in Bhutan.

1-2. Project Design

- At the beginning of the project, a detailed Project Design Matrix (PDM) had not been developed. Therefore, through the detailed planning Phase, the PDM was updated on July 28, 2023, and the objectively verifiable indications (OVI) were established.

Overall Goal

Narrative Summary	Objectively Verifiable Indicators	Means of Verification
The concept of "Data-enabled GNH/Well-being" is envisioned as a future image of Bhutan with unique digital economy and society, which will be a cornerstone of growth for the next generation.	By 2029, premature mortality due to top five diseases including hypertension will be decreased.	13th Five-Year Plan (draft)

Table 1: PDM (Overall Goal)

- Justification of OVI:
    - One of the goals of "Data-enabled GNH/Well-being" is to solve the health challenges faced in Bhutan through the use of digital technology and data. Therefore, through the use cases studied in the detailed planning phase, the overall goal was set as the health challenges to be achieved within three years after the completion of the project.The disease targeted for this project is hypertension. Detailed information regarding the specific disease selection justification, as well as its application in a specific use case are detailed in Section 2.7: Define system requirements of digital health platform based on the digital health strategy.

Project Purpose

Narrative Summary	Objectively Verifiable Indicators	Means of Verification
Healthcare services will be expanded and improved by utilizing digital technology and health data	20% of target population agree to the secondary use of data.	System report of the application
	40% of target population access to the health App on a regular basis.	System report of the application

Table 2: PDM (Project Purpose)

- Justification of OVIs
    - 20% of target population agree to the secondary use of data: If this OVI is achieved, it will prove that there are a certain number of people who are willing to improve the well-being of society by providing their own data. The target population is currently assumed to be 3,000 people participating in the pilot activities.
    - 40% of target population access to the health App on a regular basis: If this OVI is achieved, it will prove that a certain number of people are willing to change their behavior to improve their own wellbeing while utilizing digital technology. The target population is currently assumed to be 3,000 people participating in the pilot activities.

Outputs

Narrative Summary	Objectively Verifiable Indicators	Means of Verification
1. [Analysis] The situation, issues and possibilities related to the utilization of health data are analyzed.	A report regarding the situation, issues and possibilities related to the utilization of health data will be formulated.	Report from JICA Consultant
2. [Plan] Bhutan's Digital Health Strategy and a concrete health data linkage system development plan (Detailed System Design) are formulated.	The first draft of "Update Inputs to National e-Health Strategy" will be formulated.	Update Inputs to National e-Health Strategy submitted by JICA consultant
	A requirement definition document of the Digital Health Platform will be formulated.	Requirement Definition submitted by JICA consultant
3. [Proof of Concept] The function of the digital health platform will be verified through the pilot activity of data collection,	The digital health platform is partially developped for the pilot actibity based on the requirment definition document.	Report from JICA Consultant
	A device PoC will be conducted in collaboration with a local university.	Report from JICA Consultant
	Health app(s) for citizens wiil be developped in collraboration with local IT vendor(s).	Report from JICA Consultant
	Pilot activities on Health App will be conducted with over 2000 participants.	Report from JICA Consultant
	Regulations/guidelines on the use of the public cloud will be studied.	Report from JICA Consultant(Legal)
4. [Development] The digital health platform and operational framework for utilization are implemented.	The Digital Health Platfom will be developed at full scale.	Report from JICA Consultant
	A target group expansion plan for collecting and storing health data from medical facilities and all citizens will be formulated.	Report from JICA Consultant
	Support for capacity building for ID mapping, API development and pseudonymization will be provided to the RGoB.	Report from JICA Consultant
	An organizational framework for data utilization in the Bhutan government will be established.	Report from JICA Consultant
	A cyber security training will be provided to the RGoB.	Report from JICA Consultant(Cyber Security)
5. [Deployment] Through promoting data utilization originating from health sector, innovative activities sprout for the growth of next generation.	Within Bhutan, promotional activitiey for digital health services will be conducted at least once.	Report from JICA Consultant
	Within Bhutan, promotional activitiey for digital health services will be conducted at least once.	Report from JICA Consultant

Table 3: PDM (Outputs)

Activities

- Based on the discussions in the detailed planning phase, some changes were made to the "Activities" as well. Both Japan and Bhutan sides agreed to update the Record of Discussions (RD) through the Minutes of Meetings (MM) on July 28, 2023.
- The updated points are as follows:
    - Erase "2.2 Draft regulations and guidelines for utilizing health data, including sandbox system, reflectinq future technical trends" and add "3.10 Support to establish regulations and guidelines for utilizing health data, including sandbox system, reflecting future technical trends."
    - Add "3.9 Conduct pilot to create concept for a biobank in Bhutan"
    - Add "4.8 Conduct capacity building initiative on cyber security"

1-3. Implementation Structure

- During the detailed planning phase, based on the discussions at the first Joint Coordinating Committee meeting (JCC), the project was promoted with the following implementation structure.
- In the Detailed Planning Phase, GovTech took the lead in promoting the project. As a result, extensive discussions were held on the definition of the system requirements, and the project was able to successfully enter the Technical cooperation Phase. On the other hand, during the Technical cooperation Phase, the role of the Ministry of Health (MoH) will be very important in order to involve hospitals and health workers in the pilot activities. In addition, MoH is the lead agency in considering the eHealth Strategy. Therefore, in order to

strengthen the involvement of MoH, it was decided to change the implementation structure in the Technical cooperation Phase as follows. In addition, an assistant will be assigned to support the Project Manager, as there is a wide range of coordination among related ministries and agencies.

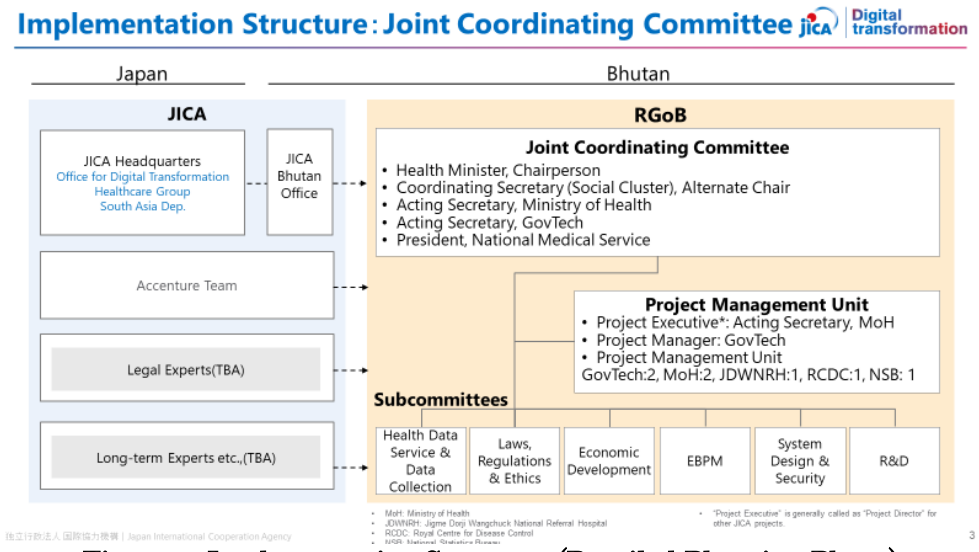


Figure 1: Implementation Structure (Detailed Planning Phase)

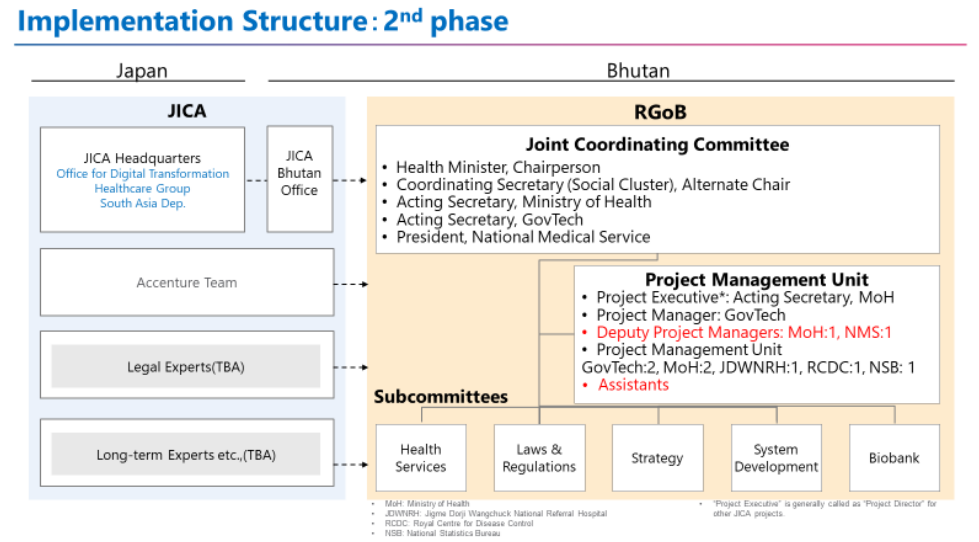


Figure 2: Implementation Structure (Technical Cooperation Phase)

- In addition, the project is managed through the establishment of sub-committees; during the Technical cooperation Phase, the relevant ministries and agencies will share roles and lead the sub-committees.
- In the detailed planning phase, the core members were identified, but there were many personnel changes, and the Project Manager played many roles. Based on this reflection, in the technical cooperation phase, both sides plan to identify the lead government agency and the person in charge by title, rather than by name.

1-4. Work Flow

These are the schedule and Plan of Operations (PO) for the second phase agreed upon by the JCC at its second meeting.

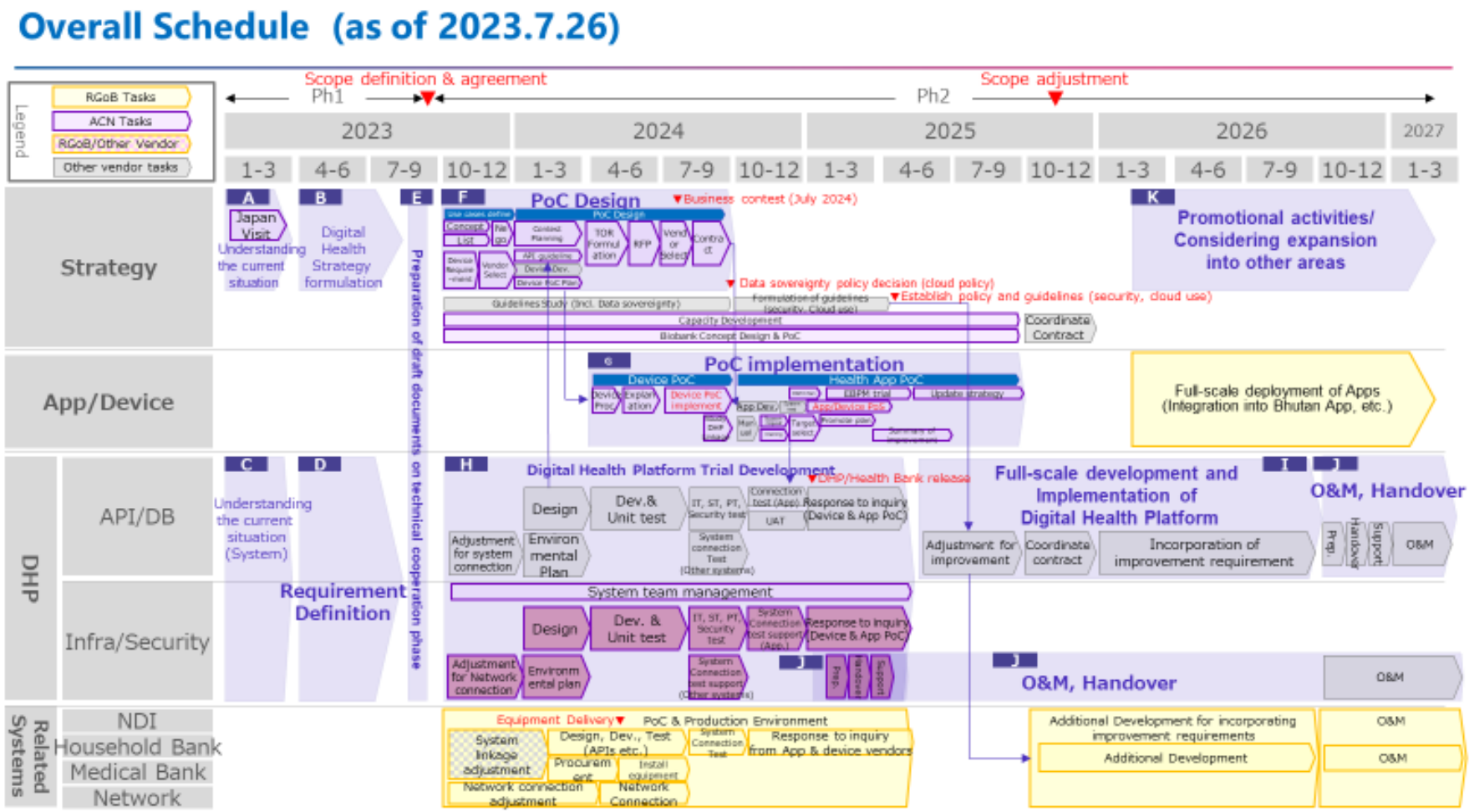


Figure 3: Overall Schedule

Inputs	Year	2023				2024				2025				2026				2027				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Expert																								
Long-term expert (Chief Advisior/Digital Health)	Plan																							
	Actual																							
Consultants (System Development, Legal expert)	Plan																							
	Actual																							
Short-term experts (if necessary)	Plan																							
	Actual																							
Equipment																								
N.A.	Plan																							
	Actual																							
Training in Japan																								
Visit to Bio Bank	Plan																							
	Actual																							
In-country/Third country Training																								
Training on Cyber security	Plan																							
	Actual																							

Activities / Sub-Activities	Year	2023				2024				2025				2026				2027				Responsible Organization		Achievements	Issue & Countermeasures
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	Japan	Bhutan		
Output 1:																									
1.1 Review government strategies and policies on healthcare and medical sectors and data utilization.	Plan																								
	Actual																							Achieved	
1.2 Analyze the situation of Bhutan on laws and regulations regarding data utilization through the benchmark to other countries.	Plan																								
	Actual																							Achieved	
1.3 Review the situation and development plan of ICT infrastructure.	Plan																								
	Actual																							Achieved	
1.4 Review and evaluate the existing systems of the healthcare sector (ex., ePIS, HMIS, DHIS), common functions (ex. Data Hub and national ID), and any related technical standards.	Plan																								
	Actual																							Achieved	
1.5 Evaluate the capacity of Bhutan's government and healthcare facilities for data utilization.	Plan																								
	Actual																							Achieved	
1.6 Analyze digital health services and ICT devices currently provided in Bhutan.	Plan																								
	Actual																							Achieved	
1.7 Analyze the situation, issues, and possibilities related to health data utilization in Bhutan, reflecting the results of the above activities.	Plan																								
	Actual																							Achieved	
Output 2:																									
2.1 Draft the Public Private Partnership (PPP) models for the healthcare sector by defining competitive and cooperative areas in the digital architecture.	Plan																								
	Actual																							Achieved	
2.2 Analyze the linkage between health data and GNH/Well-being indicator monitoring.	Plan																								
	Actual																							Achieved	
2.3 Analyze the values in the economy, society, and environment along with promoting digital health.	Plan																								
	Actual																							Achieved	
2.4 Establish and operate a coordination entity among main stakeholders related to the collection and utilization of data.	Plan																								
	Actual																							Achieved	
2.5 Develop a digital health strategy (direction, roadmap, and action plan) reflecting the situation analyses conducted in Output 1 and the result of the above considerations.	Plan																								
	Actual																							Achieved	
2.6 Define system requirements of digital health platform based on the digital health strategy (ex. data models of 4 Banks, data exchange function including the connection with the national ID, standard rules of API)	Plan																								
	Actual																							Achieved	
2.7 Confirm the connection with 4 Banks, Data Hub, National ID, and application in the service layer through the common API.	Plan																								
	Actual																							Achieved	
Output 3:																									
3.1 Partially develop the digital health platform as pilot activities.	Plan																								
	Actual																								
3.2 Specify multiple use cases related to the verification of digital health platform functions (assuming areas of data collection and storage by utilization of relevant devices and analysis and utilization	Plan																								
	Actual																								
3.3 Define target group and data points (interface, channel, flow) for the digital health service users).	Plan																								
	Actual																								
3.4 Implement digital health devices for efficient health data input from the users as pilot activities.	Plan																								
	Actual																								
3.5 Design the digital health services utilizing data as pilot activities.	Plan																								
	Actual																								
3.6 Visualize dynamic determinations related to health indications of GNH/Well-being by collecting, storing, and utilizing health data and design as pilot activities for Evidence-based Policy Making	Plan																								
	Actual																								
3.7 Conduct pilot activities of multiple use cases related to the functional verification of the digital health platform.	Plan																								
	Actual																								
3.8 Evaluate the lessons of pilot activities to verify the digital health platform's system design and revise the digital health's strategy's roadmap and action plan.	Plan																								
	Actual																								
3.9 Conduct pilot to create concept for a biobank in Bhutan.	Plan																								
	Actual																							newly added	
3.10 Support to establish regulations and guidelines for utilizing health data, including sandbox system, reflecting future technical trends.	Plan																								
	Actual																							Relocated (Output2→3)	

Output 4:				
4.1 Revise the system specification and development plan reflecting the pilot activities.	Plan			
	Actual			
4.2 Review the digital health platform from the data security perspective.	Plan			
	Actual			
4.3 Develop and implement the digital health platform.	Plan			
	Actual			
4 4 Formulate a target group expansion plan for collecting and storing health data from medical facilities and all citizens).	Plan			
	Actual			
4.5 Develop a capacity development plan for data utilization and operation and maintenance (O&M) of the digital health platform in the Bhutan government.	Plan			
	Actual			
4.6 Conduct human resources training for utilizing health data and O&M of the digital health platform (collaborating with educational institutions)	Plan			
	Actual			
4.7 Establish an organizational framework for data utilization in the Bhutan government.	Plan			
	Actual			
4.8 Conduct capacity building initiative on cyber security	Plan			
	Actual		newlly added	
Output 5:				
5.1 Conduct promotion activities to raise the awareness of citizens and the Bhutan government on health data utilization.	Plan			
	Actual			
5.2 Build the environment (ex. regulatory framework and/or commercial incentives) to stimulate entries of private businesses in competitive areas (especially service, application, and asset layer) and conduct marketing activities for the private companies, entrepreneurs and investors.	Plan			
	Actual			
5.3 Study the potential of dynamic monitoring of GNH/Well-being indicators through data utilization for economic enhancement.	Plan			
	Actual			
5.4 Specify the sectors/areas of horizontal application of data utilization/ platform models.	Plan			
	Actual			
5.5 Specify the additional data from other sectors for promoting innovation.	Plan			
	Actual			
5.6 Study the possibility of data linkage with other sectors based on the established digital health platform.	Plan			
	Actual			

Detailed Planning Phase	Plan			
	Actual			
Technical Cooperation Phase	Plan			
	Actual			

Monitoring Plan	Year	2023				2024				2025				2026				2027				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Monitoring																								
Joint Coordinating Committee	Plan																							
	Actual																							
Subcommittees	Plan																							
	Actual																							
Set-up the Detailed Plan of Operation	Plan																							
	Actual																							
Submission of Monitoring Sheet	Plan																							
	Actual																							
Post Monitoring	Plan																							
	Actual																							
Reports/Documents																								
Project Progress Report	Plan																							
	Actual																							
Project Completion Report	Plan																							
	Actual																							
Public Relations																								
	Plan																							
	Actual																							

Figure 4: Plan of Operations

2 Activities and Progress

2-1. Activities related to Outcome 1

Outcome 1. [Analysis] The situation, issues and possibilities related to the utilization of health data are analyzed.

1.1 Review government strategies and policies on healthcare and medical sectors and data utilization.

- In the detailed planning phase, the government of Bhutan provided to Japan side the documents such as the "21st Century Economic Roadmap," "12th Five Year Plan," "13th Five Year Plan Concept Note," and "National eHealth Strategy and Action Plan."
    - **21st Century Economic Roadmap:** This was found to be a document that did not actually come to fruition, and thus was not necessarily appropriate as a basis for discussion. However, the document included the concept of "Sustainable Healthcare" in light of the growing healthcare budget. The desire to rationalize the growing healthcare-related budget was also observed in discussions with the Bhutanese government. Therefore, the sustainability or rationalization of healthcare budgets is considered as a factor in the As-Is /To-be analysis when updating the eHealth Strategy and defining system requirements.
    - **13th five-year plan concept note:** There was information that a new "13th five-year plan" would be formulated, especially from July 2023. Therefore, in order to maintain consistency between the OVI(s) of this project and the "13th five-year plan," the National KGIs and the National KPIs mentioned in the "13th five year plan concept note" were referenced. National KGIs/KPIs that may be relevant to this project include health indicators and digital indicators. The health indicators are still in draft form, but as mentioned in the PDM above, there is a statement that "By 2029, premature mortality due to the top five diseases will be decreased". The top five diseases include hypertension. Since this project is considering use cases targeting hypertension, this goal was set as one of the OVIs in the PDM. Regarding digital indicators, there is a National KGI on the number of jobs in the digital economy, but it was not included in the PDM because it was not possible to involve the Ministry of Industry, Commerce and Employment which is in charge of employment in the discussions on setting the PDM.
    - **National eHealth Strategy and Action Plan (2018):** MoH had the intention to revise the document, as JICA had previously obtained information. However, as of August 2023, the update of the "National eHealth Strategy and Action Plan" seems to be in progress due to the shortage of human resources in MoH. As for the direction of revision of the document, MoH only stated that it would like to update the document in light of the ever-evolving digital technology, and the direction was not clear. Therefore, it was decided to summarize the inputs on what kind of future vision can be aimed for by utilizing the four banks and introducing digital technology in this project. The summary is shown in 2.6, and the inputs at this point are listed in the Appendix A-2. Inputs for eHealth Strategy Update (as of August 2023).
    - The "National eHealth Strategy and Action Plan" discusses the importance of improving the quality of healthcare through digital technology. However, it does not include the idea of involving the private sector in the implementation of digital technology. Therefore, it was determined that the input is particularly needed to mention the need to build a win-win-win relationship where the introduction of digital technology is beneficial not only to the Bhutanese government and people, but also to the private sector.

1.2 Analyze the situation of Bhutan on laws and regulations regarding data utilization through the benchmark to other countries.

- The activity aims to explore the established laws and regulations concerning the data utilization. It is essential to simultaneously address this issue while developing the digital health platform. In order to realize this, an assessment of legal framework of various countries will be benchmarked, considering the secondary data usage in digital health platforms, the future technological advancements, and the expansion of data utilization.
- The Legal Subcommittee has submitted Report on Bhutan Laws, Rules, and Regulations which summarizes the existing laws relevant to the project implementation. In summary, currently MoH has no specific governing laws that specifically discusses health data collection, sharing, and utilization. However, there are some existing laws that may govern broadly which also covers aspects of healthcare and medical sector which can be categorized into the following Acts and Regulations:
    - **The Constitution of Kingdom of Bhutan (2008)**

- The Fundamental Duties under Section 19 Article 7 of Constitution requires agencies and citizens to strike a balance between the right to privacy and right to information.

- **Information Communications and Media (ICM) Act of Bhutan (2018)**
  - Section 336 on Privacy Chapter 17 states that it requires ICT and Media facility service provider and vendor to respect and protect the privacy of personal information, including sensitive personal information which they receive from user and consumers.
  - Section 339 on Privacy Chapter 17 states that it requires the ICT and Media facility service provider and vendor to limit the collection, use, and disclose of personal information which is considered reasonable or appropriate depending on the circumstances
  - Section 384 on Data Protection Chapter 21 states *"A person shall obtain the express written permission of the subject for the collection, collation or processing of any personal information, unless permitted or required to do so by law"*
  - Section 385 states *"A person shall not disclose any of the personal information held by it to a third party, unless required or permitted by law or specifically authorized to do so in writing by the concerned person".*
  - Section 386 states *"The person possessing, dealing or handling any personal data, including sensitive personal data or information shall delete or destroy all personal information which has become obsolete".*

- **Bhutan Medical and Health Council Regulations (2005)**
  - The code of ethics under Clause 4.4 requires every medical or health providers to respect patients' privacy and protect confidential information.

- Based on the above information, the existing legal framework in Bhutan demonstrates a clear emphasis on privacy and protection, particularly to personal and sensitive information. It provides a broad foundation for privacy which includes areas that may cover health data. However, as the country moves towards establishing a Digital Health Platform, there is a clear need for specific clear-cut rules that address data collection, handling, and utilization of health-related data. The current regulations may not be sufficient to govern digital health data management which will require a more tailored guideline. The details of the legal subcommittee discussions are shown on the Appendix "A-5. Report on domestic laws, rules, and regulations."
- The legal subcommittee hope to discuss on following topics in the second phase.
  - Category 1 : Consideration of general data protection provisions
    - Consent from data subjects for primary use and secondary use
    - Definition and protection of sensitive data and health data
    - Cross-border data transfer into cloud environment
    - Rights of a data subject
  - Category 2 : Considerations related to governance of medical information use
    5 Governance on the utilization of health data
    6 De-identification or pseudonymization of health data
    7 Traceability
  - Category 3 : Others
    8 Responsibility

- Above legal discussion topics will be examined in the second phase of the project in the Legal Subcommittee. There are eight discussion issues in three main categories ((1) general data protection provisions, (2) governance of the use of medical information, and (3) others). These discussions will be broadly organized within these categories during the second phase, but the topics will remain flexible to align with Bhutan government's priorities.
- To find the use case examples of countries that align with the activity objectives to compare with Bhutan's existing legal frameworks, we have examined the "Governance of Key National Healthcare Dataset". This assessment evaluates 15 crucial elements related to the governance of healthcare datasets such as data set available, maturity, and utilization. As a result, we have identified six countries that meet the above criteria: Denmark, Finland, France, United Kingdom, United States, and Australia. The selection of these countries has been preapproved from JICA and Bhutan Government for benchmarking with current situation in Bhutan.

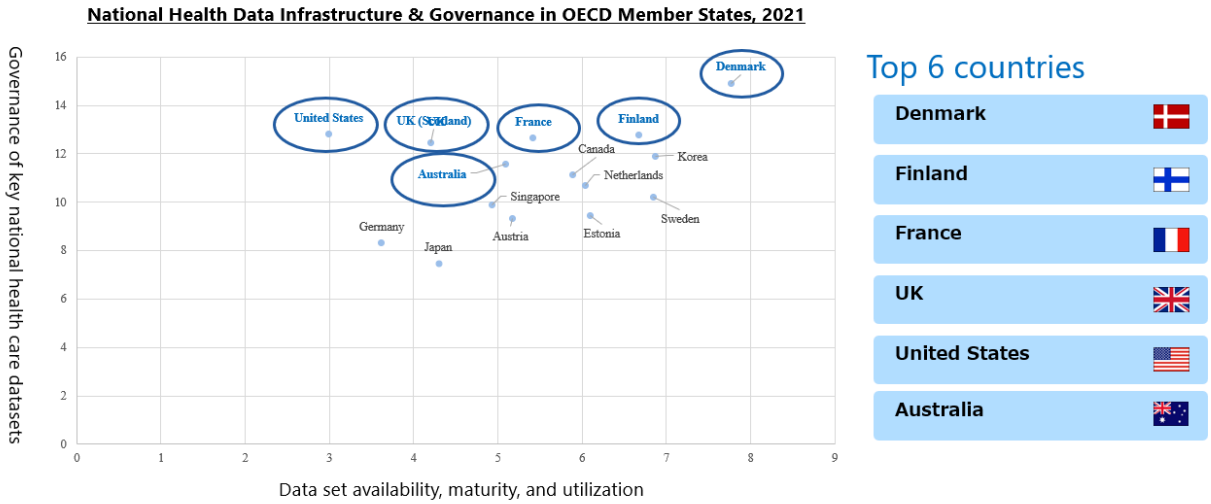


Figure 5: Modelled Countries based on Governance of Key National Healthcare Datasets

The assessment of these six countries will focus on four perspectives regarding their methodologies for data governance:

1. **Platform Ownership:** To examine the stakeholders involved and determined who owns the data within the Healthcare Platform
2. **System Architecture:** To explore the technical design flow of the system to understand how data is structured and flows within the healthcare infrastructure
3. **Data Exchange Method:** To identify the interoperability of data exchange between stakeholders for industrial development with compliance to consent management
4. **Data Content:** To specify the data items included, their level of detail, and timeframe in which data is collected and updated

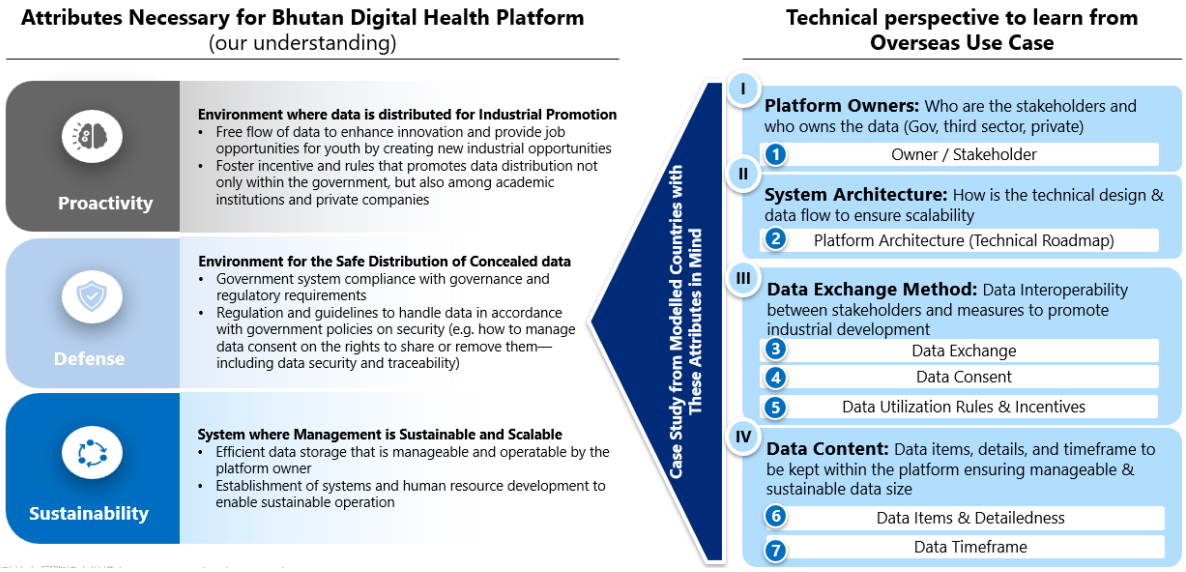


Figure 6: Perspective on How to Hold Data

Following the comprehensive analysis from the current activity research across four key perspectives (Platform Ownership, System Architecture, Data Exchange Method, and Data Content):

1. **Proactivity:** It is necessary to focus on creating data sharing incentives not only within the government, but also among academic institutions and private companies. Additionally, this recommended solution shall also encourage cross-sectoral cooperation to advance the digital societal and economic

development, and stimulate the free flow of data to stimulate the industrial growth which will eventually boost employment and educational opportunities for young citizens in Bhutan.

2. **Defense:** It is necessary to include the measures to ensure data safety and privacy. There needs to be a secure and compliant environment where datasets are safely distributed. This involves implementing regulations and guidelines to facilitate a secure data exchange among various stakeholders, ensuring that data is handled in accordance with government policies on security.
3. **Sustainability:** It is necessary to be economically manageable, factoring in the establishment of technical infrastructure and the efficient management of resources. This entails the efficient data storage that can be manageable and operatable by the platform owners. The approach to data storage and processing shall be optimized to use resources efficiently and minimize waste for sustainability. A clear process for data management and operations will need to be put in place to maintain high-quality standards in data types, formats, and processing.

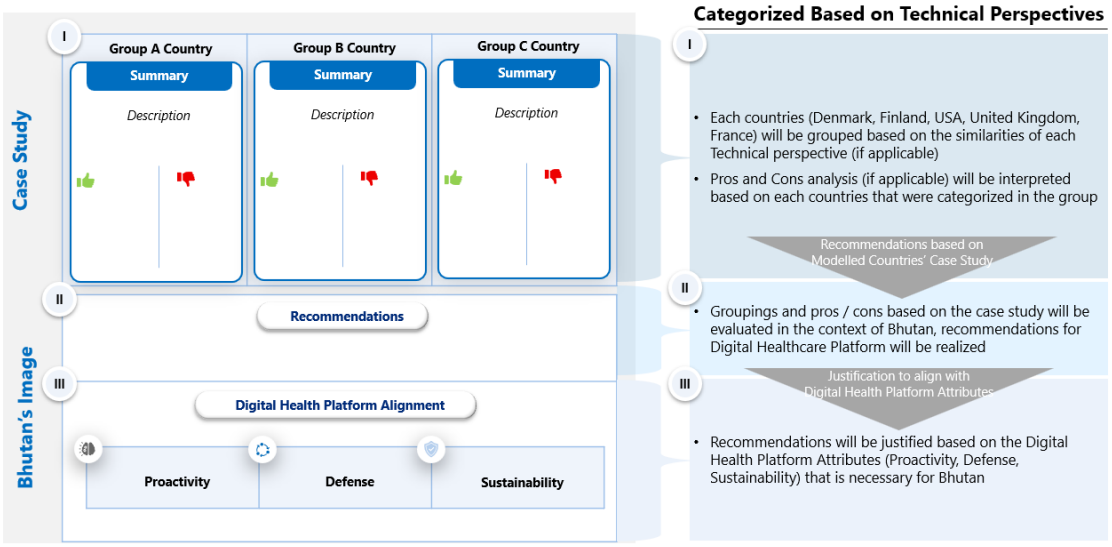


Figure 7: Benchmark Assessment Approach

- **Overview of Modelled Countries' Platforms:** To provide better context for the activity results, the digital health platform initiatives in various countries will be first briefly introduced:
    - **Denmark Sundhed.DK:** Sundhed.DK is the official national health portal of Denmark established in 2003. "Sundhed" means health in Danish which is reflective of the goals of this initiative. Sundhed.DK consists of website and application that serves as a comprehensive platform and offers a wide variety of online health services for the people. Not only that, it also facilitates information to healthcare for citizens and to healthcare providers. With operations since 2003, Sundhed.DK is one of the longest digital health services in the world and has achieved 100% penetration rate within Denmark. The portal is regulated by Ministry of the Interior and Health to ensure guidelines has been implemented. The operational and development oversight is provided by MedCom, a non-profit organization funded by MoH. MedCom is a non-profit organization that also serves secure communication infrastructure for health data exchange in Denmark called the Danish Health Data Network. This is to ensure smooth functioning of the Sunhed.DK with the broader healthcare ecosystem. Today, more than four million messages are transmitted per month which highlights the impact and utilization of healthcare data within Denmark.
    - **Finland MyKanta:** MyKanta is a national centralized medical information in Finland that aims to store data of medical records for accessibility while reducing administrative burdens within the healthcare ecosystem. It is regulated by the Finnish Ministry of Social Affairs and Health, and its operations are overseen by KantaServices, which is under Ministry of Social Affairs and Health. Additionally, KeLA, which is a Social Insurance Institution of Finland, operates as an independent budgetary structure, which reimburses healthcare costs and has jurisdiction over MyKanta. KeLA serves as central data repository for healthcare-related information which is utilized by MyKanta.

The platform was established in 2012 and has achieved full electronic health record penetration in Finland within a decade, which indicates the success and adoption of the service.

- **USA eHealth Exchange:** The eHealth Exchange Platform is an intermediary health data exchange platform established in 2009 in the USA. It serves primarily as a means to connect for nationwide exchange of medical data aiming to improve patient care by facilitating secure and standardized sharing of health information. The initiative involves multiple parties in public-private partnership. Private sector involvement is facilitated by the Sequoia Project, a private non-profit organization that supports the initiative as part of the Office of the National Coordinator Initiative. The eHealth Exchange Platform is operated by the eHealth Exchange Committee which includes federal and non-federal representatives. The electronic health record penetration rate in the USA is currently at 77%, which is comparably lower to countries like Finland and Denmark, but it is still considered impressive due to the complexity of healthcare system in the US.
- **United Kingdom NHS Digital:** NHS Digital is a national IT and data services that is responsible for collecting, transferring, storing, analyzing, and disseminating national and social health data within the United Kingdom. Not only that it also has other services, serving as a legally authorized agency to handle personal identification of patients to support clinicians in improving treatments. NHS operates under regulation of Department of Health and Social Care, and organization is operated by NHS England, a non-departmental public body under MoH and Social Care. The service was established in 2002, which has played a vital role in promoting electronic health records, with penetration of 97%. This high adoption highlights the success of two-decade large-scale implementation within NHS Digital.
- **France My Health Space (Mon Espace Santé):** My Health Space, or as known as Mon Espace Santé, is a platform in France that enables individuals and healthcare providers to manage health and personal health data through various functionalities. It was established in 2005 and relaunched in a new platform in 2019. The ownership of My Health Space involves multiple French Government Agencies—owned by Ministerial Delegation for eHealth and the Agency of Digital Health within MoH. On the other hand, the platform's operations is carried out by Caisse Nationale de l'Assurance Maladie (CNAM)—fund of National Health Insurance and operator—a government agency under MoH. With penetration rate of 80%, the platform has seen significant adoption among French citizens.
- **Australia My Health Record:** Australia's My Health Record, an online platform that stores citizen's health information which is accessible to authorized healthcare providers in Australia. It also allows citizens to have control over health information and enables real-time access for healthcare providers. The ownership and operation of My Health Record is purely from Australian Government, specifically the Australian Digital Health Agency (ADHA). Despite its late establishment of 2012 compared to above countries mentioned above, My Health Record has achieved a high penetration rate with approximately 90% of the electronic health record.

Information	Denmark	Finland	USA	United Kingdom	France	Australia
Initiative Name	Sundhed.DK	Kanta	eHealthExchange	NHS Digital	My Health Space	My Health Record
Initial Launch	2003	2012	2009	2002	2005, but relaunched new platform in 2019	2012
What is it	An official Danish national health portal. The website and application provides a range of online health service and information to help citizens and healthcare professionals access healthcare information and services.	Nationwide centralized medical information archive that reduces necessity for local data archiving to ensure preservation of medical records while reducing administrative burden of medical institutions	An intermediary IT system to connect federal agencies and non-federal healthcare organization to exchange medical data nationwide to improve patient care and public health	A national IT and data service that collect, transfer, save, analyze, and disseminate national and social-health data. Legally authorized to handle personal identification information of the patient to support clinicians to improve treatment using data.	Digital Health Platform (Mon Espace Santé) allows all French citizens to manage health data (PHR), as well as medical institutions to manage DMP (EHR), through different functionalities.	Secure online summary of citizen's health information which can be accessed by authorized healthcare provider in Australia. Allows individuals to also control access to health information which heath providers can access real-time
EHR Penetration	100%	100%	77%	97%	80%	90%

Figure 8: Overview of Digital Health Platform in selected 6 modelled countries

- **(1) Platform Ownership:** The ownership of digital health platforms can be categorized into three types: Joint-Partnership between government and an established Non-Profit Organization (NPO), Public-Private Venture, and Government-led model. In the Joint-Partnership model, the government is in charge of regulations, while the established NPO that is funded by government handles the daily operations. Meanwhile, in a public-private partnership is a cooperative partnership between the government and an independent NPO. Finally, a government-led model is where the government both regulates and operates its own digital health platform by establishing an organization that while legally is separated but is still under the government's control.
    - **Modelled Countries Insights:** The joint-partnership approach is practiced in Denmark and Finland, where there is an established NPO funded by the government in place. There is an advantage in terms of its flexibility in decision-making, with the government focusing on regulations, while the NPO manages the day-to-day operations. However, the disadvantage is that it can lead to a loss of direct control and potential conflicts of interest, as the operations are independently handled. The public-private venture is practiced in the USA. Its advantage is the easy access to the private sector's expertise and consumer-driven insights, as well as its larger investments, as private organizations are involved. However, the challenges lies in aligning the profit-driven motives with public health objectives, and the potential for inconsistent governance and regulatory frameworks due to the public-private partnership. Lastly, a government-led model, as seen in countries like United Kingdom, France, and Australia, provides a high control power and oversight by having a centralized decision-making and policy implementation. However, the drawback includes slower decision-making and implementation processes, as well as the high cost and time required to set up the operational organization.

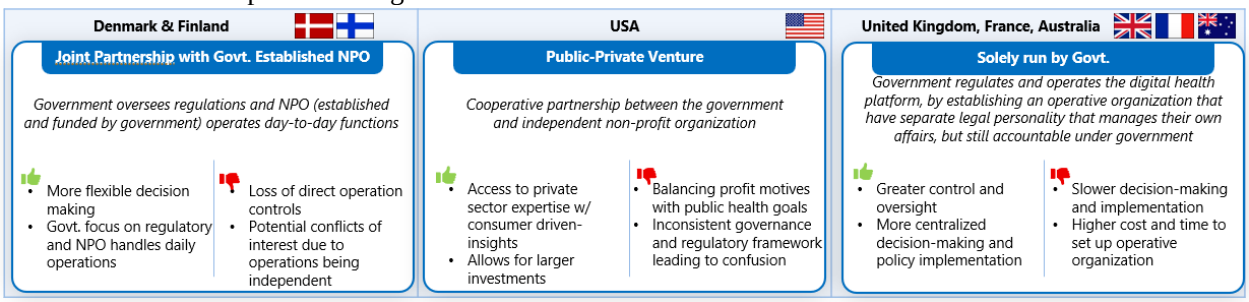


Figure 9: Modelled Countries Insight: Platform Ownership

- **Current Legislation / Situation in Bhutan:** In Bhutan, the National Statistics Bureau (NSB) is responsible for data collection and aggregation from other governmental agencies, as well as dissemination for utilization. This means that most operations related to data are exclusively managed and owned solely by the government. Unlike Denmark where they uses the government-

affiliated NPO establishments, Bhutan does not have such models. The concept of the Joint Partnership with government-established NPO is relatively new, and according to the Legal Subcommittee, there have been no establishments of this kind.

- An idea for Bhutan Digital Health Platform Ownership is to establish a Joint Partnership between Government and Government-established Non-Profit Organization (NPO), similar to Denmark's model. This model will allow the government to oversee data governance and compliance, while mitigating the risk of interference from the NPO. Meanwhile, the NPO can operate day-to-day functions under the government's regulations. This will not only save costs, but will also increase operational flexibility. This idea aligns with the three core objectives as follows:
    1. **Proactivity:** This approach offers flexibility in operations which can bring in expertise from various cross-sector industries
    2. **Defense:** The data security is still under Government's regulations whereby NPO operations will have to comply
    3. **Sustainability:** NPO can manage operations under government oversight which helps control the budget

  Although the idea to establish an NPO for platform ownership was considered for Bhutan, given that there are no existing establishments in the country for this approach, the Legal Subcommittee suggested maintaining the platform under sole ownership which would be more fitting to the Bhutan context. This decision not only aligns with the current practices, but also takes into consideration Bhutan's human resource shortages; creating an NPO would necessitate finding additional resource that are already scarce. The legal subcommittee also believes that keeping the platform under sole ownership by government would foster trust among citizens. Exploring the alternative platform ownership structures, including the potential NPO establishment, can be considered once the platform implementation has been put into place.

- **(2) System Architecture: Platform Type:** The classification of health platform types can be divided into two categories: Standardization at platform level, and standardization at input & output data level. A platform that is standardized at the platform level means that there is a unifying system (single-access point) used by both healthcare providers and citizens. Here, users will have distinct authorized roles but access through the same platform. Conversely, standardization at the input & output data level signifies that only the data is standardized across the system—meaning that the same data is referenced regardless of the platform, roles, and purpose of use.
    - **Modelled Countries Insights:** Countries such as Denmark and Finland has adopted the platform-level standardization approach. The notable examples are for instance, Denmark's Sundhed.DK and Finland's MyKanta. Users—whether healthcare providers or citizens—simply need to access through the single online platform, making it straightforward for utilization. The advantages of it is the easy-access without the need to navigating multiple sources, which saves time. The standardized at platform-level approach is also cost-effective in the long-term, as maintaining a single platform can ensure compliance more easily than managing several platforms. However, the disadvantage is the potentially high cost of setup and development time due to the huge requirements to consider all user access levels. Additionally, the scope for customization may be limited as the system relies on a single platform, making it difficult to adapt quickly to new development requirements or new changes.

      Standardization at the level of input & output data is more common amongst countries—such as USA, United Kingdom, France, and Australia. For example, United Kingdom in particular, maintains numerous platforms each with distinct uses and functions, with centralized data used all across. The data is linked through NHS Spine, a data processing platform that supplies data to core products. For instance, Citizens can access range of NHS services online through the NHS App and NHS Website. On the other hand, healthcare providers will need to use different platforms to access the data for different purposes, such as GP connect, which allow for clinical staff to view clinical information that is inaccessible to citizens.

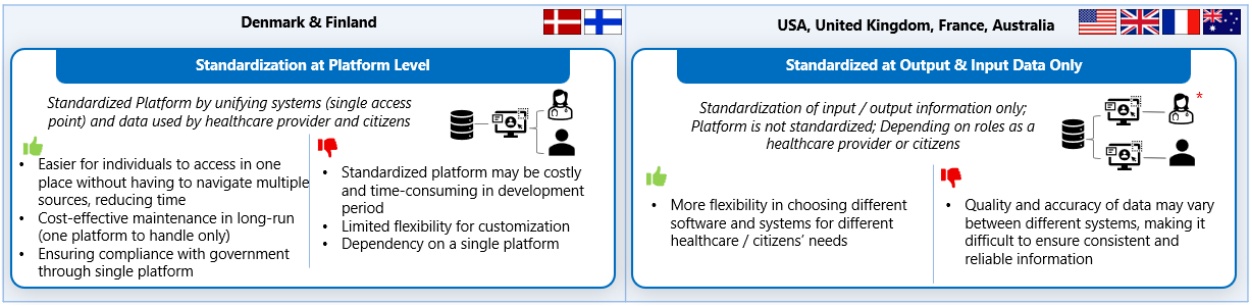


Figure 10: Modelled Countries Insights: System Architecture: Platform Type

- **Current Legislation / Situation in Bhutan:** Within Bhutan, the ePIS system has standardized the database at a platform level, meaning that healthcare providers will be using the same system, but access permissions are granted based on individual roles. Currently, servers are located at JDWNRH, and backup operations are planned at the common data centers.
- **Recommendations for Bhutan:** Based on Denmark and Finland Models, it is suggested that Bhutan should have a Standardization at Platform Level, where there will be a single-point of entry for all users, with varying levels of access based on their roles. This approach simplifies the user experience, making it easier for individuals to navigate and access necessary information without the need to navigating through different platforms. The following is the justification based on the three objectives:
    1. **Proactivity:** Standardized platform offers a unified and streamlined approach to data analytics and sharing, enabling more efficient collaboration and promoting industrial growth
    2. **Defense:** A single platform ensures compliance with government and regulatory requirements
    3. **Sustainability:** Standardization minimizes data redundancy, improves data quality, and accuracy, and ease of maintenance—which reduce cost and enhance scalability overtime

- **(2) System Architecture: Database Type:** The classification of database types for health platforms can be divided into two key categories: Centralized database system and Dispersed database system. A centralized database is characterized by transmission of data to a centralized storage location which can be access via multiple platforms. On the other hand, dispersed or decentralized database type is where data is stored individually by each healthcare provider, with a centralized API service which facilitates the connectivity of data.
    - **Modelled Countries Insights:** Centralized database utilization is the most common approach used by countries such as Denmark, Finland, United Kingdom, France, and Australia. This type of approach consolidates data into a single repository which will simplify the management and maintenance of the system. It also greatly reduces the likelihood of data inconsistencies and errors, as well as provides enhanced control over data access and monitoring. Despite these advantages, it also comes with potential risk such as the system failure; If backup systems are inadequate or not in place, the centralized system could cause a data downtime and unavailability. When it comes to decentralized or dispersed database system, the USA stood out as the only country within the modelled countries that utilizes this approach. The advantages is that the data is not controlled by entity which provide more flexibility to each individual organization. Not only that, a decentralized approach also avoids a potential single point of failure. On the other hand, the system may also create potential difficulties such as data inconsistencies stemming from different data sources and complications in monitoring data exchange activities to ensure data compliance. However, this approach is particularly suited to the USA given the country's vast geographical and population size, whereby centralized database may not be suitable.

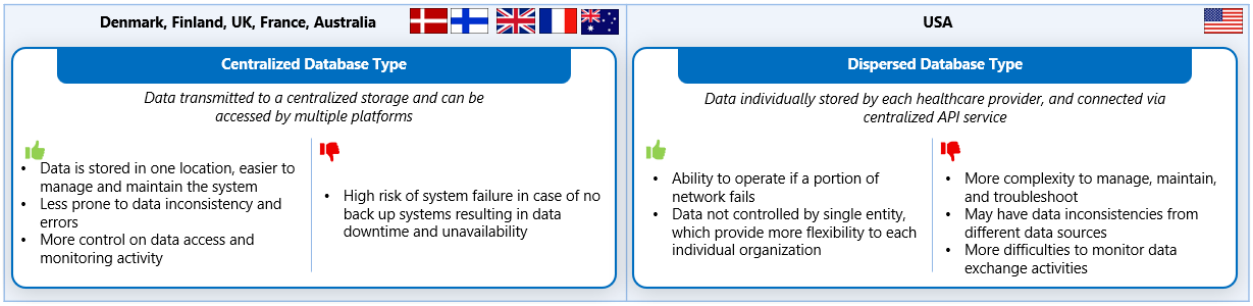


Figure 11: Modelled Countries Insights: System Architecture: Database Type

- **Current Legislation / Situation in Bhutan:** Benchmarking based on ePIS system's model, a centralized data platform is being developed for ePIS.
- In Bhutan's context, data source transmitted to a centralized database will help ensure better data management and reduce the duplication efforts. This approach is similar with countries such as Denmark, Finland, United Kingdom, France, and Australia, aligning with the three main objectives as follows:
  1. **Proactivity:** Centralized database serves as a single data source, making it easier to manage and share data with stakeholders, including academic institutions and private companies
  2. **Defense:** Centralized database facilitates data exchange among stakeholders whereby data exchange can be monitored and tracked efficiently
  3. **Sustainability:** Centralization of data allows for efficient data storage and reduced risk of data redundancy and inconsistency, thereby promoting long-term sustainability

- **(2) System Architecture: Technical Roadmap:**
  - **Modelled Countries Insights:** When considering the technical roadmap and system implementation, it is apparent that the development of such platform would require time; Every modelled country recognize the need for comprehensive approach to implementing digital health initiatives, with initiatives and legislation supported at a national level. Each country also have a purpose-specific or feature-specific focus for release. Figure below provides the summary of the year released and roadmap insights of each modelled country.

Roadmap	Denmark	Finland	USA	UK	France	Australia
Initiatives Plan	2001	2007	2006	2000	2004 (former DMP)	2010 (former PCEHR)
First Phase Launch	2003	2012	2009	2002	2005 (Pilot)	2010
Open to Citizens	2007	2013	N/A	2016	2022	2012
Starting Point	Login access, Lab results, Reimbursement registry, medicine	Pharmaceutical database & Patient data repository	Data exchange between Social Security Administration and other Participants	Exchange of electronic health records	Decentralized local medical records	Electronic health record storage for citizen
Roadmap Insights	• Clear timeline of their national healthcare systems • Similar focus on electronic health records and patient data repositories • Timeline pattern introducing various data integration, services and functionalities gradually over time		• Focused more on development of secure data exchange system • Functionalities introduced over time after integration has been stabilized	• Clear timeline for development of national healthcare system • Timeline more spread out and less focused than Finland and Denmark's	• Various revisions & relaunches • Change from Decentralized to Centralized from security issues • Slow adoption of use & needs re-strategize	• Change from Opt-in to Opt-out model with trials undertaken in 2016 • Opt-Out commenced in 2017, but period for citizen opt-out is 2018 – 2019 (2 years)

Figure 12: Modelled Countries Insights: System Architecture: Technical Roadmap

- **Current Legislation / Situation in Bhutan:** Bhutan's roadmap for Digital Health Platform aligns with the National KPIs in the "13th Five Year Plan Concept Note" which targets the reduction of mortality of top five diseases including hypertension by 2029. Additionally, the eHealth Strategy Action Plan emphasizes enhancing healthcare quality through digital technology. The Digital Platform project aims to adhere to this roadmap which will foster advancements in healthcare through technology.
- In terms of technical roadmap, all modelled countries recognize the need for comprehensive approach to eHealth implementation with national initiatives and legislation to support the services. Bhutan will need to establish a clear and cohesive roadmap from a purpose-specific or feature-specific point of focus and progressively expanding the system by incorporating feedback and addressing the needs of healthcare providers and citizens. This approach aligns with the tree main objectives:
  1. **Proactivity:** Continuous improvement of system based on feedback / needs can help identify trends and data that will be useful for proactive data use
  2. **Defense:** Clear legislation and initiatives on data governance can ensure that data security

is implemented with appropriate security measures

3. **Sustainability:** A focused starting point can ensure that technical infrastructure is sustainable and scalable which can also help identify technical issues early on

- **(3) Data Exchange: Primary or Secondary Use:** Data exchange for utilization can be classified into two categories: Primary and Secondary use. Primary use refers to the direct utilization of data for the purpose of healthcare only. On the other hand, secondary use pertains to any use beyond the direct healthcare purposes other than primary use; This can be further classified into secondary use for commercial purposes, such as selling of data or services involved using those data, and non-commercial purposes, such as uses of data for research.
    - **Modelled Countries Insights:** In the specific case of USA's eHealth Exchange Platform, only primary use of data is permitted—meaning that the free flow of electronic health record information is solely for healthcare purposes only. Additionally, USA is under the Health Insurance Portability and Accountability Act of 1996 (HIPAA), which is a federal law that creates national standard protocols to protect sensitive patient health information. By limiting data usage for primary uses, the platform also avoids the potential data management and compliance issues that does not comply with HIPAA regulations. Additionally, since the data exchange is only for primary use, data exchange within the eHealth Exchange Platform is freely flowed among the participants within the eHealth Exchange Program.
      In contrast, the United Kingdom, France, and Australia allows for both primary and secondary usage, with secondary uses restricted to non-commercial purposes only. Primary data usage within the data exchange often uses authentication via ID cards or healthcare professional cards to ensure safety for primary care. While secondary data usage is restricted predominantly for research and policy-making, which will require de-identification process. This secondary usage for non-commercial purpose approach allows for increased scope for research aimed for public benefits, and is a cost-effective way to conduct research as it eliminates the need for repetitive data collection. De-identification is required due to the data privacy and security reasons.
      Lastly, Denmark and Finland allows for both primary and secondary use of data, but unlike the countries mentioned above, the two countries also permit the use for commercial purposes. Authentication via ID Cards or insurance cards is required for primary data use, while de-identified secondary data is used for both commercial and non-commercial purposes. This not only allows for generation of revenue, but also contributes to the growth of direct healthcare industries and indirect industries outside of healthcare.

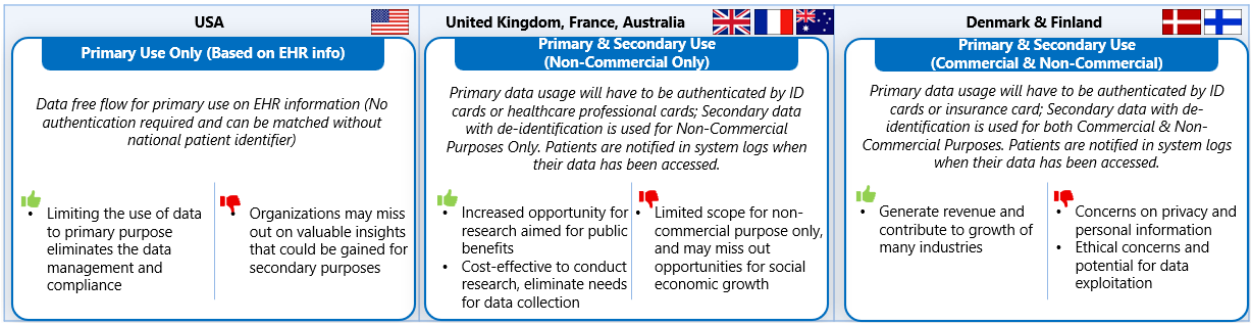


Figure 13: Modelled Countries Insights: Data Exchange: Primary or Secondary Use

- **Current Legislation / Situation in Bhutan:** Since there are no regulations concerning the secondary data usage in Bhutan, it is assumed that health data is primarily use for immediate patient care; Only specific data is employed for secondary aims such as policy-making and patient data tracking such as bed-ridden cases and NCD cases. Much of the medical data recording is still done manually via health books and patient registry, necessitating patients to carry health books when visit doctors. The implementation of the ePIS systems signals a positive shift to reduce manual data entry and paving the way for efficient data collection for primary care. With these new systems in place, arrangements for data exchange for secondary purposes will also need to be established.
- To fit with Bhutan's vision, it is possible that data exchange should follow Denmark and Finland's eligible for primary and secondary use, with potential commercial application. Primary data shall be freely moved and shared between hospitals and citizens. This access should be authenticated via a National Digital ID (NDI Wallet) to support efficient and secure patient care. Moreover, secondary data exchange for both non-commercial and commercial should ensure privacy through data de-

identification or pseudonymization to ensure data free flow and safety, which will help foster trust among citizens.

1. **Proactivity:** Available de-identified secondary data encourages more researchers to analyze data for new insights, leading to new health-related products and services
2. **Defense:** Primary data can be securely accessed through Digital National ID, while secondary data can be securely accessed through de-identification which protects patient privacy while still enabling data analysis
3. **Sustainability:** Available and free flow of primary data reduces the workload for health providers to manage redundant data

- **(3) Data Exchange: Data Consent:** Consent is crucial factor when handling personal data especially in healthcare settings. Generally, obtainment of consent can be classified into three types: No consent, Opt-in consent, and Opt-out consent. In the no consent model, consent is not generally required. On the other hand, Opt-in consent requires the patient's explicit permission before data can be shared. In terms of Opt-out consent, patients are automatically enrolled, but they have the choice to opt-out later by notifying the data holders. This topic will explore each modelled country's selection of data consent method:
    - **Modelled Countries Insights:** Denmark, Finland, and France uses Opt-in consent model. While data collection by medical institutions is necessary to perform healthcare, opting in is required for secondary usage and data sharing; Patients can revoke their consent at any time. For Denmark and Finland, the statistical and registry data does not require consent, as it is viewed as obligatory. By allowing patients for opt-in consent, it creates patient autonomy, enhancing trust between citizens and government agencies or healthcare providers. However, an op-tin system may slow down data acquisition, as only subset of citizens may opt-in, which may potentially led to bias in secondary data received for analyzing.
    - On the other hand, United Kingdom and Australia uses Opt-Out model. This model also respects patient autonomy, yet simplifies the consent process, resulting in higher enrollment rates. For instance, Australia's system has transitioned from an opt-in to an opt-out model in 2019. Enrollment is autonomic and consent for secondary use is implied unless the individuals opt-out. This approach, however, has also controversies; While enrollments rates have significantly increased, there may be a lack of informed consent, leading to concerns that citizens may not be aware of how their data is being used, and could feel that their data has been used without explicit consent. Finally, the USA's eHealth Exchange does not require consent. Since data in eHealth Exchange Platform is solely used for primary care purposes only, data sharing within the partnered organizations is free-flow. HIPAA laws also do not mandate consent, although certain states may have legislation on consent.

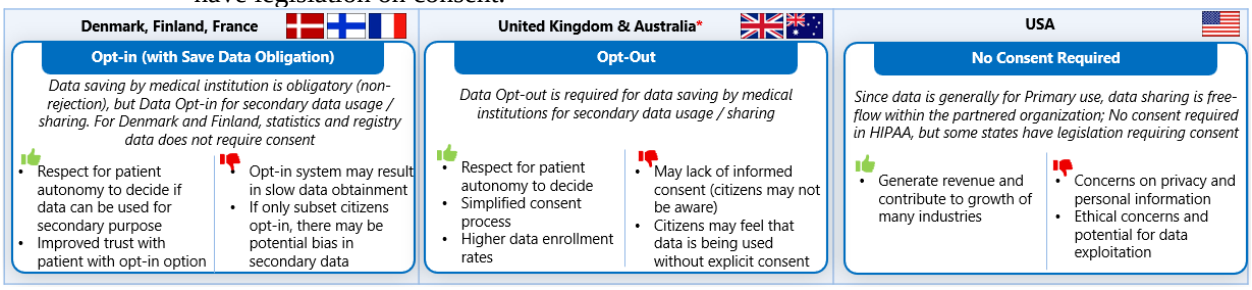


Figure 14: Modelled Countries Insights: Data Exchange: Data Consent

- **Current Legislation / Situation in Bhutan:** Currently, there is no specific guidelines for individual consent related to digital health data sharing. While in Bhutan Medical Healthcare Council Laws and Regulations (2005) outlines consent management for health services, it particularly concerns mostly on surgical procedures which are often executed during patient registration. Thus, there is a need to develop extensive procedures and governing laws specifically targeting the management and utilization of health data consent beyond the existing legal framework.
- In the context of data sharing consent, an opt-out model is recommended, similarly to the United Kingdom and Australia. In this approach, citizens will be automatically enrolled, making it more efficient and cost-effective for the government to operate as opposed to the opt-in method. With opt-in, the government would have to actively encourage and enroll citizens to ensure comprehensive data analysis.
    1. **Proactivity:** The opt-out model results in a more inclusive and diverse data set, which

potentially can lead to identifying of trends and patterns that can spur industry growth

2. **Defense:** The opt-out approach is more flexible, yet promotes transparency by giving citizens the knowledge of data collection and the choice to opt-out of data sharing
3. **Sustainability:** The opt-out approach ensures data collected is relevant and necessary, reducing storage and data processing

The suggestions of "Opt-out" Model was made, however, the subcommittee expressed concerns that this approach may not be sufficiently explicit enough within the Bhutan context, which could lead to transparency and potential trust issues between the citizens. Thus, it was proposed that the "Opt-in" approach to be used during the registration process of the application instead. Additionally, citizens shall have the ability to opt-out via settings in the citizen health application. While this change may result in a slower adoption rates for secondary data sharing, it is expected to significantly boost transparency and foster trust amongst the citizens.

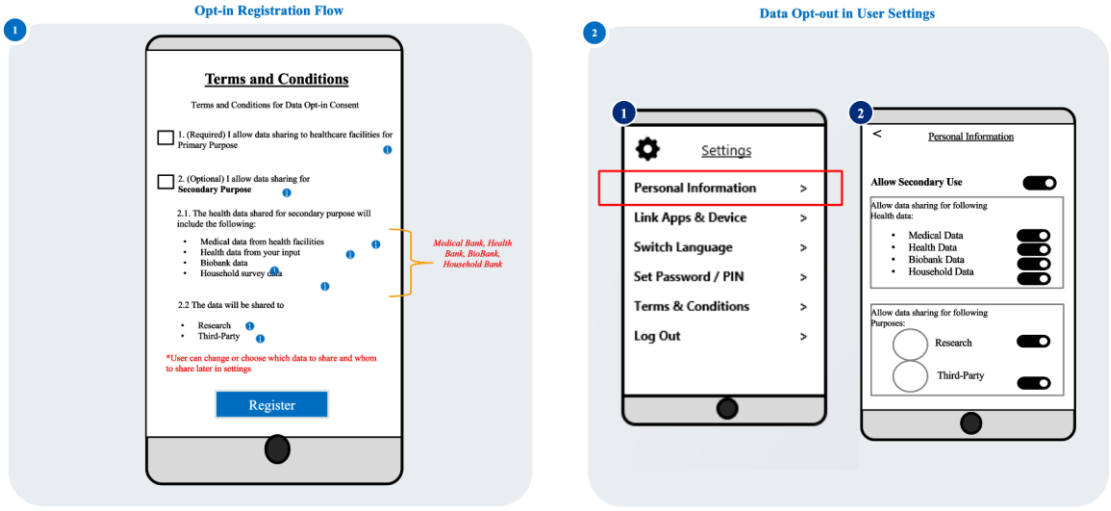


Figure 15: Mock Up Wireframe of Opt-in Registration Flow and Opt-out in User Settings

- **(3) Data Exchange: Secondary Usage Rules & Incentives:**
  - **Modelled Countries Insights:** In the context of data governance and incentives for secondary use, countries like Denmark, Finland, United Kingdom, France, and Australia maintains a strong data rules. These nations adhere to the General Data Protection Regulation (GDPR) or equivalent frameworks, which promotes trust in citizens on data usage. For instance, Finland also implemented The Finnish Act on Secondary Use of Social and Health Data to govern the processing of data for secondary purposes such as statistics, scientific research, and other activities. This not only provide trust amongst citizens that there is a regulation involved but also incentivizes data users to leverage the data.

    Additionally, in European countries, de-identification or anonymization of data is also endorsed, encouraging secondary data use as it ensures privacy. For instance, Denmark, Finland, and France have specific government-secured and easy to access platforms to facilitate easy access to data exchange. This promotes trust amongst stakeholders and offers incentives for data users due to its accessibility. Not only that, there is also clear application process to request for secondary usage to ensure that the data utilization is appropriately regulated, minimizing the risk of misused and unauthorized access. Furthermore, countries like Finland and Denmark offers free access to generic data. At the same time, they also provide more detailed data for a certain fee. This strategy serves as an incentive which encourages the usage of their data.

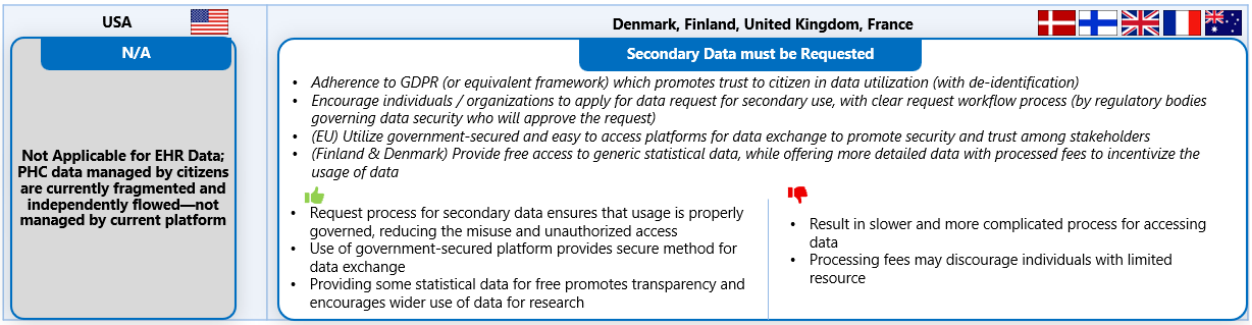


Figure 16: Modelled Countries Insights: Secondary Usage Rules & Incentives

- **Current Legislation / Situation in Bhutan:** There is a specific definition of "Personal Data" and "Sensitive Personal Data" stated in Privacy and Data Protection 2022 Guidelines. However it is essential to note that these definitions are focused on the financial service providers which does not relate to health data. Additionally, the Legal Subcommittee shared that within the Bhutan Medical Healthcare Council Laws and Regulations (2005), there is a code of ethics requiring medical or health professional to respect patient's privacy, but this is a broad definition that lacks specific details regarding personal health data and its secondary utilization.
- Additionally, there are also no current regulations which promotes data incentives. The National Statistics Bureau (NSB) is responsible for consolidating data for public access for policy makers, researchers, businesses, and international organizations involved in Bhutan's development activities. However, unlike practices in countries like Denmark and Finland, the information is only posted without promotions of data utilization incentivization.

- **(4) Data Content: Data Items & Detailedness:** Data content and management can be generally classified into three groups: those managed solely by healthcare providers, those managed by both healthcare providers and citizens, and those managed by healthcare providers and citizens with the ability to integrate third-party data. In this section, data management practices of each country will be explored:
  - **Modelled Countries Insights:** The USA, in the context of eHealth Exchange Platform, is the only country where data is exclusively managed by healthcare providers. This means that citizens do not have the ability to manage their own data. Information such as medical records, drug history, allergies, lab tests, and more, are solely controlled by healthcare providers. Personal Health Records (PHR) data managed by citizens is not currently incorporated into eHealth Exchange Platform, which results in a fragmented and independently flowing data ecosystem when it comes to PHR data.

    In contrast, Denmark and Australia follows a model where data is managed by both healthcare providers and citizens. Healthcare providers have the ability to manage data such as medical records, referral letters, allergy, prescriptions, drug history, lab tests, vaccination records, and more. Simultaneously citizens can manage data such as patient-reported outcomes, personal health notes, and indigenous people's status (specifically in Australia). However, this will be manually inputted voluntarily by citizens.

    Lastly, Finland, United Kingdom, and France follows a model where data can be managed both by healthcare providers and citizens, with the additional capability to link third-party data. Healthcare providers manage data such as medical records, allergy, prescriptions, drug history, and more, with the level of detail varying by country. Citizens have the ability to manage data such as personal health records, assessments, etc., which can be automatically linked from devices (as seen in United Kingdom), or linked to state-approved third-party applications (as seen in Finland, United Kingdom, and France). It is also worth nothing that data managed by citizens can also be supplemented or modified by healthcare providers as well.

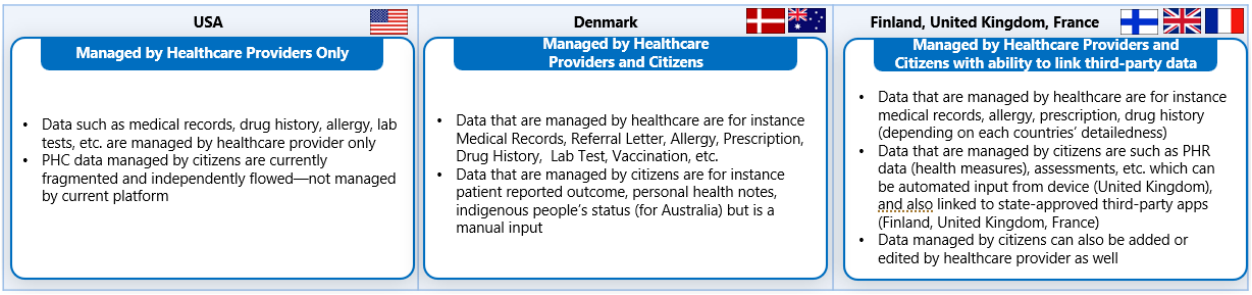


Figure 17: Modelled Countries Insight: Data Items & Detailedness

- **Current Legislation / Situation in Bhutan:** According to the Legal Subcomittee, there is no specific definition in place that determines what is health data. The existing regulations only provide a broad and general definition which lacks details related to medical data.
- It is possible that data item details to be able to be managed by both healthcare provider and citizens similar to Finland, United Kingdom, and France. This implies that certain data such as Medical records, Prescription, Drug History, Lab tests, and vaccinations, will be exclusively managed by healthcare providers. On the other hand, other data such as Daily Personal Health Record (i.e. height, weight, blood pressure, blood sugar levels) can be jointly managed by healthcare providers and citizens. Additionally, these data can be automated through syncing of wearable devices and third-party applications.
    1. **Proactivity:** By enabling linkage with the wearable device, a more accurate detailed analyses can be conducted which can lead to identification of patterns for preventative care
    2. **Defense:** Setting clear guidelines on data handling ensures for data security and identifies who have access to manage patient information
    3. **Sustainability:** Allowing healthcare provider to add or edit citizen-managed data ensures data accuracy and integrity. Additionally, integration with third-party wearable apps can also reduce the need for manual entry of data

- **(4) Data Content: Data Timeframe:** Data timeframe refers to the period during which data is retained, starting from the date of record creation. This data timeframe and duration of storage varies across countries, generally governed by a regulation that stipulate that the data should be retained only as long as it serves a purpose.
    - **Modelled Countries Insights:** Countries like Denmark, Finland, United Kingdom, and France, most health records are kept for a fixed amount of years based on the country's regulation. For example, in Denmark, the general rules is that the health record should be stored for at least ten years from the date of the last activity in those records. The United Kingdom, on the other hand, has a more detailed system where different records are retained for different lengths of time. When it comes to USA and Australia, data retentions is not determined on a national-level basis, but instead depends on the laws of the respective state or territory. For instance, in Australian regions like the Australian Capital Territory, New South Wales, and Victoria, privacy laws require health service providers to keep records for seven years, or until a child patient turns 25. However, this specific requirements do not apply to all the states in Australia.

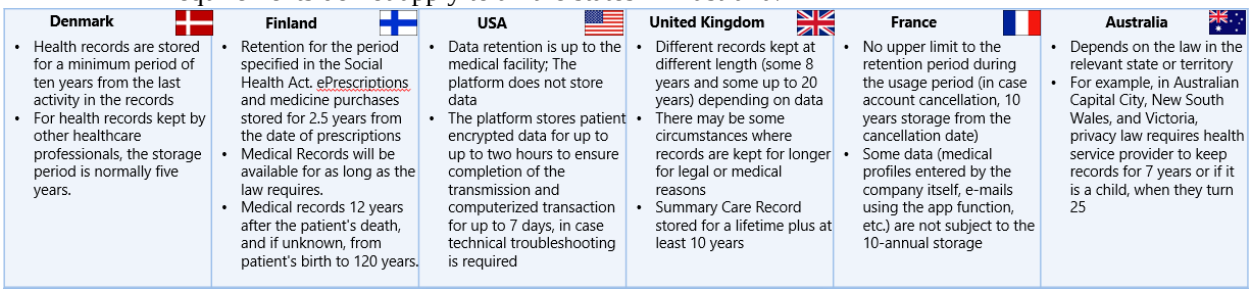


Figure 18: Modelled Countries Insights: Data Content: Data Timeframe

- **Current Legislation / Situation in Bhutan:** Currently, there are no specific regulations or definitions regarding data timeframe for retention or the rights of individuals concerning the portability or deletion of health data in Bhutan. However, MoH (MoH), Bhutan Medical and Health Council (BMHC), and associated hospitals are in the process of drafting The Bhutan Medical

Record Manual and Standard Operating Procedures (SOPs). This document aims to establish standard protocols for data storage. For instance, to draft a 21-year retention period for Maternal & Child Health data, life-long storage for criminal cases (with archival after death), five-year storage for outpatient department (OPD) data, and indefinite storage for inpatient department (IPD) & emergency room (ER) data.

- Adopting Denmark's data retention policy, the idea is that the data shall be stored for minimum of 10 years depending on the types and details of record. This idea is grounded on three primary considerations. Firstly, by allowing longer storage, there will be continuity of care. This will ensure healthcare providers to have access to historical medical data for informed future treatment decisions. Secondly, it will also allow for research and public health. Storing data for extended period of time allows for more comprehensive data analysis, which can potentially identify trends and data patterns for new health initiatives. Lastly, is the patient safety. By providing healthcare providers with complete access to timely medical records, it may potentially help improve patient's health by tracking changes in patient's personal health record over time.
    1. **Proactivity:** Long-term storage of health data can provide insights for researchers and companies, leading to development of new technologies, drug, and treatments, which can attract investments in digital health industry
    2. **Defense:** Clearly defined data timeframe ensures that data will not be kept for lifetime, which prevents fraudulent activities. It also ensures that medical histories are not lost or accidentally destroyed.
    3. **Sustainability:** Remove unnecessary data that might not be relevant contributes to the saving of costs for optimized data storage system and reduce workload of data management

  With the ideas in mind, the data retention guidelines still requires further consideration. There has been a consensus that data retention will be a minimum of 10 years. However, it is still undecided whether the data should be deleted or archived after 10 years. The subcommittee proposed archiving data first and will assessed later whether it is still needs to be kept; However, as this may have the potential impact on data storage capacity estimation, the proposed archiving from subcommittee will need to be further discussed and assessed during the pilot implementation of the Digital Health Platform.

1.3 Review the situation and development plan of ICT infrastructure.

- Internet access in Bhutan has been experiencing rapid growth, as reported by WorldData.Info and World Bank. Between 2020 and 2021 alone, the percentage of internet access jumped from 53.5% to 85.6%[1]. This indicates that out of Bhutan's population of 777,486 (2021), 85.6% of them have access to the internet. The Main Telecom service providers are Bhutan Telecom Limited (BTL) and Tashi InfoComm Limited (TICL), with both service providers offering bandwidth of up to 30 Mbps. Bhutan's current median fixed speed is at 8.12 Mbps[2]. 4G is available in all 20 Dzongkhags, and 5G has been implemented in core areas of Thimphu, Paro, and Phuetsholing; Now, 5G service is now available in 18 Dzongkhags mainly in major towns. In terms of Broadband infrastructure, Bhutan has highest percentage of individuals using internet among neighboring countries[3], highlighting the remarkable progress.

[1] Based on Statistics from Statista: https://www.statista.com/statistics/767603/internet-penetration-rate-bhutan/

[2]Based on Data from Ookla (January 2022) https://www.speedtest.net/global-index/bhutan

[3] Based on data from World Bank https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=BT

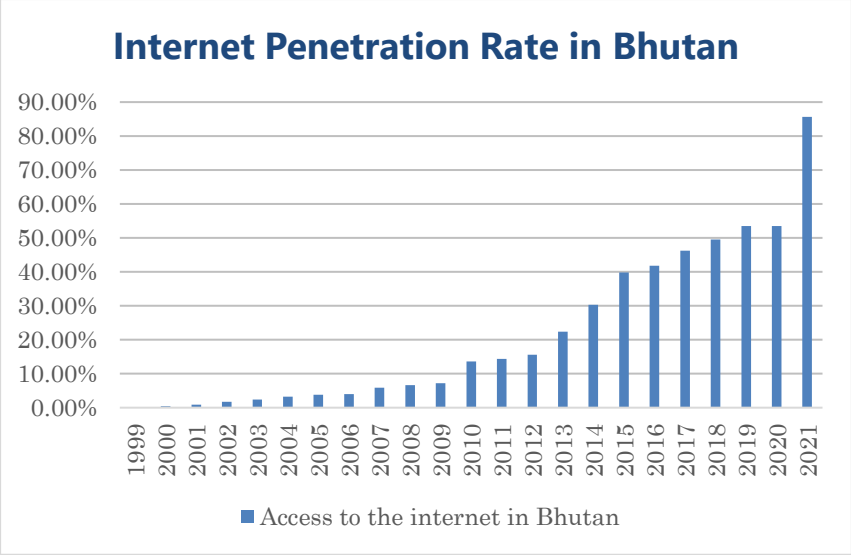


Chart 1: Internet Penetration Rate in Bhutan

- **Current Situation on Data Transmission Speeds:**
  - **Health Facilities:** Based on a survey at Health Facilities, it was found that internet access is available in all health facilities, either with 35.3% utilizing Local Area Network (LAN) and 64.7% using Wireless Local Area Network (WLAN). The survey also involved conducting internet speed tests, and was observed that the speeds in health facilities ranges from 1 – 5 Mbps to 10 – 15 Mbps within the health facilities. The current internet speed is considered adequate for basic connectivity in the current healthcare facilities usage. However, it is important to note that the speed may vary depending on the number of users accessing the internet. For instance, regional hospitals, which typically have more users, experience greater fluctuations and lower speeds compared to the Primary Health Centers (PHCs). PHCs generally have higher internet speeds which can be inferred from fewer users (maximum 3 – 4 users) accessing the internet services. Additionally, it is important to highlight that the internet service provider and management of internet connectivity varies across healthcare facilities. While district hospitals, PHCs, and Sub-Posts rely on the ICT unit of the district administration for the internet access, National Referral Hospital handles its internet services internally by its ICT Officials. According to the sentiments expressed by health facility staff, majority of respondents (94.1%) considered that the internet transmission speed at work is extremely important to them. A significant number of them reported experiencing data transmission speed issues at work, with a few encountering these issues always (5.9%) and majority encountered it often (44.1%). However, despite these internet speed issues, the majority of the respondents (67.7%) expressed a level of satisfaction, stating that they are somewhat satisfied with the current internet speed.

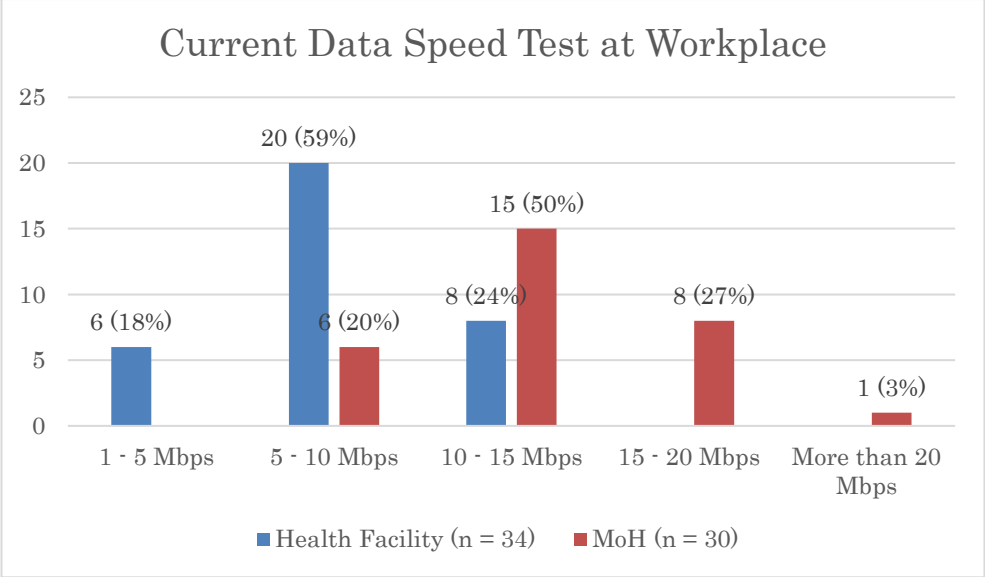
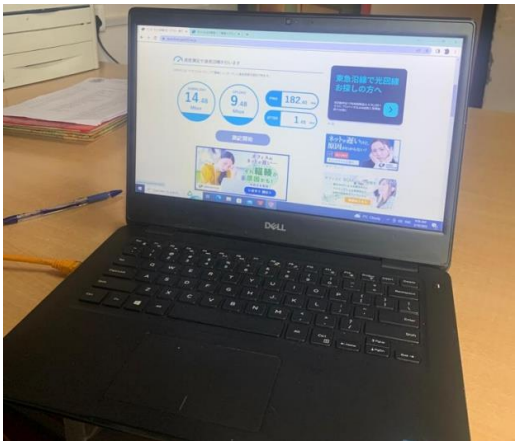


Chart 2: Current Data Speed Test at Workplace



Picture 1: Internet Speed Testing at a PHC

- **MoH:** MoH currently has a monthly leased line fiber optic bandwidth of 85 Mbps. The majority of users (90%) access the internet using WLAN via Wireless Access points. However, according to the survey results, majority of respondents (50%) reported the internet speed ranges from 10 – 15 Mbps, which is lower than the available bandwidth of 85 Mbps. Based on the sentiments expressed by MoH staff, a majority of respondents (90%) considered that the internet transmission speed at work is extremely important. The response regarding data transmission issues at work were divided, with 43.3% of respondents reporting occasional issue and 40% stating that they rarely face internet connection problems. It can be inferred that MoH's staff members do not experience data issues as frequently as the health facility staff. In terms of the staff's satisfaction with the internet speed, a majority of respondents (56.7%) expressed that they feel somewhat satisfied, while 30% of respondents indicated neutral sentiment on the internet speed satisfaction.

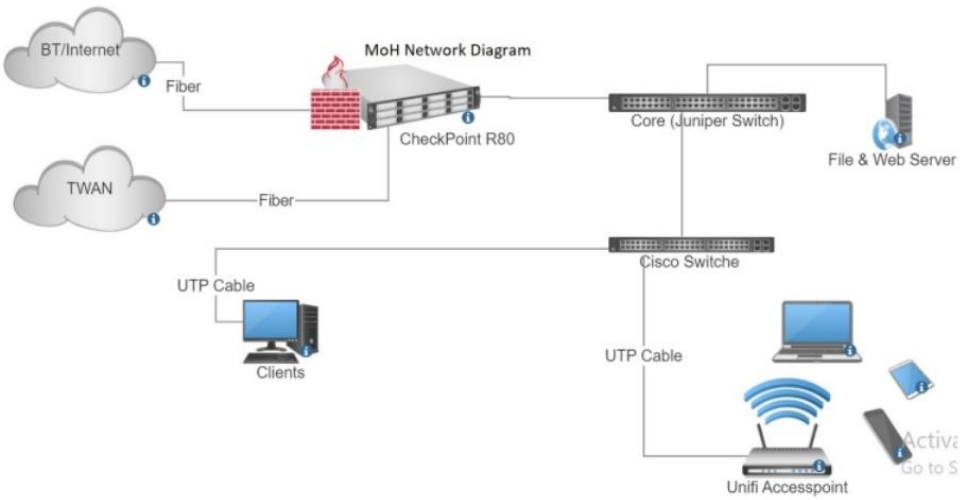


Figure 19: Internet Connection in MoH

- **Comparison between Groups:** When comparing internet connectivity between the two groups, there are a few notable differences; MoH generally experiences fewer issues with the internet speed and has higher internet speed compared to Health Facilities whereby internet speed varies across different facilities. The survey result also shows that health facility staff expressed higher level of concern on data transmission speed issues encountered during work, with significant number reporting frequent encounters when compared to MoH's. Despite these issues, majority of both groups expressed some level of satisfaction on the internet speed and recognized the significance of internet connectivity for their work and emphasizes the need for reliable and efficient internet services to support healthcare operations effectively.

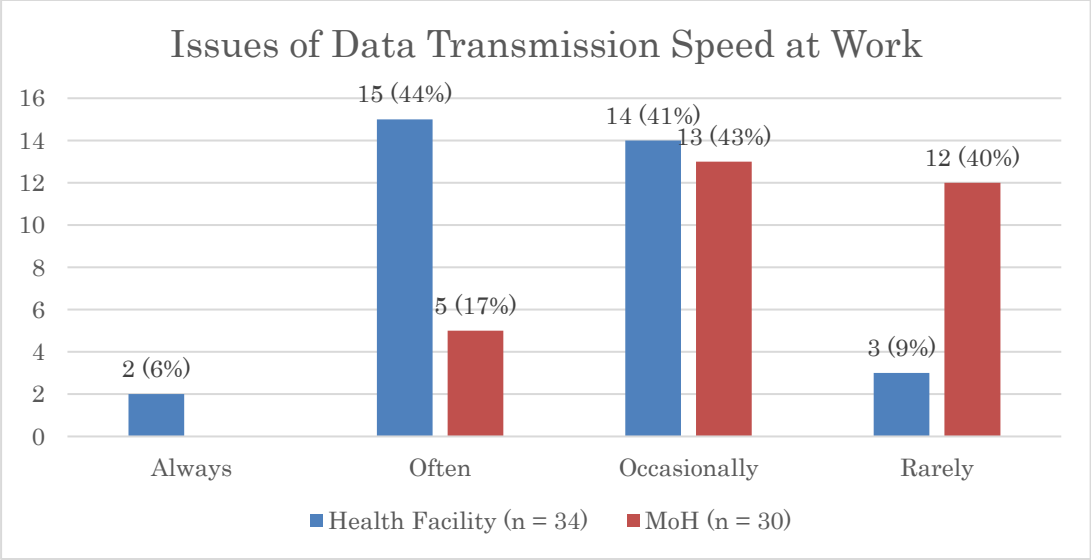


Chart 3: Issues of Data Transmission Speed at Work

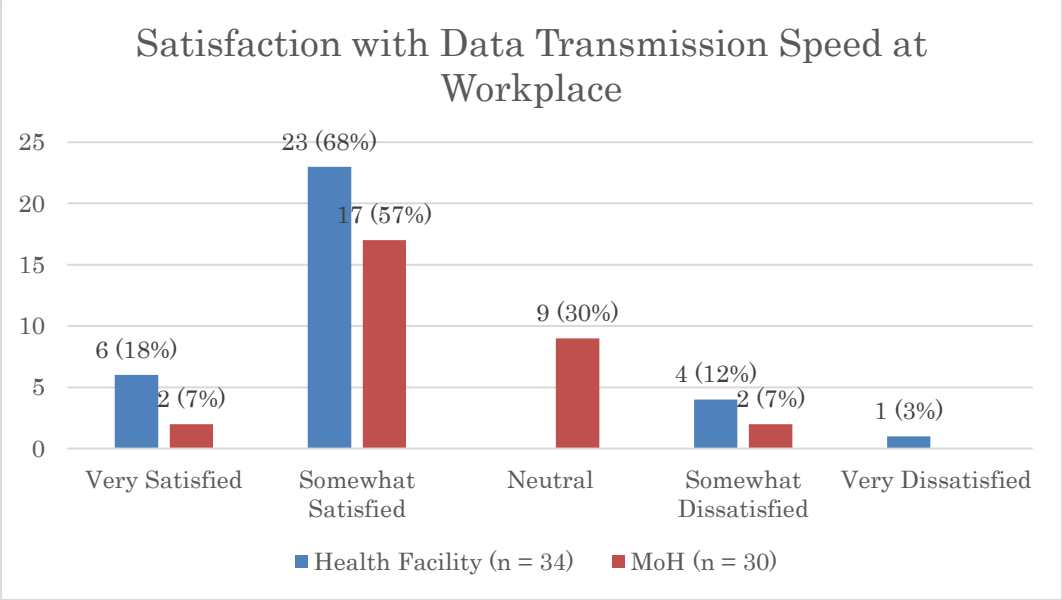


Chart 4: Satisfaction with Data Transmission Speed at Workplace

- **Current Situation on System Security:**
  - **Health Facilities:** During the survey conducted within health facilities, a significant majority of healthcare staff (88.2%) reported using organization's system frequently during work. Among them, a majority (60.6%) reported that the access to these systems is open and does not require specific permission, while a smaller portion (39.4%) mentioned restricted access. For those who reported that the access is restricted, the restrictions mainly are on the access to WLAN internet and access to specific systems like Health Management Information Systems (HMIS), specifically DHIS2. Participants highlighted that the permission to access DHIS2 is granted using individual's authorized username and password to ensure system security. However, despite DHIS2's secure nature and its functionality that enables data sharing between DHIS2 users, the primary means of data sharing within healthcare facilities still relies on external communication tools such as WhatsApp, Google Forms, etc. as stated by the majority of respondents (60.6%). While the second most prevalent method of data sharing is through paper-based documents (27.3%)
  - **MoH:** During the survey conducted within health facilities, all of MoH staff (100%) reported using organization's system during work. Among them, a majority (93%) reported that the access to these systems is restricted and would require permission through access. For those who reported that the access is restricted, the restrictions mainly requires username and password for authorization to use computer systems. Specifically, for MoH to access shared files and folders from the shared file server, one needs to join health domain with their credentials. Administrative rights are also restricted in Health Domain group, and only standard-users rights are granted to users who have joined the Health-Domain. However, despite the Health Domain's security, still the primary means of data sharing within MoH is external communication tools, with 97% of personnels stated that data is being shared through means such as G-mail and WhatsApp, to mainly government agencies (74%).
  - **Comparison between Groups:** When comparing the system security between two groups, there is a difference in terms of system access. The majority of healthcare staff (60.6%) reported that the access is open and does not require specific permission, which could indicate that the System security is relatively still low in Health Facilities as majority do not need additional permission to access the system. On the other hand, Network access in MoH is relatively standardized and requires permission with different levels of accessibility of shared files in the server depending on user's credential. However, what is common is that despite the security of system access, personnels still relies on external means of communication such as WhatsApp and Google Tools, which may not be specifically designed for healthcare to protect sensitive patient information.

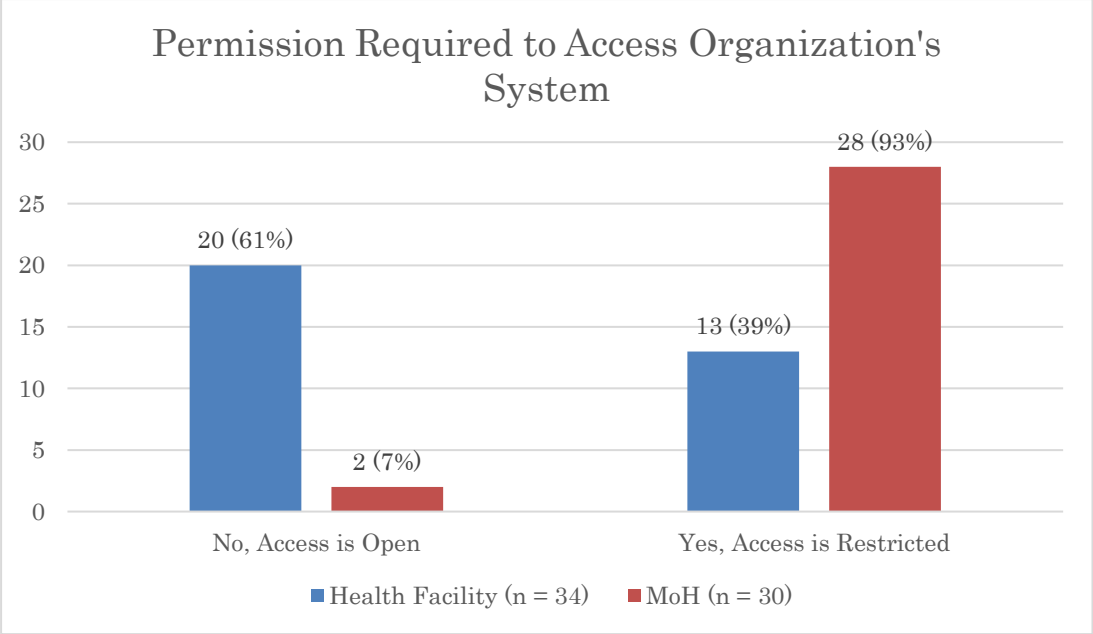


Chart 5: Permission Required to Access Organization's System

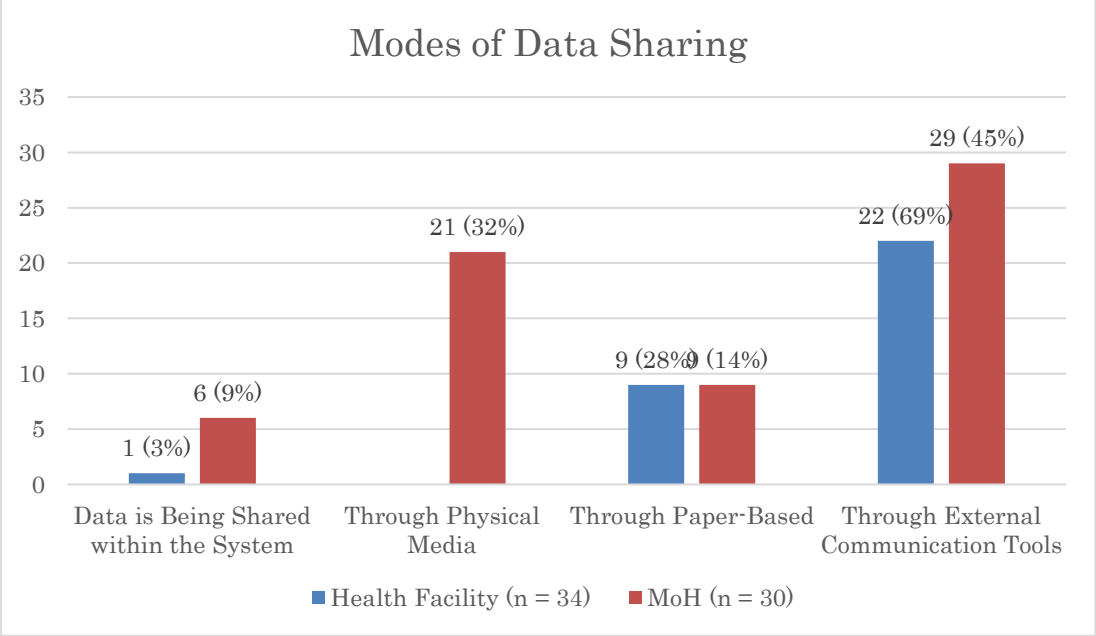


Chart 6: Modes of Data Sharing

- **Current Situation on Back Up Systems**
  - **Health Facilities:** When it comes to backup systems, Health Facilities is generally lacking.
  - **MoH:** MoH has backup system.
  - **Comparison Between Groups:** There are similarities between Health Facilities and MoH. In both groups a significant number of respondents reported the absence of backup systems both in physical and on-cloud. While system failure occur, both groups face challenges in terms of protocols and trainings, and seeking alternative workarounds during system failures.

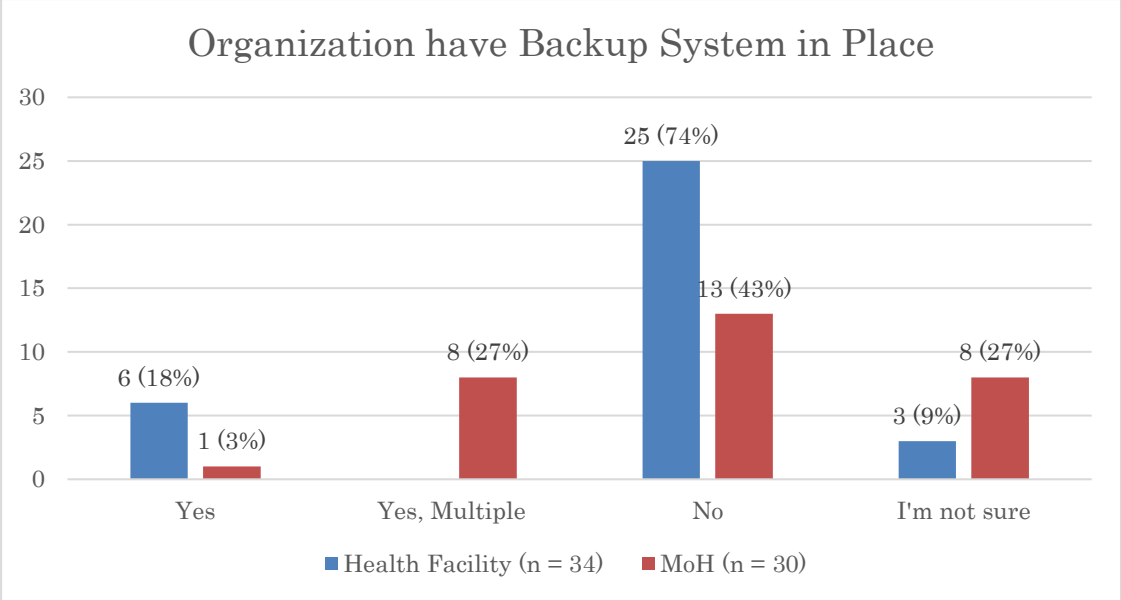


Chart 7: Organization have Backup System in Place

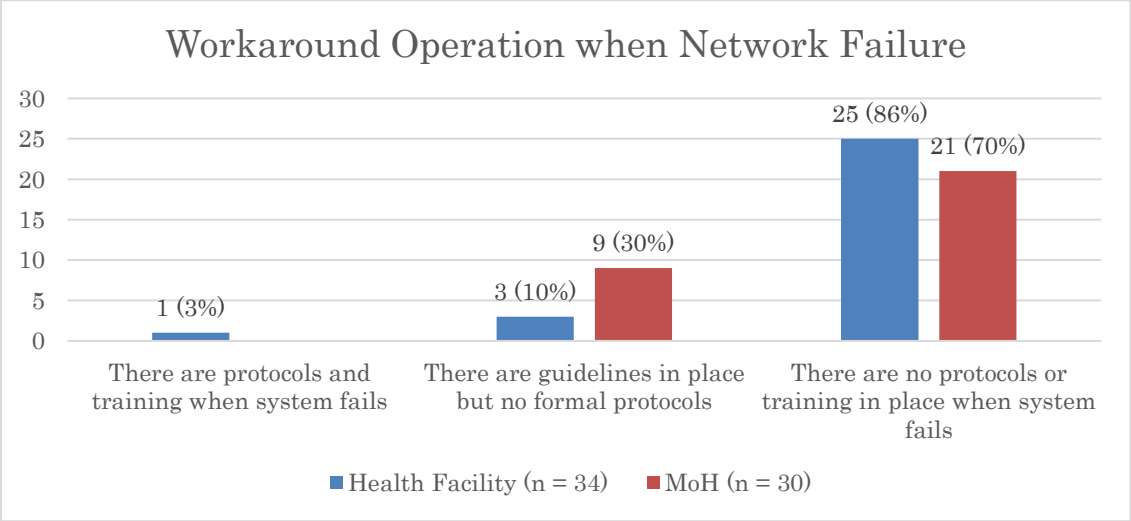


Chart 8: Workaround Operation when Network Failure

1.4 Review and evaluate the existing systems of the healthcare sector (ex., ePIS, HMIS, DHIS), common function (ex. Data hub and national ID), and any related technical standards.

- In the big picture, there are various levels of hospitals in Bhutan, but not all levels of hospitals use the same system. First, the most state-of-the-art system is ePIS, which was only fully implemented at JDWNRH in April 2023 and has not yet been implemented at other hospitals in the hierarchy. The ePIS functionality currently in place at JDWNRH is also limited to services for the Outpatient Department (OPD). Inpatient Department (IPD), Maternal and Child Health (MCH), Referral, mobile app and other modules will be implemented in the future. On the other hand, the lowest-tier hospitals use District Health Information System 2 (DHIS2) for statistical reporting to MoH, in addition to paper-based patient management ledgers. If this is the case, it would not be surprising if middle-tier hospitals also use DHIS2, but in reality, they do not use DHIS2, but rather create their own Excel sheets for tabulating patient data and report it to MoH. This lack of utilization of a unified national system is characteristic of Bhutan. According to the Bhutanese government, ePIS will be introduced gradually in the future, but it remains to be seen how long it will actually take.
- The second feature is that the Bhutanese government is working on patient information management using National ID (or Citizen ID: CID). When patient information was managed on a paper basis, there was no electronic information management linked to the national ID. The ePIS system was introduced with the aim

of tagging individual citizens' information with their IDs by issuing patient IDs that are linked to the national IDs. It also has potential for analyzing social determinants of health by combining various statistics and personal medical histories associated with national IDs (It should be noted, however, that the various current statistics are often tied to household IDs and not necessarily to national IDs.).

- The third characteristic is that ePIS and other medical information systems are designed to help government agencies such as MoH and healthcare professionals efficiently capture the medical information of individual citizens. This point is made clear by an article in a local newspaper announcing the launch of ePIS, which says, "Now, patients visiting health facilities will no longer have to maintain paper prescriptions or health books"[4]. The project team also observed NCDs screening[5] at an outreach clinic. Patients with hypertension, for example, were informed that they had hypertension, but there was no indication that they were given guidance on how to take action on their own. Through the interviews, there was no clear indication that detailed data from health checkups conducted at workplaces, for example, was distributed to individual citizens, and it appeared that MoH and hospitals were basically managing the data. Certainly, it would be convenient for government officials and health care providers if ePIS allowed for integrated management of patient data. On the other hand, in order to solve the NCDs and other issues facing the people of Bhutan, it is important not only for medical professionals to provide guidance, but also for individuals to change their attitudes toward health and to change their behavior. In particular, in a situation where prevention is more important than cure, individual patients need to understand their own health data more than healthcare professionals do.

1.5 Evaluate the capacity of Bhutan's government and healthcare facilities for data utilization.

- **Number and Level of Personnels with Experience and Capabilities in Data Analysis**
  - **Health Facilities:** Most of the data analysis and collection tools that healthcare providers are capable of using are in-house systems (55.9%)—namely DHIS2. DHIS2 is used mainly in Primary Healthcare Centers, commonly in Community Child Health Units (CHU), Traditional Medicine Unit, and Hospital Record section, thus, not everyone knows how to use the system. Types of decision-making generated from data analysis varied, with the highest percentage (76.5%) responded that research and development decisions were made based on the analyzed data. When it comes to the percentage of staff capable of performing data analysis within the system, the majority of facilities (55.8%) believes that less than 20% of healthcare providers within the health facility are equipped with data analysis skills. This suggest that only a small portion of the workforce is equipped with data analysis capabilities. When assessing whether this number is sufficient, there seems to be some disagreement in the survey; Approximately one-third of respondents (35.2%) agree that there are enough personnel equipped with the skill, however, a significant portion of respondents (47.1%) either disagree or strongly disagrees. Despite that significant portion that disagrees, the majority (55.7%) still agrees and strongly agrees that the organization has enough investments in training.

[4] ePIS to ensure better healthcare services | Kuensel Online

[5] Existing Blood Pressure Measuring Process in Health Facilities: When it comes to environment related to health facilities, sphygmomanometer, an equipment that is used for measuring blood pressure, is commonly utilized within the health facilities. The majority (53%) of health facilities uses both manual and automated equipment based on its availability. Despite the availability of an automated equipment, a significant percentage (76.5%) of healthcare providers still manually record blood pressure readings on paper. This is typically done twice, first on the patient's treatment handbook and second on the doctor's register, which creates repetitive efforts. Measuring blood pressure is a regular routine task that everyone in the hospital is familiar with. While sometimes doctors may be involved in taking blood pressure readings, Health Assistants (HAs) are often trained to perform this task and make decision based on the readings. This is prevalent in Primary Health Care units where doctors are not available. There are also challenges encountered by healthcare providers when it comes to ongoing treatment. Approximately 38.3% of providers feel that patients have insufficient education on NCDs, while 26.5% reported that patient non-adherence (patient not coming back to treatment) is an issue.

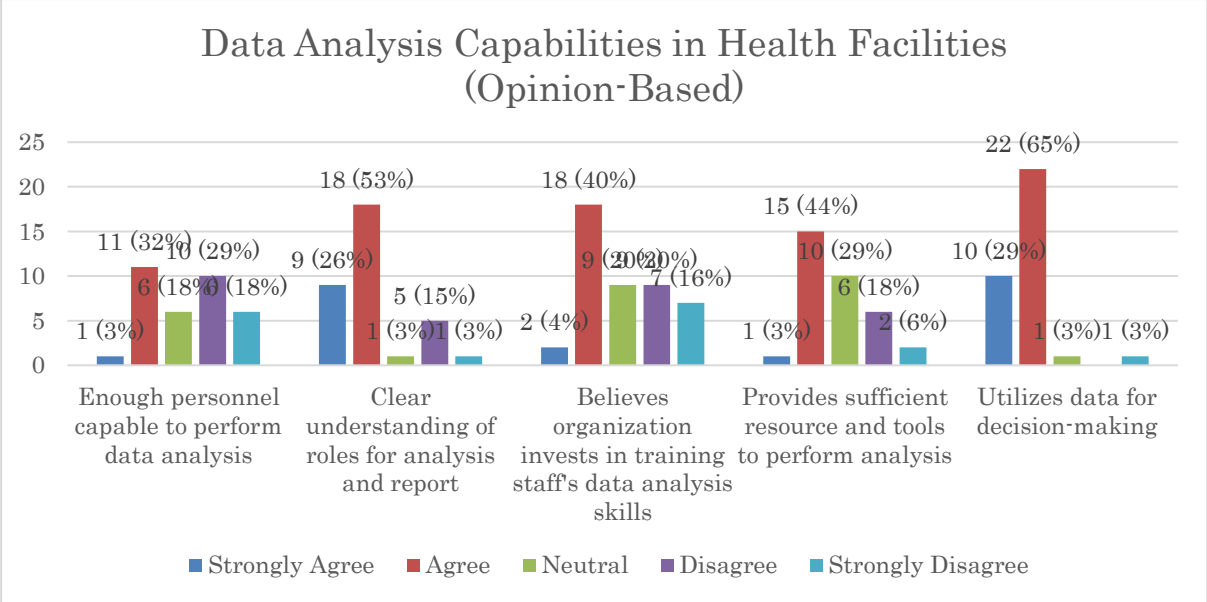


Chart 9: Data Analysis Capabilities in Health Facilities

In summary, there is a mixed perception regarding the availability of capable of performing data analysis. Although there is relatively positive understanding of roles and responsibilities, investment in training, and data utilization, there are some concerns about the sufficiency of resources' tools and capabilities for data analysis.

- **MoH:** Most MoH respondents indicated that they have capabilities to conduct data analysis with basic tools to a certain extent. All expressed that the staff are capable of using Excel (100%), followed by STATA (77%) and Epidata (67%). MoH uses the data mainly of public health policy (73%) and research and development (57%) based on the analyzed data, and all (100%) responded that there are clear roles and responsibilities of who are responsible for data analysis and reporting. When it comes to the percentage of staff capable of performing data analysis within the system, the significant portion of MoH respondents (40%) believes around 40 – 60% of staff are able to perform data analysis, which suggest a better number compared to healthcare providers with less than 20%. When assessing whether the number is sufficient, 54% of respondents agrees or strongly agrees that there are enough personnel equipped with the skill. However, when asked to express whether or not there are enough trainings within MoH, majority (50%) have remained neutral, which indicates that there needs to be further assessment and potential improvement in this area.

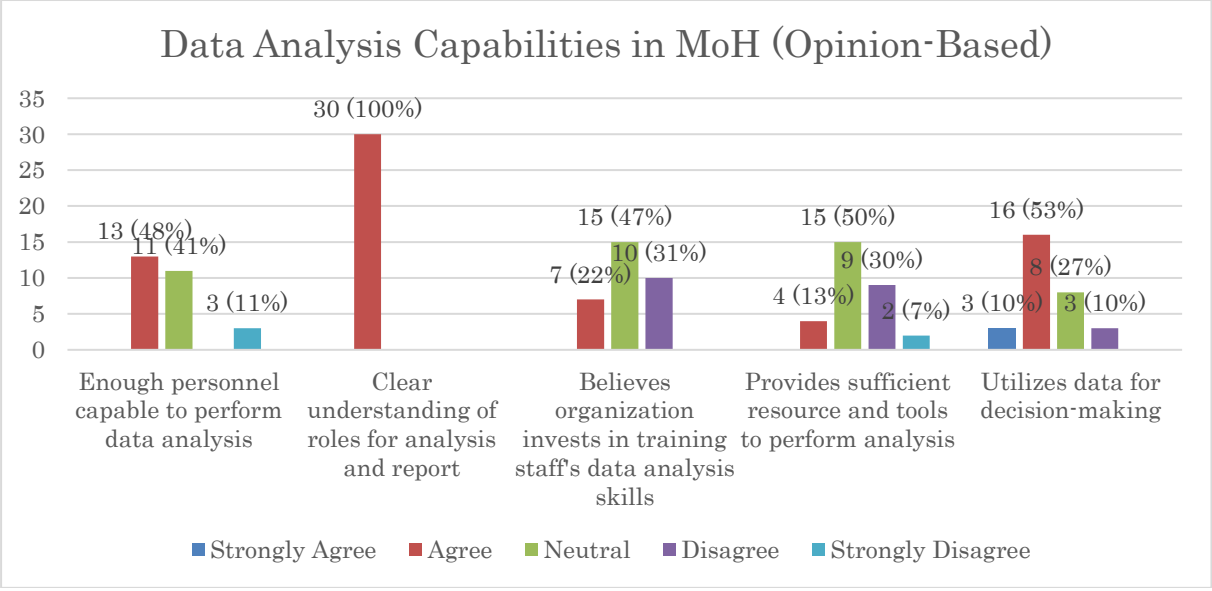


Chart 10: Data Analysis Capabilities in MoH

Overall, MoH respondents exhibits a higher level of confidence in the staff's data analysis capabilities compared to healthcare providers. They have clear roles and responsibilities and acknowledge better percentage of staff who are capable of performing data analysis. Nevertheless, the neutral response on training available suggest that there may be room for improvements in the training initiatives in MoH.

- **Comparison:** Healthcare providers rely on in-house systems with DHIS2 as a primary tool used in mainly Primary Healthcare Centre. However, there is a significant gap among healthcare providers since not everyone is familiar with how to use the system effectively. In contrast, MoH respondents expressed the organization to have higher proficiency in using systems such as Excel, STATA, and Epidata. Both healthcare providers and MoH recognize the importance of data analysis for decision-making, particularly in research and development for healthcare facilities, and policy-making for MoH. However, there is a concern on the low percentage of staff with data analysis in healthcare facilities, while MoH have more capable staff. Nonetheless, there is also potential improvement in training within MoH.

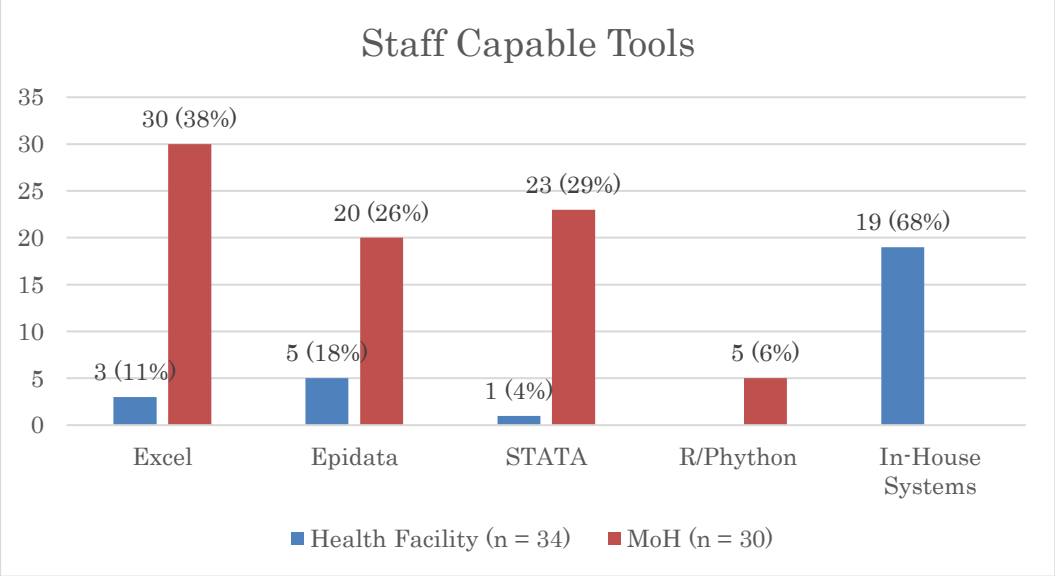


Chart 11: Staff Capable Tools

1.6 Analyze digital health services and IoT devices currently provided in Bhutan.

- **Level of Understanding of Digitally Enabled Health Services (DEHS)**
  - **Health Facilities:** When it comes to the familiarity of Digitally Enabled Health Services (DEHS), majority of respondents (52.9%) are familiar with DEHS, as DHIS2 is used routinely used within the primary healthcare facilities—including Monthly Morbidity & Activity Reports & Annual Household Survey Report, Mother & Child Health (MCH) Tracking, Voluntary Counselling Testing (VCT) Reporting for HIV, Annual Medical Waste Reporting, Traditional Medicine Reports, Monthly C4CD Report, etc.
    When it comes to the most important functionality within the DEHS, the most important functionality is the Obtaining & Tracking Patient Record (52.9%). In terms of the most important data, health data such as vital signs (85.3%) and medical history (85.2%) is deemed to be most important for the healthcare provider respondents. Furthermore, "Ease of Use", with 88.2% responses, was identified as the most important factor for DEHS development.

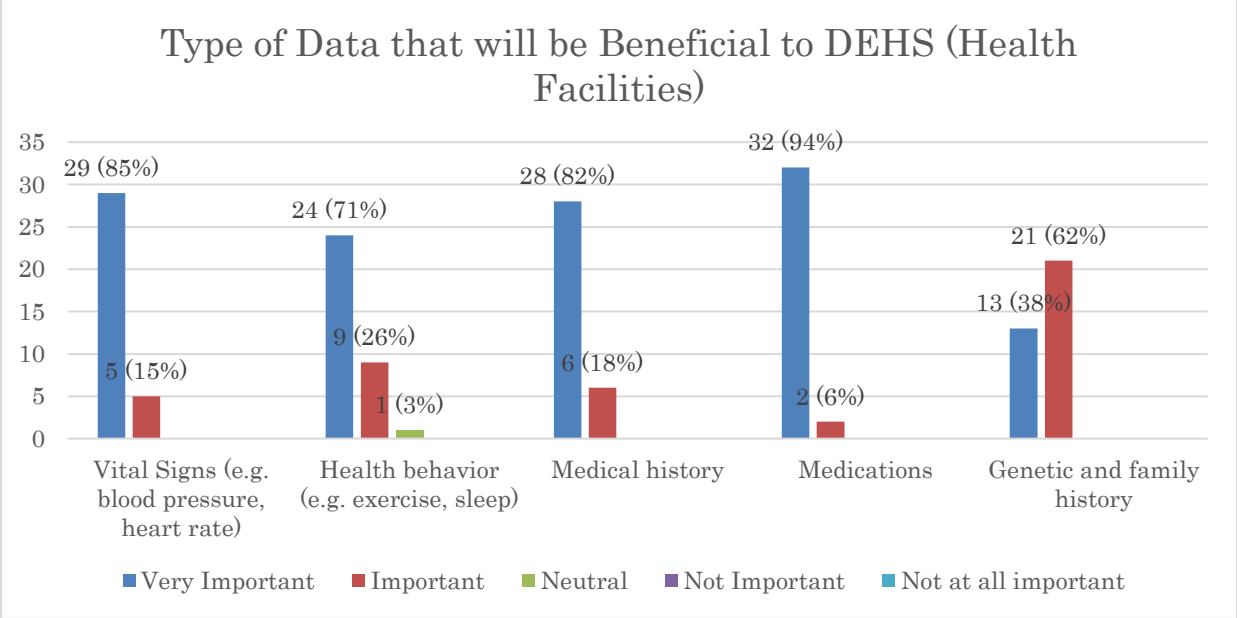


Chart 12: Type of Data that will be Beneficial to DEHS (Health Facilities)

- **MoH:** Almost majority of respondents (47%) is familiar with DHES. When it comes to the most important functionality, similar to healthcare facilities, MoH believes the most important functionality is to Obtain & Track Patient Record (33%). In terms of the most important data, health data such as Health Behavior (i.e. Exercise and Sleep) (70%) and Medical History (70%) is deemed to be most important for MoH. Furthermore, "Integration with Other System", with 100% of respondents, was identified as the most important factor for DEHS development.

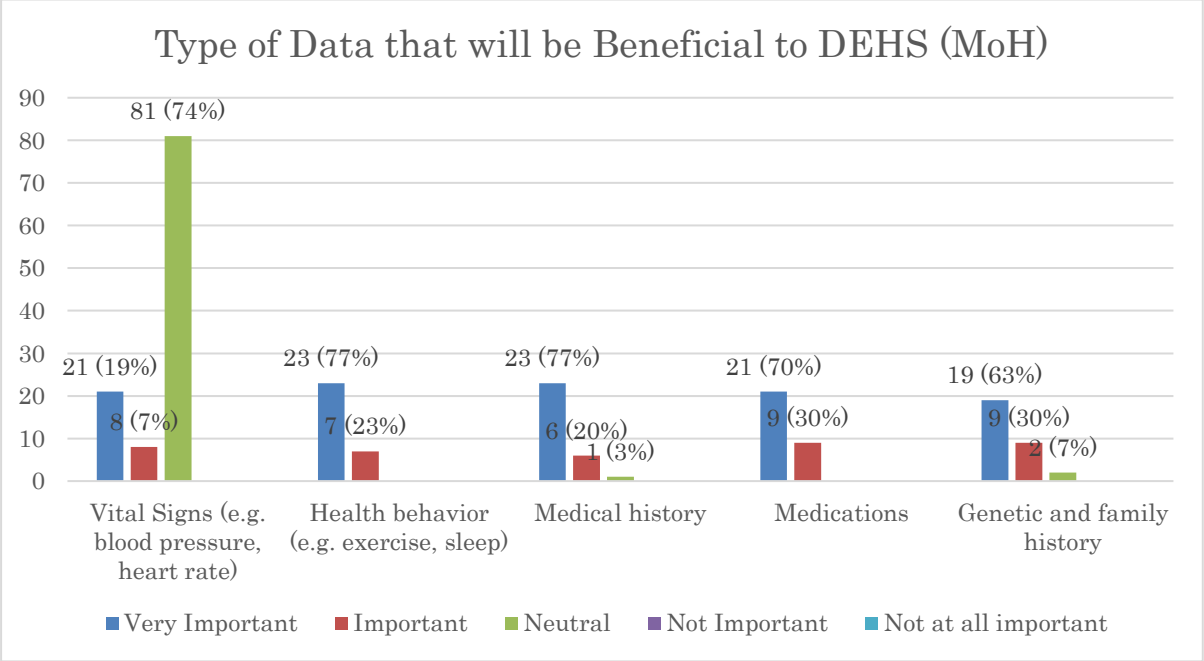


Chart 13: Type of Data that will be Beneficial to DEHS (MoH)

- **University:** Only 20% of the respondents have full understanding of Digitally Enabled Health Services (DEHS), while 40% have some level of familiarity, and the remaining 40% of respondents are not familiar with the term at all. This indicates that there may be a need for further awareness among the respondents, particularly considering that they are university respondents that may not be fully involved in healthcare like MoH and healthcare facilities does.
- When it comes to the most important functionality, similar to both healthcare facilities and MoH, the respondents believe the most important functionality is to Obtain & Track Patient Record (50%). In

terms of the most important data, health data such as Medication (63%) and Family History (63%) is deemed to be most important for MoH. Furthermore, "Data Privacy and Security", with 83% of respondents, was identified as the most important factor for DEHS development.

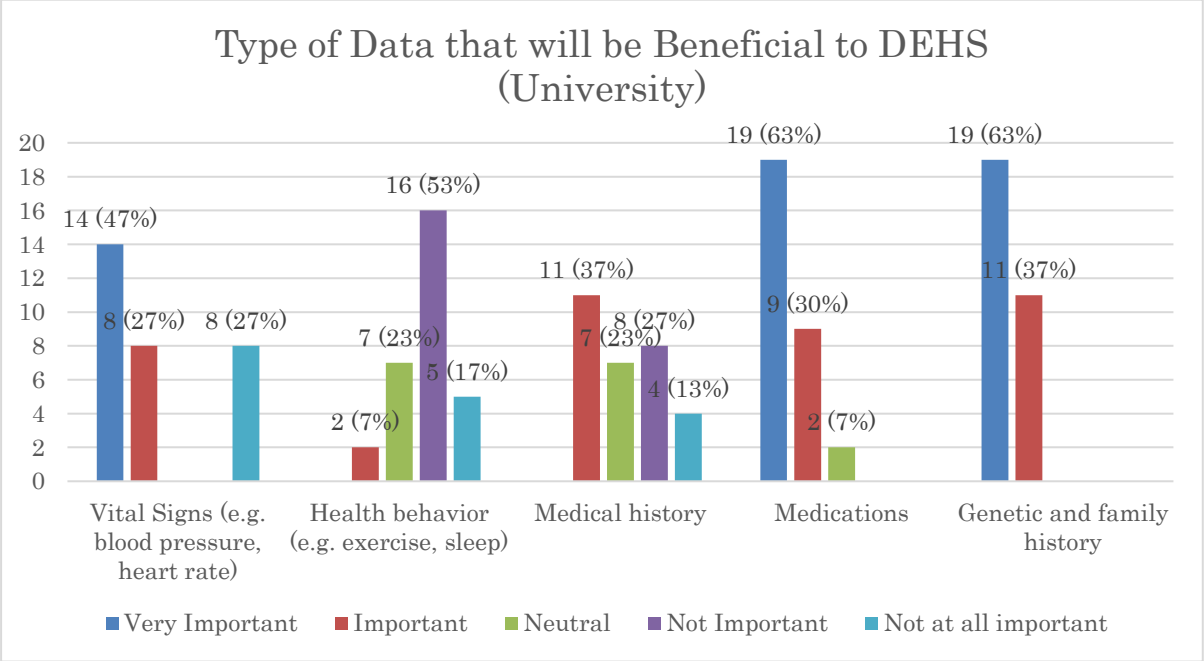


Chart 14: Type of Data that will be Beneficial to DEHS (University)

- **Comparison between Groups:** Most Health-related organizations, such as respondents from MoH and Health Facilities, demonstrate a good level of understanding of DEHS. However, universities may not be as familiar with the jargon of DEHS, and the level of familiarity may be lower in non-health settings. All respondents have recognized that obtaining and tracking patient records is the most important service that they believe would be advantageous for DEHS. Across different organizations, there are variations in the priorities for development values and types of data to be recorded. Furthermore, each organization have different needs and areas of focus when it comes to the utilization of DEHS. Thus, considering the different development priorities across varying organizations based on their specific requirements and goals is essential for the successful implementation of DEHS.

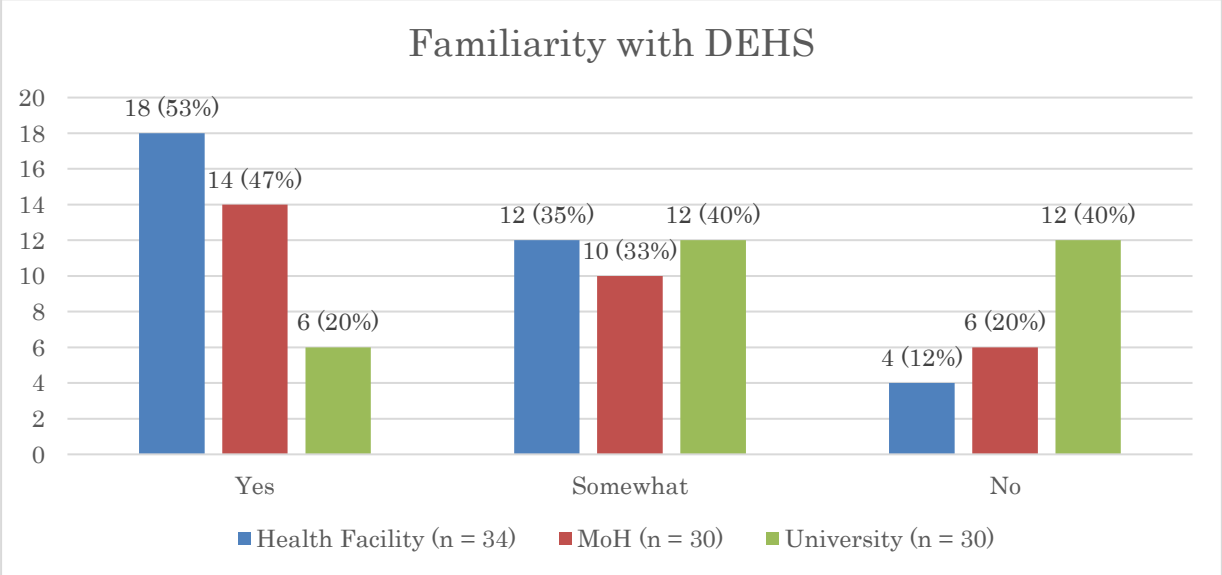


Chart 15: Familiarity with DEHS

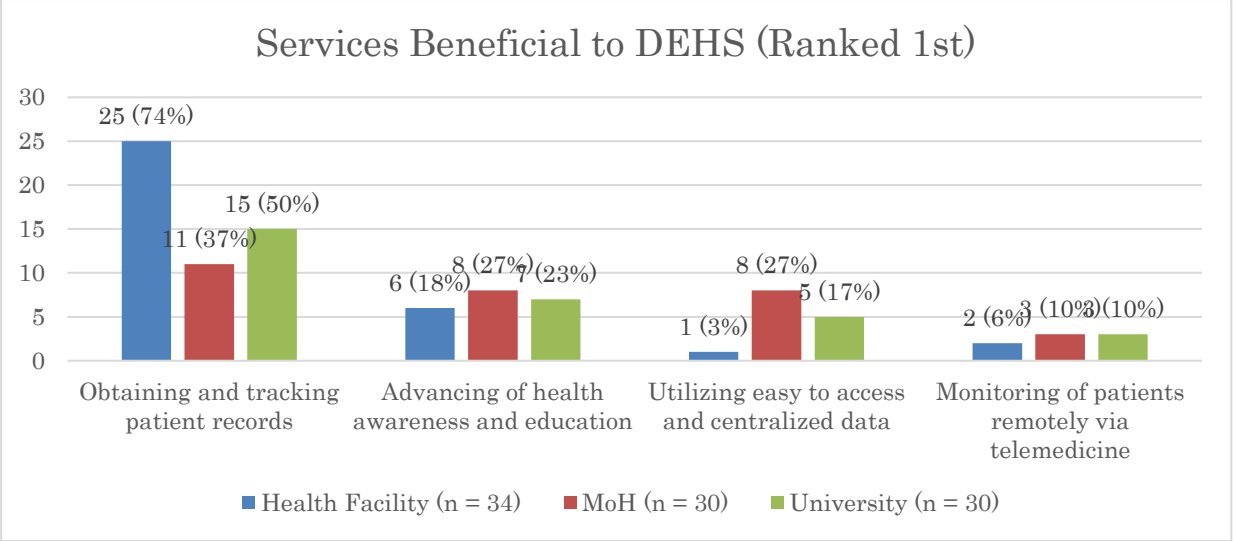


Chart 16: Services Beneficial to DEHS (Ranked 1st)

- **Availability and Utilization of Digital Health Services and IoT Devices**
  - **Health Facilities:** Within the health facility, the majority (55.9%) of respondents does not use Digitally Enabled Health Services (DHES) devices or IoT devices. Among the respondents who use such devices (n = 15), 40% uses glucose monitoring, 20% use pulse and SPo2 monitoring, and only 13% uses smartwatches like Apple or Fitbit. This indicates that IoT wearables such as smartwatches are relatively new and rare within the healthcare providers for personal use.

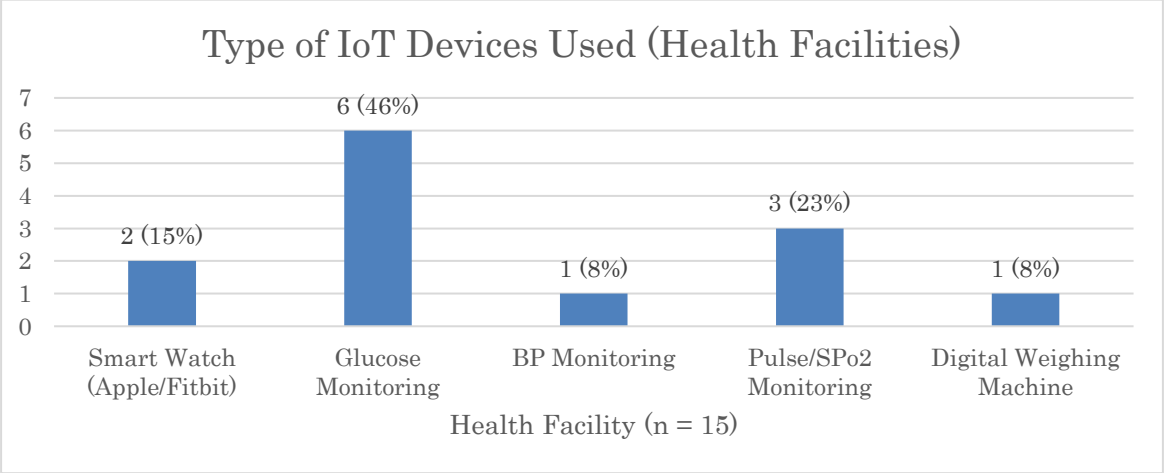


Chart 17: Type of IoT Devices Used (Health Facilities)

The respondents who uses these devices primarily utilize them to monitor health conditions (40%). Moreover, almost all (93.3%) respondents agree or strongly agree that the use of these devices improve their health, which indicates a positive indication of the effectiveness on health improvement mindsets. When it comes to additional features that the respondents want to add in the device, 40% feel that they need for more accurate sensors for health monitoring, suggesting the desire for improved accuracy in

data collection.

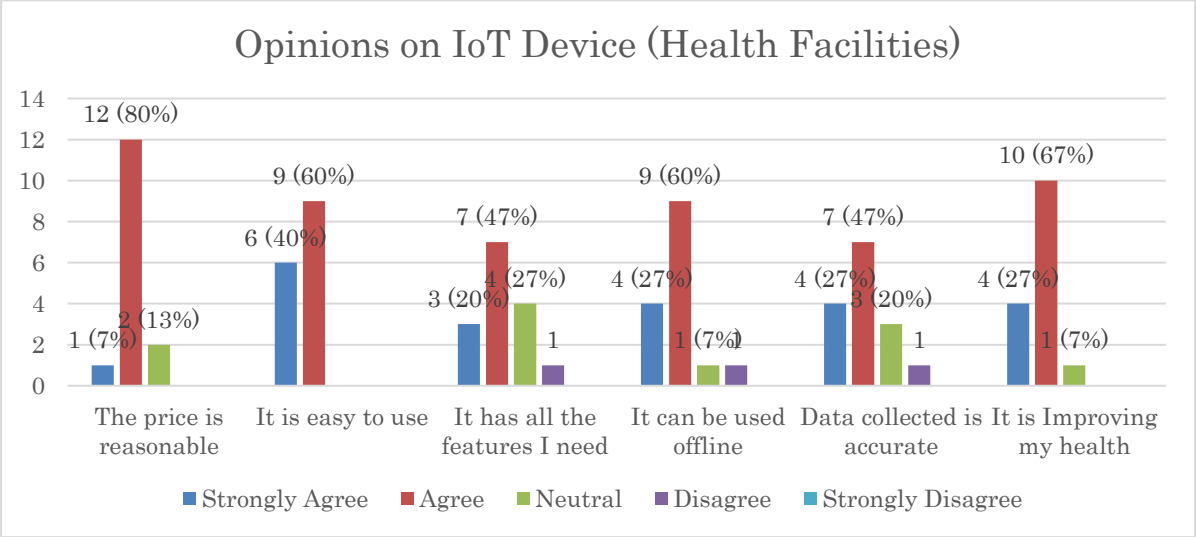


Chart 18: Opinions on IoT Device (Health Facilities)

- **MoH:** Within MoH, the majority (87%) of respondents does not use Digitally Enabled Health Services (DHES) devices or IoT devices. Among the respondents who use such devices (n = 4), all of them were found using Apple Watch. This indicates that IoT wearables such as smartwatches are the preferred choice among the respondents in MoH.
  The respondents who uses these devices primarily utilize them to track physical activity and exercises (100%) and monitor health conditions (50%). When it comes to the improvements of health, majority (50%) agrees that it is improving health, while (25%) remains neutral or disagrees, which indicates the varying perspectives of effectiveness of health improvement using these devices. Additionally, when it comes to additional features that the respondents want to add in the device, 100% expresses that they want the integration with other services, which can be inferred the importance of seamless connectivity with other DEHS.

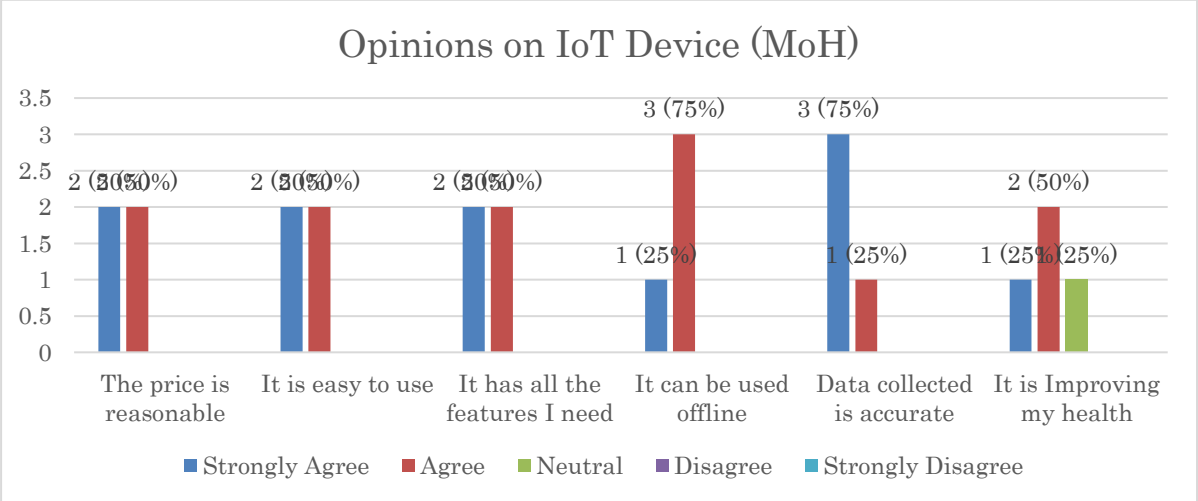


Chart 19: Opinions on IoT Device (MoH)

- **University:** Within the University Institutions, the majority (73.3%) of respondents does not use Digitally Enabled Health Services (DHES) devices or IoT devices. Among the respondents who use such devices (n = 8), all of them were found using smartwatches such as Apple Watch and Fitbit products. This indicates that IoT wearables such as smartwatches are the preferred choice among the respondents.
  The respondents who uses these devices primarily utilize them to track physical activity and exercises (62.5%), monitoring health conditions (62.5%), and managing medication schedules (12.5%), which indicates that the devices is not only used for fitness tracking but also health monitoring and medication management. Interestingly, when it comes to whether the device improves the respondent's health or

not, the responses varied; While the majority (62.5%) of respondents remain neutral, 25% of respondents agrees, and 12.5% strongly agrees that it improves health. This indicates some ambivalence among the majority of respondents on the impacts of device on health improvement. Additionally, when it comes to additional features that the respondents want to add in the device, 75% of respondents suggests the importance of personalized recommendation based on user's data, as well as more accurate sensors for health monitoring.

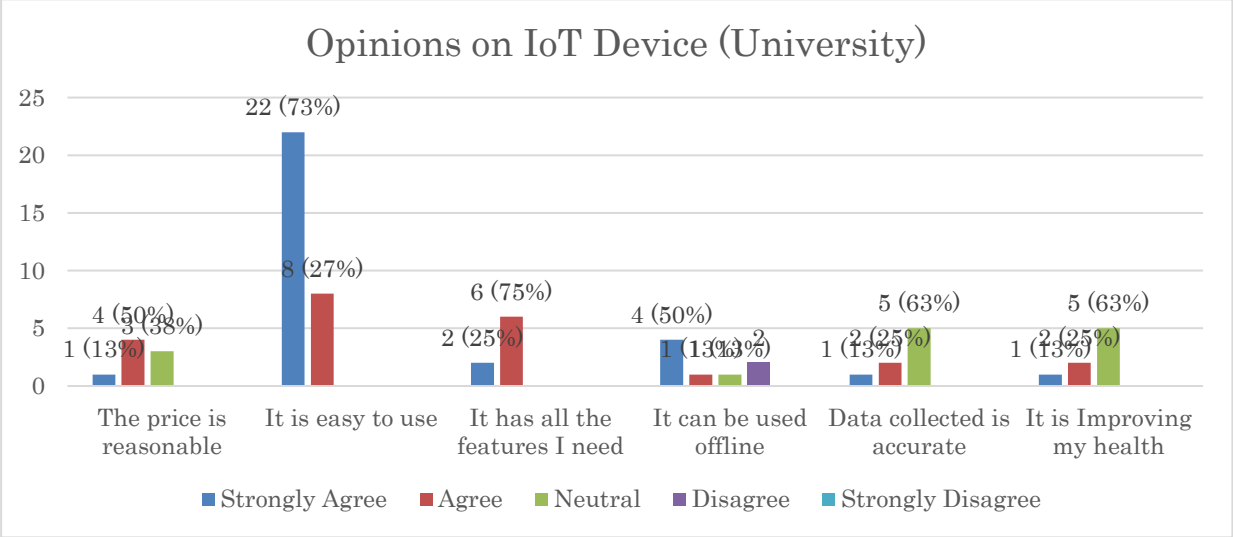


Chart 20: Opinions on IoT Device (University)

- **Comparison between Groups:** When comparing DEHS devices or IoT device across different respondents, there are both similarities and differences; One prevalent similarity is that the majority of respondents across all groups do not use IoT device or health wearables. This may suggest the potential barriers to adoption such as cost. Minimum wage in Bhutan is around 3,750 per month (6,130 JPY or $45.8 USD), while smartwatches such as Apple Watch and Fitbit starting price is way higher than the average minimum wage. This suggests the need for lower-cost options to make the devices more accessible. Another similarity is the primary use of devices across respondent groups, which is health condition monitoring and physical activity tracking. While there is a general agreement amongst healthcare facilities and MoH that these devices improve their health, majority of university respondents expressed neutral sentiments, which may indicate the ambivalence on the impacts on their health. On the other hand, when it comes to differences, priorities for health IoT device development differs across organizations, which highlight the importance of varying priorities and needs for different groups in IoT device creation.

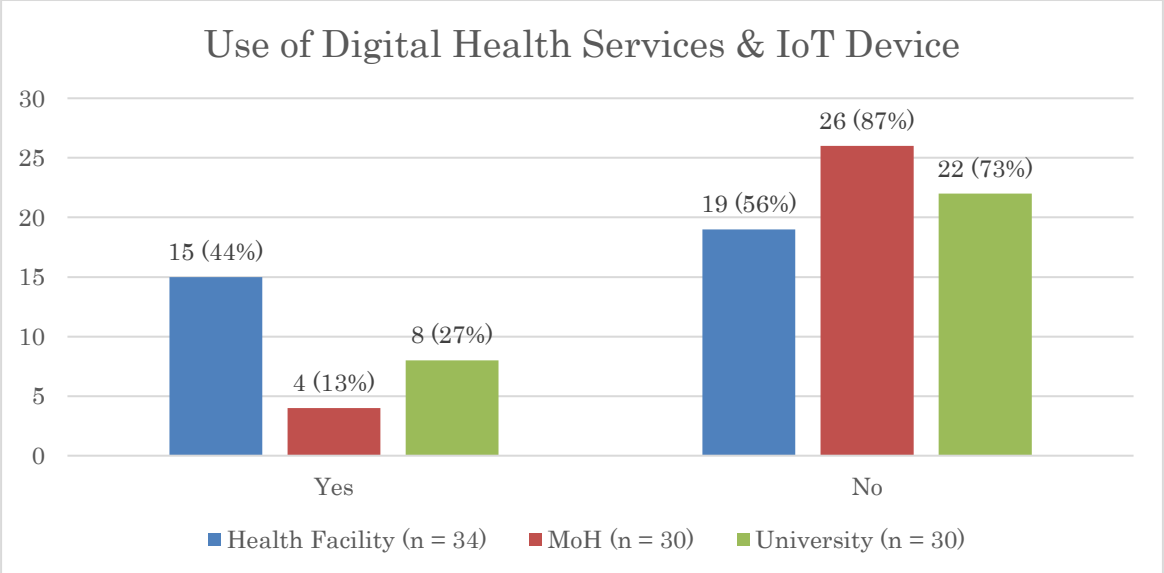


Chart 21: Use of Digital Health Services & IoT Device

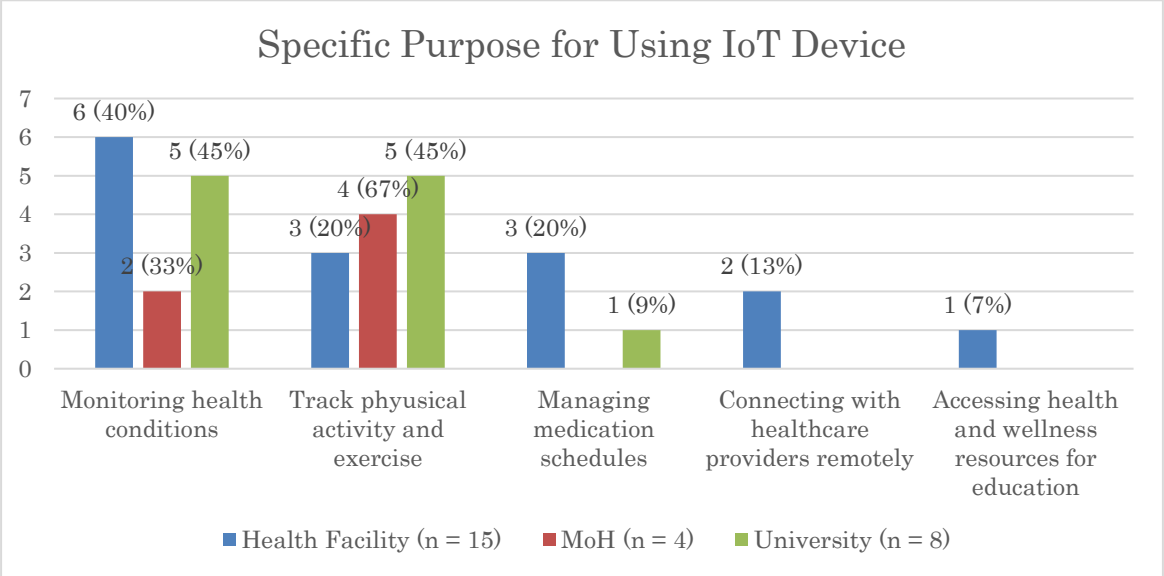


Chart 22: Specific Purpose for Using IoT Device

- **Health Data Sharing for IoT Devices**
  - **Health Facilities:** When it comes to data sharing aspects for respondents who own DHES devices or IoT devices, the majority of respondents (53.3%) express that they are comfortable in sharing data with the government, health facilities, and non-profit research institutions. However, when it comes to private DEHS or companies, opinions vary; While 26.7% expresses that they are comfortable to extremely comfortable, 40% remained neutral and 33% expresses that they are uncomfortable or extremely uncomfortable to share the data with private organizations. This can be inferred that respondents may still have hesitancy and doubts in sharing data with private entities.

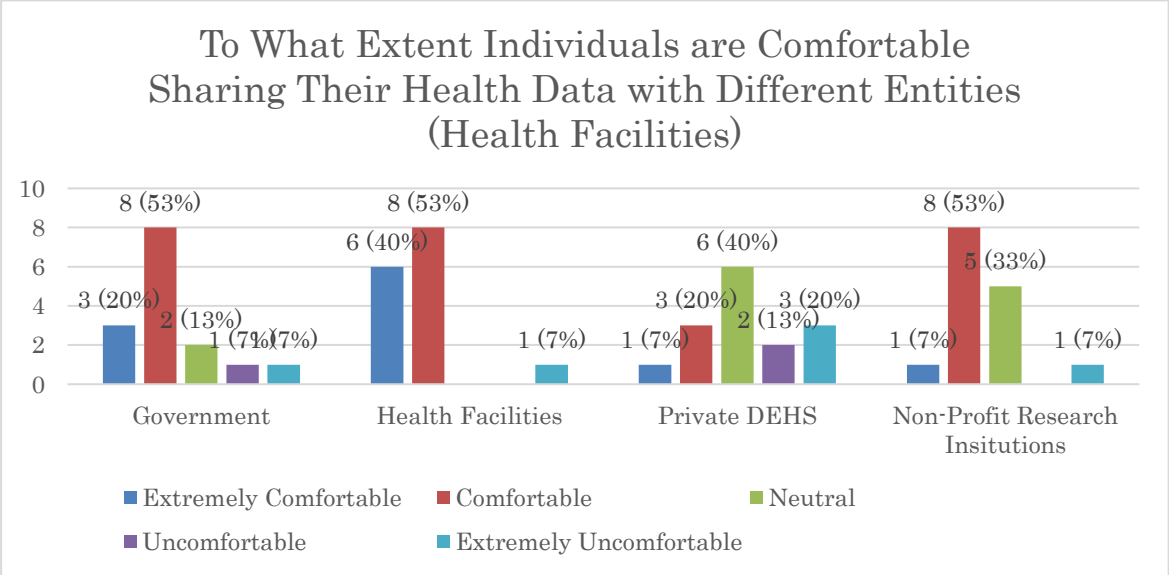


Chart 23: To What Extent Individuals are Comfortable Sharing Their Health Data with Different Entities (Health Facilities)

The respondents also expressed that their decision to share health data largely depends on their ability to control and limit data sharing (46.7%), followed by the data privacy and security policies (33.3%). When it comes to the health data that they are comfortable to share, majority expresses the comfortability in sharing data of health behaviors (i.e. Exercise, Sleep, Nutrition, Lifestyle) (53.3%), Medical History (53.3%), and Medications (60%), and Genetic & Family History Data. However, interestingly, majority of respondents (53.3%) expressed comfortability in sharing their vital signs data—such as blood pressure, heart rate, temperature. One possible inference is that respondents may perceive vital signs as

a more personally identifiable data, which may lead to privacy concerns. In contrast, respondents may view genetic data as more abstract and not directly linked to immediate individual identification, as genetics data requires specific tools and knowledge to access and interpret, which makes it more difficult to immediately identify individuals. This discrepancy may explain the high level of comfortability in sharing the genetic data when compared to vital signs data. This also highlights the importance of the need to raise awareness of sensitivity and identifiability of different types of data, which will enable citizens to know more about data sharing and privacy.

- **MoH:** When it comes to data sharing aspects for MoH respondents, the responses tend to be more skeptical than healthcare providers' responses; The only organization that MoH feels comfortable in sharing data is with health facilities, with 50% of respondents express. In contrast, when it comes to data sharing to the government, non-profit organizations, and private organizations, respondents expressed discomfort; Surprisingly, despite the Ministry's affiliation to government, half of the respondents feel extremely uncomfortable to share data with government, while another half express that they are comfortable. In terms of non-profit organization, 50% expresses extreme discomfort or discomfort, while the other 50% expresses neutral or comfort. However, the most emphasis on discomfort is seen in the private organizations, where over 75% respondents express extreme discomfort. These findings suggests concerns regarding data sharing with external entities. Building trust and addressing the concerns will be essential in data sharing collaborations.

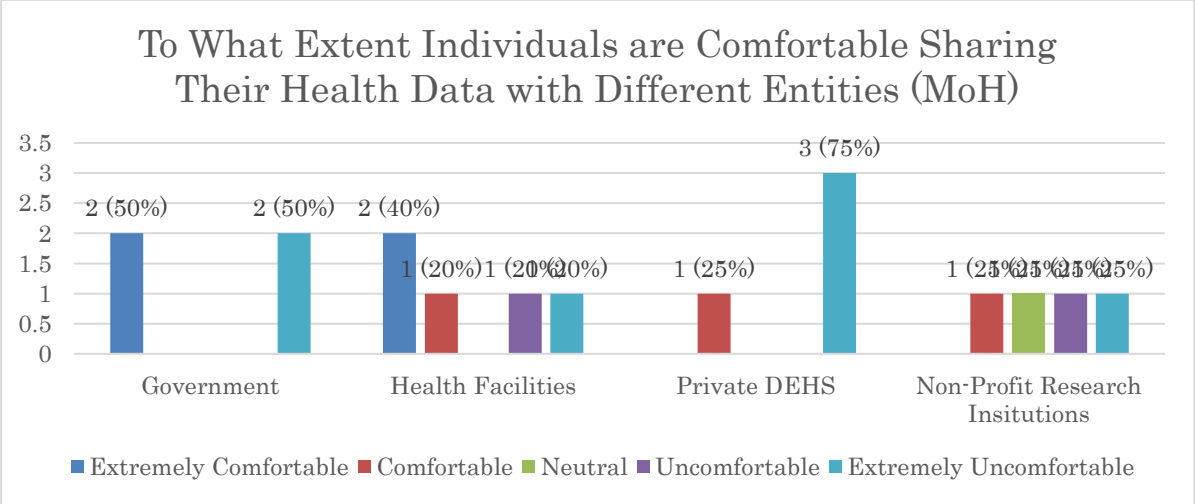


Chart 24: To What Extent Individuals are Comfortable Sharing Their Health Data with Different Entities (MoH)

When it comes to the factors influencing decision to share data, 75% of respondents suggests that trust in health services, data privacy and policies, and ability to control and limit what data can be shared—are the factors. Additionally, when it comes to the health data that the respondents are comfortable to share, majority expresses that they are extremely comfortable to share vital signs (75%) and medical history (50%). For health behavior data, 50% respondents expressed comfortability. However, there is a remarkable discomfort there is a notable discomfort, with 50% expressing extreme discomfort or discomfort, and the remaining 50% express varying levels of comfort. The most pronounced discomfort is the genetics and family history data, with 100% of respondents expressing strong discomfort or discomfort to some extent. These findings highlight the high level of caution and sensitivity towards data privacy within MoH's respondents, which can infer their careful approach in personal health information.

- **University:** When it comes to data sharing aspects for University Institution respondents, the responses are more positive than health facilities and MoH's; The respondents express comfortability in sharing data with government (75%), health facilities (100%), and private organization (75%). However, surprisingly, for research institutions, majority (50%) of respondents remained neutral, but still with significant portion expressed positive comfortable response (37.5%).

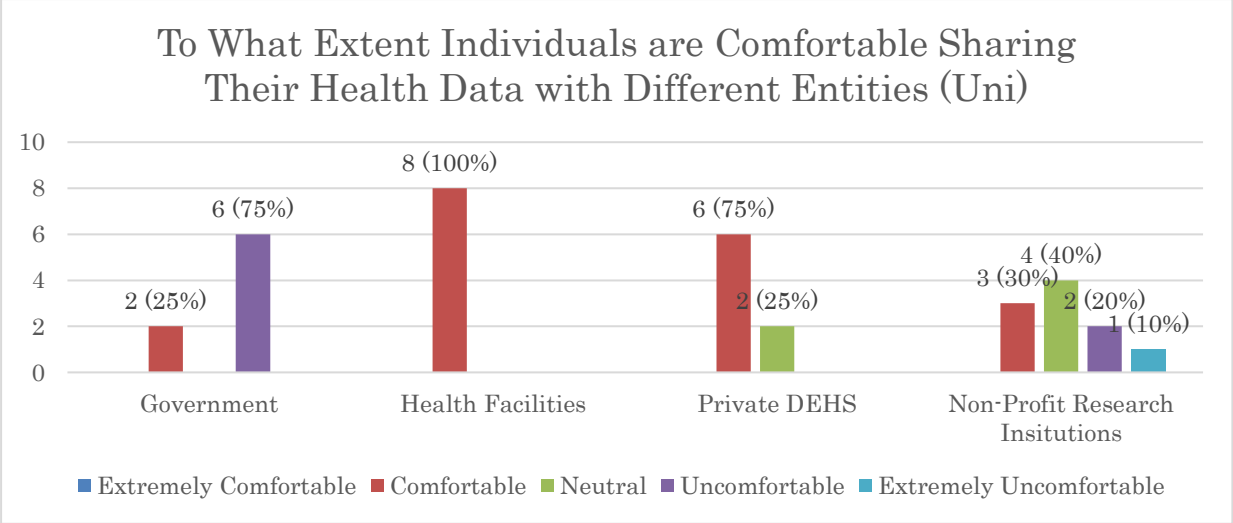


Chart 25: To What Extent Individuals are Comfortable Sharing Their Health Data with Different Entities (Uni)

When it comes to the factors influencing decision to share data, 87.5% of respondents suggests that trust in health services and data privacy and security policies are the main factors. Additionally, when it comes to the health data that the respondents are comfortable to share, majority expresses that they are comfortable to share vital signs (75%), health behavior (75%), and medications (50%). However, respondents remained neutral when it comes to medical history (50%) and genetic & family history data (75%), which may suggest reservations or uncertainty regarding sharing more sensitive data.

- **Comparison between Groups:** When comparing data sharing aspects, all groups express some level of comfort in sharing data with government and health facilities, indicating trust in these entities. However, when it comes to private organizations, opinions vary with some expressing some comfort, neutrality, or discomfort. This may suggest that all groups of respondents may have skepticisms on sharing data with private organizations. Additionally, when it comes to decision on sharing data, all groups expressed the importance of data privacy and security policies, as well as the ability to control which data can be shared. Therefore, it is essential to establish clear communication and transparency in data sharing and privacy policies to create trust among citizens and address their concerns.

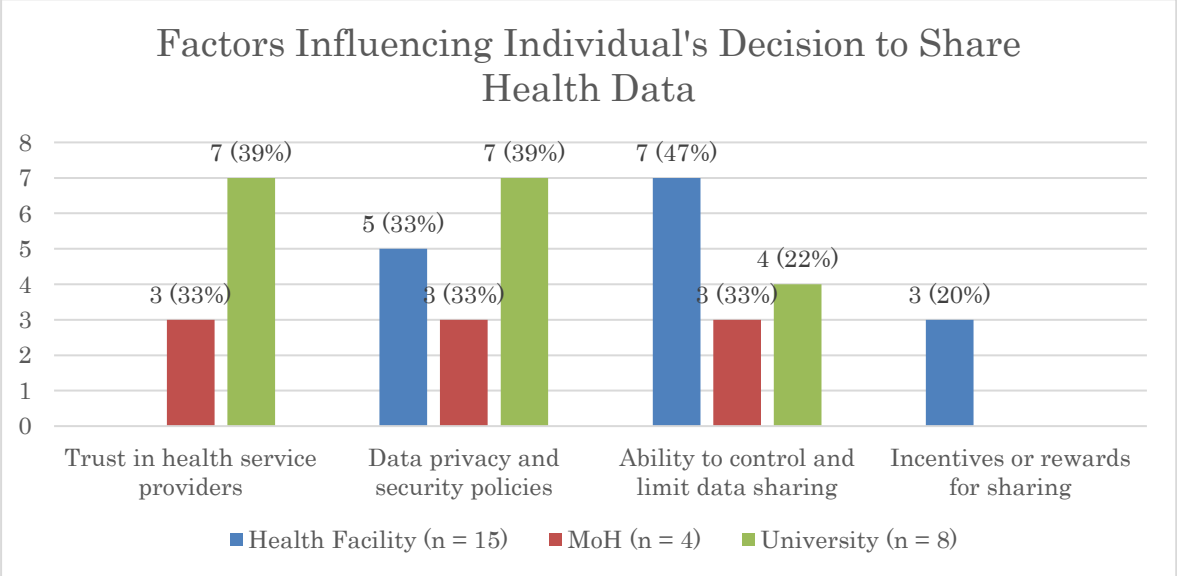


Chart 26: Factors Influencing Individual's Decision to Share Health Data

1.7 Analyze the (1) situation, (2) issues, and (3) possibilities related to health data utilization in Bhutan, reflecting the results of the above activities.

- **(1) Situation Analysis Based on Above Activities:** We have also conducted visits to six different healthcare

facilities of different levels. The purpose of these visits is to find additional insights and compare it to verify the alignment with the results on the above activities. This was done to ensure that the perspective shared by respondents are reflective of the actual on-ground reality. The findings and conclusion are as follows:

- **Wi-Fi Accessibility in Primary Health Centers:** Data transmission speed in Bhutan—specifically in healthcare facilities, was found to generally be stable, with a speed ranging from 5 – 10 Mbps, which aligns with the survey results. However, what was not highlighted in the survey is that the data connections are mostly based on mobile cellular networks. During our visits to some primary health centers, although mobile cellular data is available, it was observed that there is still a lack of dedicated fiber internet and Wi-Fi specifically for the facility. Thus, healthcare providers often have to rely on workarounds such as using limited data from their own SIM cards, sometimes at their own expense when there is a lack of connection or when the internet connection failed. This also aligns with the responses from the survey, indicating that healthcare providers conduct workarounds in such situations. The issue of the limited accessibility in Wi-Fi in primary health centers seems to be a recurring issue, which may impact the utilization of digital healthcare services in the future. Thus, it is important to address the limited accessibility of Wi-Fi to primary health centers. With this in mind, alternatively, government is making plans to enhance the network connectivity of these health facilities concurrent with the roll-out of the ePIS systems.
- **Equipment Maintenance and Sustainability:** Apart from the internet data accessibility, another significant issue observed during the visit, which was not highlighted in the survey, is the equipment accessibility; While larger healthcare facilities such as national hospital or regional hospital may have sufficient budgeting and funding for equipment maintenance and support, this may not be the case for primary healthcare centers; It was observed that many IT equipment were provided to primary healthcare centers, but there is lack of maintenance which can lead to sustainability issues. For instance, a particular primary healthcare center visited lack proper computer hard drive, making it impossible to turn on the computer to input data. In another case, a particular primary healthcare center had Wi-Fi router, but no internet connection, which indicates the issue of the router itself or the improper network configuration. These equipment-related challenges need to be addressed in order to ensure effective and sustainable use of technology in healthcare facilities.
- **Fragmented Use of System:** Although the survey discusses the usage of DHIS2 system as Health Management Information System (HMIS) for data collection and reporting, it seems that in reality, most hospital still do manual writing for patient health records. Many facilities encounter issues where healthcare providers have to manually write information in patient registers (owned by health facility) as well as MCH Health books (owned by citizens). This results in duplication of effort and time-consuming repetitive data entry tasks. On top of that, if a patient does not come with their handbook, it becomes a challenging task to ensure proper follow-up. Moreover, the use of DHIS2 is limited to Primary Health Centers, even though some of the PHCs also did not use the system. When visiting the district hospital, it was observed that they have their own independently managed Google Sheets for tracking patients and reporting to MoH. Yet still, the recording of patient records is still done by writing manually, then later transferred to Google Sheets for reporting purpose only. From the reasons above, it remains unclear which healthcare facilities are following which system, indicating that there are still fragmented usage of system or process. To address these challenges, the rollout of a uniformed centralized system is seen as a promising solution. Thus, as a step towards this goal, the ePIS system has been implemented which started in JDWNRH.
- **Digital Literacy of Healthcare Providers:** In addition to the fragmented use of systems, another significant issue affecting the extensive data collection is the digital literacy of healthcare providers. The survey findings actually align with the reality where less than 20% of healthcare providers, as reported by respondents, lack the necessary skill for data collection and analysis. This non-familiarity with the system was prevalent during the rollout of ePIS system in JDWNRH, where many healthcare assistants may express concerns that it slows down their work. Some healthcare providers may feel that typing data is slower compared to writing by hand, which further slows the adoption of the new system. As a result, there are efforts to gradually introduce the ePIS system to the workers, by entering only around 5 – 10 patients' data per day to the system, while the rest is still done manually. Another prevalent example is observed in a particular primary healthcare center, where health assistant admits to not being familiar with navigating the Papsmear system developed by RCDC for the clinic. In such cases, the health assistants relies on the chief PHC to handle the system. However, when asked their willingness to learn new technologies and / or system, the health assistants expressed their eagerness to acquire the necessary skills and acknowledge the adoption of technology would be

inevitable. They also emphasized on the extensive training and having responsibility of device they use, as it will enable healthcare providers to take accountability when device malfunction or breaks. Based on the on-ground findings above, the significance of training on digital literacy should be underscored. While respondents in the survey may believe that the organization has made sufficient training efforts for the healthcare facilities, in reality, the actual on-ground observations did not reflect that; It is evident that sustained efforts will be required to create digital literacy by training and change management. Particularly, the training should not be a one-time initiative but a periodic one, to continually refresh the understanding of healthcare providers.

- **Patient Data Security Awareness:** The challenges in data security and privacy is a concern highlighted both by survey and on-ground findings, demonstrating the alignment. Despite that the systems require credentials and password to login, still significant amounts of data is being shared outside of secured platforms through applications such as WhatsApp. Additionally, many health facilities and initiatives such as NCD Service with Care and Compassion Initiative (SCCI) utilizes Google Sheets for tracking, which may not be the most secured environment and can potentially exposed patients' personally identifiable information when shared to the wrong person. Thus, the implementation of ePIS system will in hopes to address this issue. Furthermore, apart from implementation of the right systems, it is also important to address proper training and education to provide healthcare providers on security protocols and importance of safeguarding the patients' information. Additionally, with the substantial amount of Bhutanese workforce moving overseas (particularly in Australia), standard protocols for onboarding and offboarding process is required to manage data accessibility for those who leave to eliminate any potential security risks.
- **Affordable Alternatives for IoT Devices:** The survey findings align with the on-ground observation on the prevalence of IoT devices. It is observed that adoption of wearables and smartwatches are not yet widespread which may be due to the high cost associated with this device, which may present as a gap for personal health record collection purposes for digital development. Thus, alternative options shall be explored to provide same functionalities at a lower cost to make these devices more accessible.

- **(2) Feasibility and Issues for Pilot Implementation:** Based on the activities above, various recommended possibilities is highlighted to consider for improvements. The section is divided into two parts: Feasibility which discusses the positive aspects that can be leveraged for the pilot, and Gaps of Improvement, which discusses the areas that will require further support and attention for successful pilot implementation:
  - **Feasibility: Collection of Data in Rural Areas:** Collection of data from rural areas—specifically within the primary healthcare centers appears to be feasible for the pilot implementation. This is due to the fact that the accessibility of cellular data connectivity and the 4G network coverage is widely prevalent all across 20 Dzongkhags. While activities such as transferring larger files and video conferencing calls may experience delays and require higher speed and internet bandwidth, basic personal health records collection will have sufficient amount of internet speed for the purpose of pilot implementation.
  - **Feasibility: Adoption of Digital Health Platform:** Although Digital Health Enabled Services and IoT Wearables is not yet widely available in Bhutan, there are still high possibilities for citizens to adopt the digital health platform due to the high rate of smartphone penetration, cellular data, and prevalence of social media. It has been observed that the citizens have basic mobile skills such as navigation and typing from commonly used applications such as WhatsApp. However, it is also essential to note the ease of use for citizens with low literacy and to have user-friendly user interfaces with supported Dzongkha language as well as comprehensible icons.
  - **Gaps of Improvements: Support on Equipment:** Strong support will be required in terms of equipment to ensure adequate supply and maintenance for implementing seamless pilot; This involves providing sufficient equipment to handle data collection process and ensuring there is sufficient budget for ongoing maintenance support to create sustainability. Particularly, the maintenance of Wi-Fi routers in the selected pilot areas will be crucial. Additionally, equipment supply support will be needed; For instance, tablets used by healthcare providers to input data is essential, and assigning registered ownership of these tablets is recommended to facilitate the accountability for equipment maintenance. Not only that, providing high-quality and standardized blood pressure devices to measure accurate blood pressure data, as well as the IoT wearables such as smartwatches for citizens to gather behavior data. These specific equipments are currently lacking and the availability will also be variables to determine the success of the pilot implementation as it could impact the expected collection of personal health records that health facilities will need to achieve in the pilot phase.
  - **Gaps of Improvements: Address Digital Literacy Gaps for Healthcare Providers:** Currently

majority of healthcare facilities still rely on manual recording of patient health records. While some of the larger hospitals have started to adopt digital records, the pace of adoption may be slow to the healthcare providers' unfamiliarity with theses systems, in turn, slowing down their work more. It is essential to familiarize healthcare providers with the basic functionalities of the pilot application to encourage faster adoption. Additionally, basic technological knowledge such as troubleshooting skills will have to be provided to address any issues that may arise. Emphasis on training the data collection process is essential not only for efficient data collection, but also for data security—which includes knowledge about data sharing and compliance with patient data sensitivity in mind. Additionally standardized training methods are necessary during the pilot implementation to ensure uniformity in data collection practices. Specifically, this includes the trainings on data collection methods, duration required for collection, and other measures to increase productivity without causing slowdowns in their work.

- **Gaps of Improvements: Establish Clear Communication Channels:** Regular communication is required to effectively address the concerns faced by healthcare providers during pilot implementation. On-ground support and communication channels are needed and regular feedback sessions to collect feedback from healthcare providers, which will allow continuous improvements of system's ease of use and identifying gaps that will require adjustments and improvements for the long-term implementation plan in the future.

- **(3) Further Possibilities Related to Health Data Utilization through Biobank:** One of the main possibility to further utilize health data is the concept of Biobank. Currently, Bhutan has a very rich system of household bank data. When combined with the ePIS (medical bank) and health bank, this presents an exciting opportunity to create a comprehensive biobank. Bhutan could become the first country to integrate biobank data with other extensive dynamic data sources. This integration is seen as a potentially valuable asset for Bhutan especially for industrial promotion. To verify the feasibility of biobank establishment, two key activities have been done: (1) Verifying the current Biobank capabilities within Bhutan (2) Investigating new possible industrial promotion scenario.
  - **(1) Verifying the current Biobank Capabilities within Bhutan:** We have conducted the status of equipment and human resource capabilities. The results are omitted:

  - **(2) Investigating New Possible Industrial Promotion:**
    - We have explored especially Denmark's approach to industrial promotion and data utilization through Biobanks. The Danish National Biobank, known to one of the world's largest biobanks, includes 27.4 million biological samples from 5.9 million citizens, with additional of million new samples each year. Organizations can access analyses of the biobank samples, and will have to follow a clear approval workflow, which is reviewed by the Danish Health Research Ethics Committee. The data is made available in a pseudonymized forms to Danish entities, and results of analyses is made available for international data utilizers. This utilization has significantly contributed to Denmark's strong growth in Health Tech. Denmark now is known to be one of the world's most digitalized countries in the world, and fastest-growing EU Nations in BioTech Investments second to the Netherlands.
    - For instance, Denmark has fostered communities like Health Tech Hub Copenhagen to support he leading health tech organizations and startups. An example of this is one of the largest pharmaceutical companies—Novo Nordisk Foundation, which supports establishing the BioInnovation Institute. This institute accommodates up to 500 researchers which attracts international talents and assist early-stages of Health Tech startups. This illustrates how Denmark utilizes its extensive data to foster growth and innovation in various industries, demonstrating the potential of integration of biobank data for technological advancements. We believe in order for Bhutan Bio Bank to be successfully develop new industries, since Bhutan is the new player in the Biobank field, it is vital to differentiate the type of data Bhutan can provide in first initial years. We also looked at China, Korea, Australia, Denmark, UK, USA if they connect with health bank and household bank. As summary, we observed, only few countries have managed to integrate biobank data with dynamic household data for patient treatment or for other secondary purpose. Considering other centuries biobank, if Bhutan can utilized the data combined with health bank and household bank data will precisely be the differentiator. Thus, making sure to know what target to select would be important to find out the quick wins.
    - If successfully implemented in Bhutan, this integration could foster growth and innovation in

both direct and indirect industries, following the example set by the field leader like Denmark. Direct industries that may benefit include pharmaceutical companies who could utilize the data for new drug discoveries. Indirect industries such as agriculture, tourism, etc. might also find new opportunities for growth using these integrated data. This demonstrates how data utilization can have wide-range impacts across multiple sectors. The industrial promotion are for instance:

- **Primary Biobank Utilization:** Personalized healthcare can be one of the main benefits through genomic analysis. Through genomic analysis, healthcare providers can gain deeper understanding to individual's genetic profiles. Combining with other medical information , it will allow for more informed decisions and customized treatments. This data-driven approach paves the way for more personalized care and enhance healthcare delivery.
- **Secondary Biobank Utilization:** Another significant application of the biobank can be in the field of new drug discover. For instance, there is currently lack of study and information on drugs targeting early-stage pregnant women who has hypertension. Extensive collection and analysis of data might uncover patterns that could lead to new drug discoveries. This research could contribute to direct industrial promotion for pharmaceutical companies.

- **(3) Japan Visit Program:**
  - In addition to the above discussions, Bhutanese delegation visited Japan. With the aim of deepening the overall understanding of genome data utilization in Japan, the visit focused on policy-level inputs from the Ministry of Health, Labor and Welfare, as well as on visits to biobanks, both population-based and disease-based such as Tohoku University Tohoku Medical Megabank Organization and the National Cancer Center. In Japan, the legal system to utilize data while protecting privacy, including pseudonymization, and the sites of biobank utilization were seen, and the concept of a biobank unique to Bhutan by utilizing the NDI is developed. The detailed program is shown in Appendix "A-8. Japan Visit Report."

2-2. Activities related to Outcome 2

Outcome 2. [Plan] Bhutan's Digital Health Strategy and a concrete health data linkage system development plan (Detailed System Design) are formulated.

2.1 Draft the Public Private Partnership (PPP) models for the healthcare sector by defining competitive and cooperative areas in the digital architecture.

- The initial hypothesis was as follows. Currently, the initial hypothesis remains unchanged. There are "Cooperative areas" and "Competitive areas."
- 1. Application Layer
- 1-1. Data Primary Use
  - Conceptualization: Mainly cooperative areas Determine focus areas for the use of digital technology and consider the balance between areas in which private companies should be encouraged to participate and areas in which national healthcare policy should intervene, such as primary health care for the poor.
  - Implementation: Mainly competitive area. Compete through business contests, etc.
  - Marketing: Mainly cooperative area. While government-led national promotions should be conducted for overseas markets, domestic promotions should be competitive areas, especially in areas where private companies should be encouraged to participate.
- 1-2. Data Secondary Use
  - Mainly competitive area.
  - New services and other new industries may be created by utilizing the collected data.
  - Assuming the possibility of creating stakeholders involved in platform operation, as in the case of X-Road in Estonia.
  - Data utilization in areas other than healthcare is also assumed to be a competitive area.
- 2. Platform layer and Data layer
  - Mainly cooperative area.
  - Platforms for integrating health data and health data should be the common property of the nation.
- 3. Device layer
  - Mainly competitive layer.

- n the case of foreign investment in the area, it is necessary to secure employment in the country through rules such as half of the capital must be Bhutanese, as in Thailand, or the majority of employees should be Bhutanese.
- Because there are various standards for wearable devices and different ways of capturing data, specifications for linking data are defined by the government initiative.

- While the above is the principle, there may be circumstances unique to Bhutan. In Bhutan, healthcare service should assured by the government. Therefore, for example, there is an idea that the Bhutanese government buys up health applications developed by IT vendors, integrates them into "Bhutan App" provided by the Bhutanese government, and the government provides them for citizens. Since the number of IT vendors in Bhutan is limited, one idea is to form joint ventures among IT vendors and coordinate by leveraging their strengths, rather than through complete competition. The development of devices could also be government-led and developed in collaboration with local universities, rather than purely private sector competition.

2.2 Draft regulations and guidelines for utilizing health data, including sandbox system, reflecting future technical trends.

- This activity would take place in the technical cooperation phase.

2.3 Analyze the linkage between health data and GNH/Well-being indicator monitoring.

- The relationship between health data and GNH/Well-being indicators was examined, especially in the task related to the 2.6 eHealth Strategy Update. In addition to the study by the project team, the team exchanged opinions with the Centre for Bhutan Studies (CBS), which conducts research related to GNH.
- As described in detail in section 2.7, the project specifically assumes hypertension as the target disease and designs the following four use cases.
  - **Shifting to Prevention through Community Health Guidance:** Rather than seeking medical help after problems arise, preventative measures will be advocated which will be led by the community health workers. By obtaining consistent personal health record data within the primary care settings, community health guidance can examine the extensive data to guide citizens in preventative measures.
  - **Building Social Health through Online Communities:** Enabling citizens to share their health goals and progress in the online social community will foster motivation and encourage healthy behavior from the citizens. The social platform can lead to lifestyle changes that are particularly beneficial for treating hypertension, the targeted disease. It has been proven that lifestyle adjustments can address the root cause of hypertension effectively.
  - **Bridging Data Gaps in Medical Triage through Data Integration:** An integrated data platform can minimize the redundancy in health check-ups which will conserve healthcare resources and enhancing efficiency in medical care. This medical triage through centralized platform can utilize the accurate and consistent data collection, which will enable more precise care.
  - **Improving Healthcare Access through Telemedicine:** Given Bhutan's mountainous region that can create geographical constrains in accessing medical care, telemedicine will offer a practical solution. This approach will save citizens both time and travel costs, as well as allow healthcare providers to efficiently manage outpatient visits, thereby reducing the resource required for in-person hospital visitations.

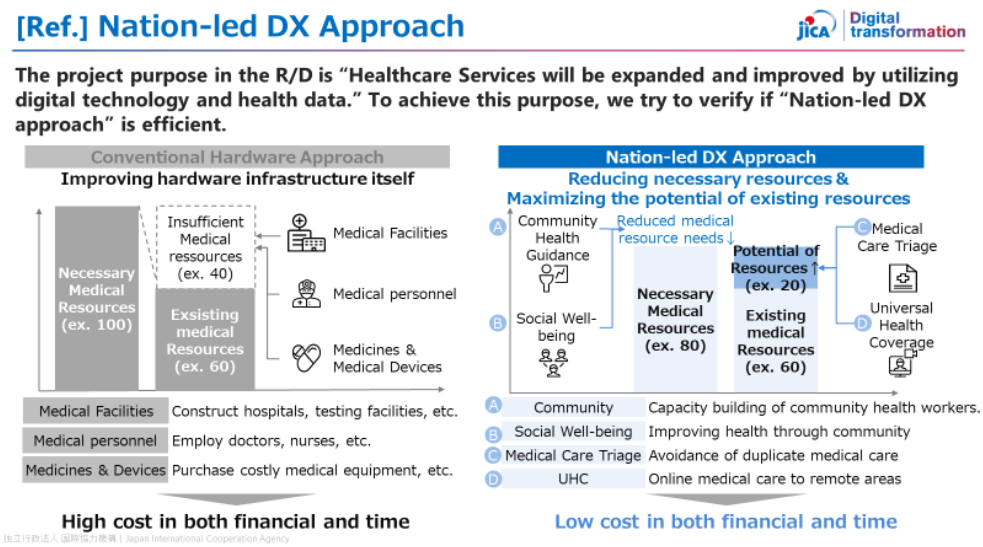


Figure 20: Nation-led DX Approach

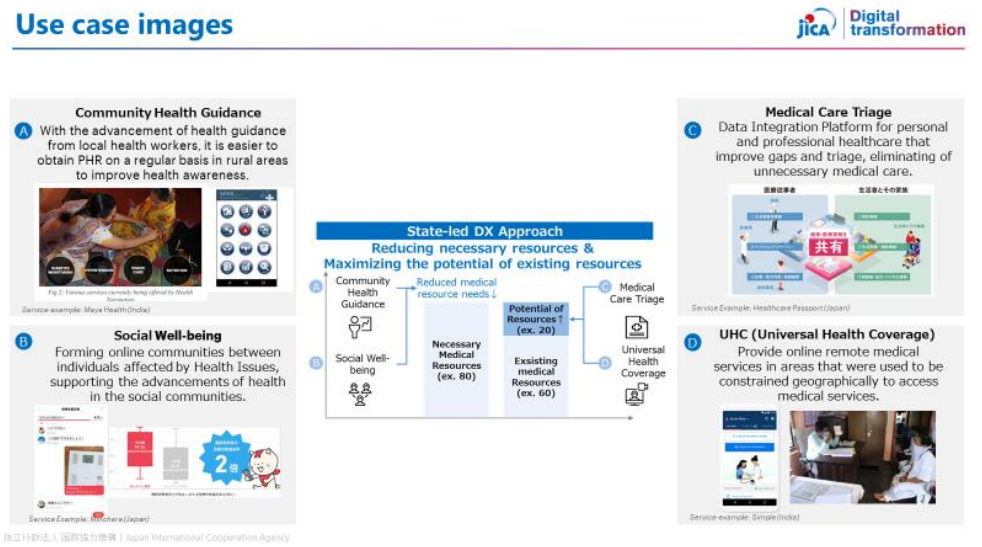


Figure 21: Use case Images

- The first notable use case is "social health through online community building". When we think of health, we usually think only of physical health, but as defined by WHO, there are three concepts of health: physical health, mental health, and social health. If we can work toward health by encouraging each other through the digital technology of creating online communities, we will not only be physically healthier, but we will also feel less mentally alone and more socially connected. This approach to health in a broad sense seems to have been easily accepted by the Bhutanese side, which has GNH. As shown in the chart below, GNH consists of nine domains, and "Health" includes not only physical health but also "Mental Health." Phycological Wellbeing" can also be seen as a type of health in the broadest sense, and there are questions related to social health in "Community Vitality". Therefore, the GNH/Wellbeing approach is a good match for this use case enabled by digital technology.

Figure 22: GNH overview

- In addition, use cases such as collaboration with community health workers, medical triage, and online medical care will allow Bhutanese to access medical and health services in a more universal way. For example, online medical care is useful for people who face hurdles in going to the hospital because of the distance to the hospital. If the situation is not serious, the increased collaboration with community health workers may allow people to receive adequate care without going to the hospital. If medical triage is advanced and hospital crowding is reduced, this would be beneficial for those who have felt hurdles to going to the hospital because they think they cannot tolerate long waiting times.
- The following questions were asked in the GNH Survey.
    - 62. On the last occasion you or your family visited a health care center within the past 12 months, how long did you have to wait before receiving the health care service?
    - 63. How long would it usually take you to reach to the nearest health care center by usual mode of transport?
    - 64. On the last occasion you needed to see doctor or health care provider, to what extend did each of the following factors make it difficult for you to do so?
    - 96. How often do you meet socially with friends, relatives or work colleagues?
    - 97. How much do you trust your neighbors?
- The GNH survey results are scored and used for policy evaluation. On the other hand, its frequency is about once every five years. Therefore, it is difficult to utilize the results for policy evaluation in a shorter span of time. On the other hand, in the digital age, digital companies, for example, obtain user access rates to their apps on a daily basis at the shortest possible time, and use this information to improve their services. In the world of policy evaluation, the importance of evaluating policies every few years or on an annual basis is not denied, but the importance of acquiring data at a higher frequency and dynamically reviewing policies is beginning to be discussed. The former can be called static EBPM and the latter dynamic EBPM.

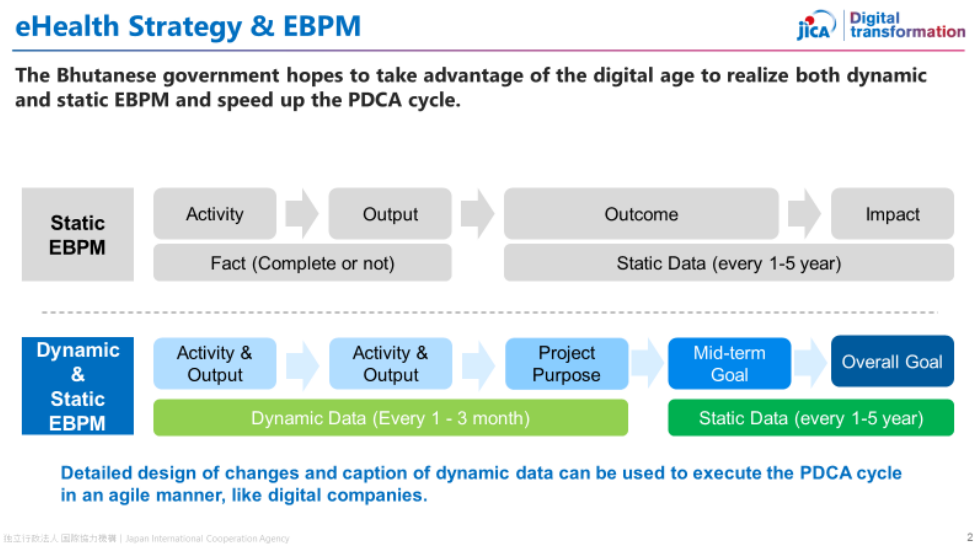


Figure 23: Dynamic EBPM

- The project team is currently considering the possibility of applying the concept of dynamic EBPM to the project. For example, as shown in the figure below, a questionnaire similar to the GNH survey questions will be sent via push function once a quarter through an App produced by the project. We believe that this will allow us to identify the impact of this project on GNH/Well-being aspects in a dynamic manner.

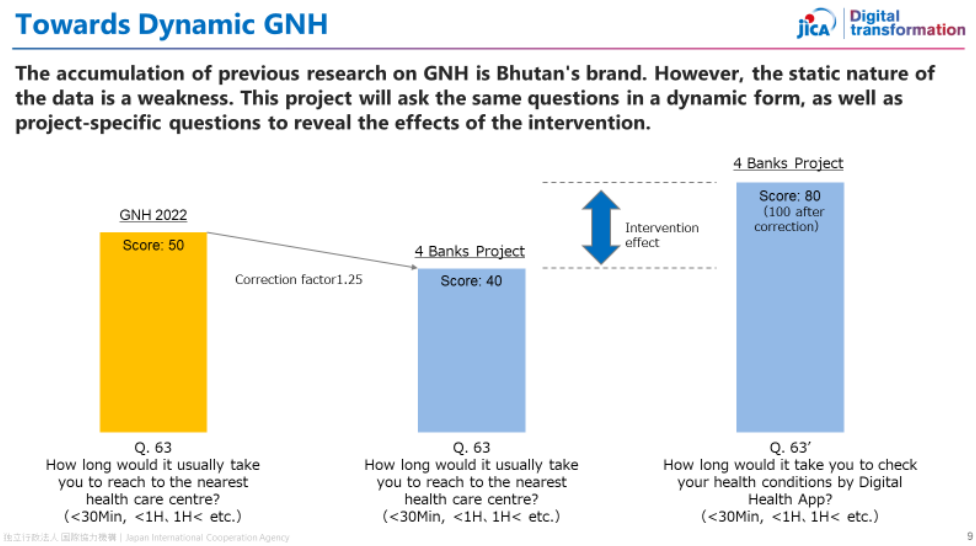


Figure 24: Idea of Dynamic EBPM (GNH)

2.4 Analyze the values in the economy, society, and environment along with promoting digital health.

- This task was also discussed primarily in the 2.6 eHealth Strategy Update.
- The Bhutanese side expects this project not only to improve the health of the Bhutanese people, but also to promote industry through the use of health data. Therefore, a rough scenario has been developed for how this project could have an impact on industrial development. Specifically, as shown in the figure below, the idea is that as the public realizes the value of providing data, they will provide more data, and as a result, industries that utilize the data will grow.

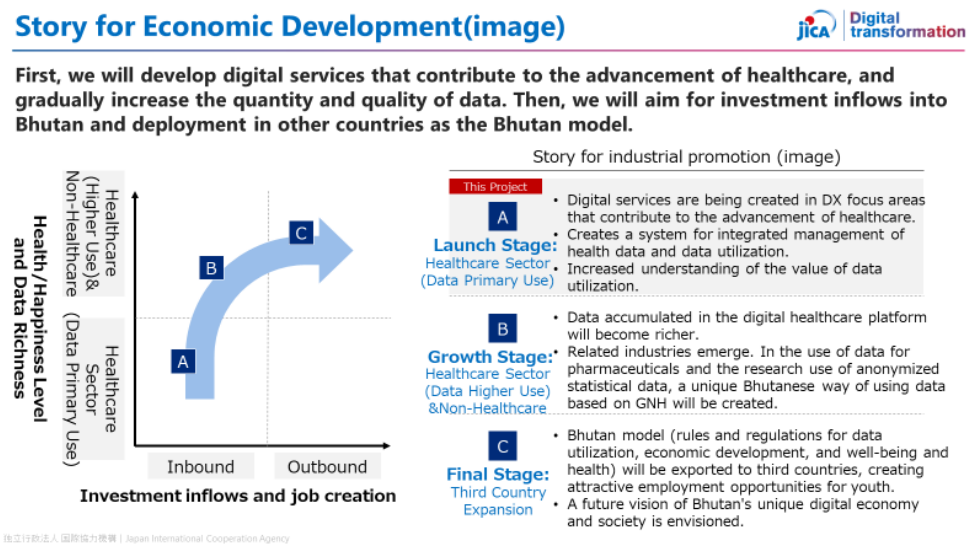


Figure 25: Story for Economic Development

- The pharmaceutical industry, which utilizes data from biobank, is a particularly obvious example of an industry that could be fostered through the utilization of data. In addition, depending on the degree of difficulty of data acquisition and the type of data that can be acquired (anonymous, pseudonymous, etc.), industries such as Wellness Tourism can be expected to be created, as the figure below shows.

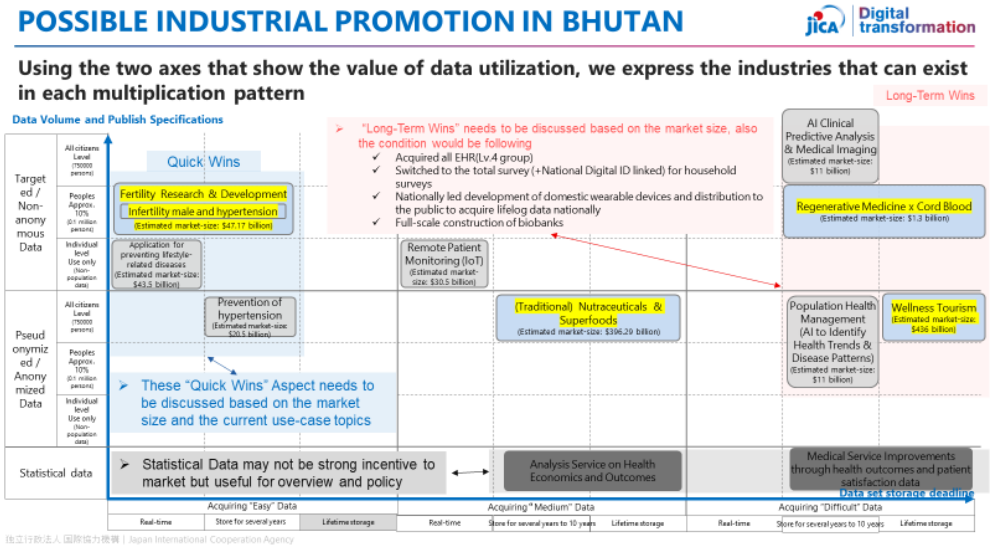


Figure 26: Possible Data Use for Industrial Promotion

- As described in Appendix "A-2. Inputs for eHealth Strategy Update (as of August 2023)," the wellbeing industry could also be attracted if it is combined with the dynamic monitoring of GNH/Wellbeing indicators mentioned above. What digital companies such as Wellbeing Tech are looking for is a test bed for developing their new services. Such a test bed would require a government and public willing to participate in pilot activities and provide data. In this regard, Bhutan not only has the GNH Survey, which has already accumulated Wellbeing-related data, but also a government that is willing to attract companies by providing them with data, and a population that has formed a relationship of trust with the government. Thus, it would be a win strategy for Bhutan to establish an environment in Bhutan as a test bed for Wellbeing Tech.
- The KGI for industrial promotion based on such a scenario could be measured in terms of the number of jobs in the digital economy or the share of the digital economy in GDP, as indicated by Bhutan's National KGI (Draft). However, as a preliminary step toward such KGIs, it is suggested that the number of data sets that the government has made public, the number of citizens who agree to secondary use of their data, and other indicators that show that the Bhutanese government and citizens are willing to provide data. Based on this

concept, one of the OVIs in the PDM is the percentage of citizens who agree to the secondary use of the data.

2.5 Establish and operate a coordination entity among main stakeholders related to the collection and utilization of data.

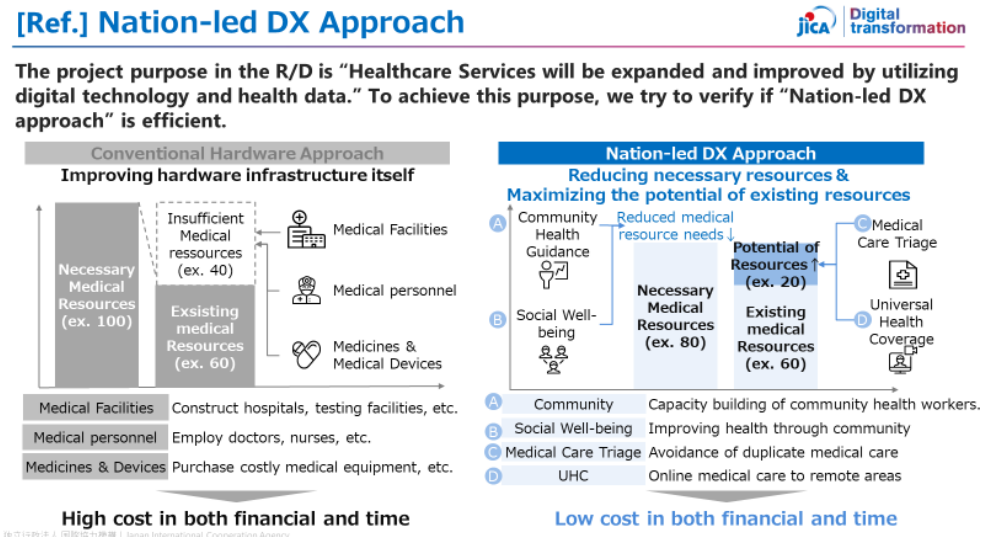
- Following the Activity, "**1.2 Analyze the situation of Bhutan on laws and regulations regarding data utilization through the benchmark to other countries**." for Bhutan's Digital Health Platform based on the modelled countries, coordination entity and platform ownership has been suggested to realize the collection and utilization of data.
- It has been concluded that maintaining the platform under the sole ownership of government would be the most appropriate solution, as the current practice follows this approach. By maintaining the platform under sole ownership, the legal subcommittee believes that this will also foster trust among citizens. Exploring the alternative platform ownership structures, including the potential NPO establishment, can be considered once the platform implementation has been put into place. Figure below shows the concept overview of platform owners and the functions involved within the data utilization coordinating council.
- Within the suggested high-level framework of Data Utilization Coordinating Council, policy-makers shall to establish rules for data utilization. This will include aspects such as data governance framework, data compliance, security compliance, secondary usage promotion, etc. Following this, the Data Utilization Coordinating Council with government and non-government agencies such as GovTech, MoH, NSB, and Technical vendors who develop the platform, will maintain and operate to align with the data utilization policies. Once alignment is in place, data promotion will be possible; Third-party data users such as pharmaceutical companies, researchers, and other companies can then request for data utilization. This request shall be made under the governance of the Data Utilization Coordinating Committee who will ensure compliance with the Bhutan Government's regulation on data management.

2.6 Develop a digital health strategy (vision, roadmap, and action plan) reflecting the situation analyses conducted in Output 1 and the results of the above considerations.

- Following "1.1 Review government strategies and policies on healthcare and medical sectors and data utilization," the following inputs for updating the National eHealth Strategy were identified, in particular through the eHealth Strategy Workshop.
- First, we discussed whether "digital health strategy" means "National eHealth Strategy and Action Plan" or not. In fact, " National eHealth Strategy and Action Plan " does not include the perspective of industry promotion. In this regard, there was an opinion that "National eHealth Strategy and Action Plan" is a document that describes a strategy to improve the health of the people mainly through the use of digital technology, and that it would not be appropriate to include the perspective of industrial promotion. However, the "National eHealth Strategy" is now in the process of revision, and fostering the digital health industry will lead to the improvement of people's health. Thus, a common understanding was cultivated with the Bhutanese side to getting the inputs from this project for the update of the "National eHealth Strategy and Action Plan".
- The next task was to define the "Overall Goal" of the project in the words of the Bhutanese stakeholders themselves. Of course, the Overall Goal was stipulated in the RD from the beginning, but its content was fuzzy. Therefore, the Bhutanese side defined the goals they wanted to achieve through this project in their own words, which were "Self-sufficient healthcare" and "Building a data economy. "Self-sufficient healthcare" implies that the Bhutanese government's healthcare budget is sustainable and that the Bhutanese people are proactive about their own health. "Building a data economy" implies that the government and the people of Bhutan will create new industries by providing data to the private sector. This warding was discussed at the second JCC meeting, and it is necessary to continue to discuss the topic. On the other hand, the importance of the meaning of the words "self-sufficient healthcare" and "building a data economy" was confirmed.
- Other discussions included how to realize the Project Purpose and what path of change to take to achieve the ultimate goal. The details are described in Appendix "A-2. Inputs for eHealth Strategy Update (as of August 2023)".
- Importantly, both parties agreed that the effectiveness of the "Nation-led DX Approach" should be examined in order to realize Project Purpose. The "Nation-led DX Approach" will be briefly described. Traditionally, in developing countries where medical resources such as hospitals and doctors are in short supply, hard approaches such as building hospitals and training doctors have been used to overcome the challenges. Such approaches are costly in terms of both time and money. On the other hand, we believe that digital technology can balance the supply and demand of medical resources with less cost in terms of both time and money by reducing the total amount of medical resources needed, as well as by drawing out the potential of existing medical resources.

For example, if citizens focus on prevention through Apps, the need for medical resources, such as doctors and hospitals, will decrease. In addition, online medical services can be used to provide medical services to those who do not have a hospital nearby. As citizens become more aware of the value of digital health and more willing to provide data through the "Nation-led DX Approach," services utilizing the data will be created, and the benefits will be passed on to the citizens. This virtuous cycle will ultimately contribute to the realization of "self-sufficient healthcare" and "building a data economy.

- In order to verify whether such changes are actually taking place, the OVIs of this project were also established. Please refer to "1-2 Project Design" for details.



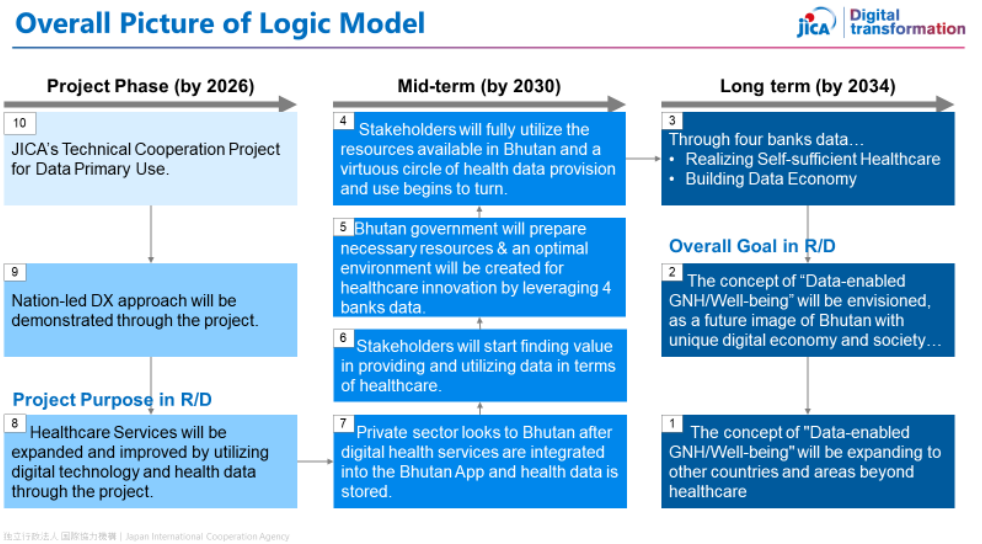


Figure 27: Overall Logic Model

2.7 Define system requirements of digital health platform based on the digital health strategy (ex. data models of 4 Banks, data exchange function including the connection with the national ID. standard rules of API).

- In defining the system requirements a technical analysis of the existing system owned by the Bhutanese government was conducted as well as an analysis of "As-Is and To-be" was conducted in parallel. Defining "As-Is and To-be" was priority as it also leads to defining system requirements to identify the functions and performance that is expected.
- In this regard, what we would like to demonstrate through this project is the "Nation-led DX Approach" as described in 2.6. Through this approach, we are looking to provide the necessary healthcare resources by having time and cost efficiency, as opposed to the investing on infrastructure to build several hospitals. There are four main stakeholders: citizens, healthcare workers, government, and the private sector, each with different goals to be achieved through data and digital technology. The details are shown in the figure below, but to summarize,

citizens want to receive more personalized healthcare services through digital technology, while health workers want to provide efficient services. Governments want to achieve optimal distribution of healthcare budgets through Evidence-based Policy Making, while private companies aim to develop data-driven services.

- In order to set the "As-Is" and "To-Be" we also needed to identify the use-case. In order to sod so, we looked at Non-Communicable Diseases (NCDs) as it is am increasingly prevalent social issue in Bhutan, with the percentage of deaths caused by NCDs rising from 41.7% in 2000 to 72.7% in 2019. The figure below shows the top 10 causes of deaths among the Bhutanese people, with NCDs such as alcohol liver disease, cardiovascular disease, etc. taking up the most. This issue also worsened by the vulnerability of the country's health systems due to the limited medical personnel resource, with only 0.5 physicians per 1000 population in 2019. The lack of access to basic medical care and poor medical technology is another growing concern, which may lead to increased healthcare costs endured by the government, as well as potential long-term impacts on economic and social productivity.

Rank	Diseases
1	Alcohol liver disease
2	Cardiovascular disease
3	Malignant neoplasm
4	Cerebrovascular disease
5	Respiratory / nasal disease
6	Kidney/ reproductive organ disease
7	Digestive diseases
8	Pneumonia
9	Stomach cancer
10	Sepsis

Table 4: Top 10 Causes of Death of Bhutan (2021)

- Hypertension has been chosen to be the main focus, as it is a prevalent NCD within Bhutan, which also is an underlying conditions for other diseases such as diabetes and cardiovascular disease. Additionally, the Bhutan Government already has a strong initiative to control hypertension, such as the Service with Care and Compassion Initiative (SCCI). This initiative represents Bhutan's adaptation of WHO PEN protocols, which highlights the commitment to address the reduction of hypertension cases. Thus, focusing on this particular disease aligns with both the existing healthcare challenges and government priorities within Bhutan.

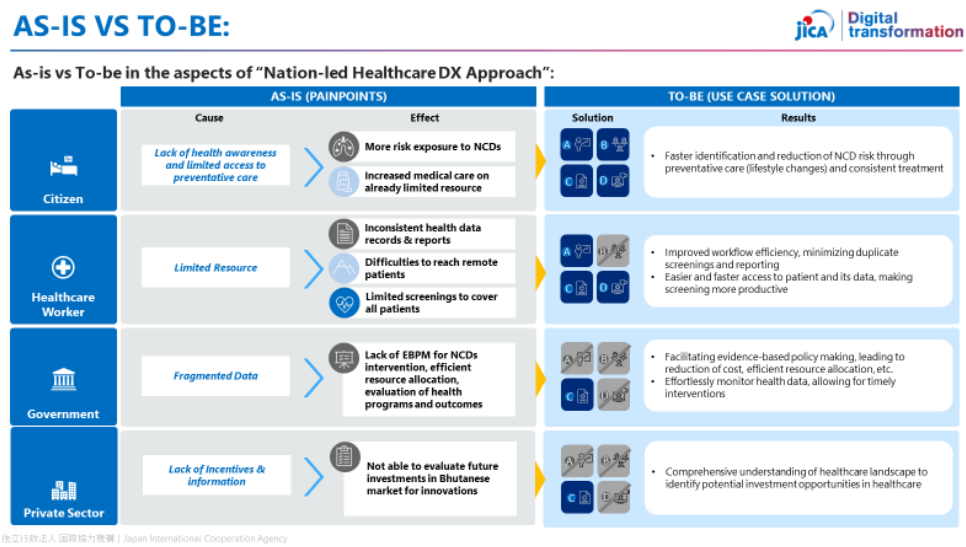
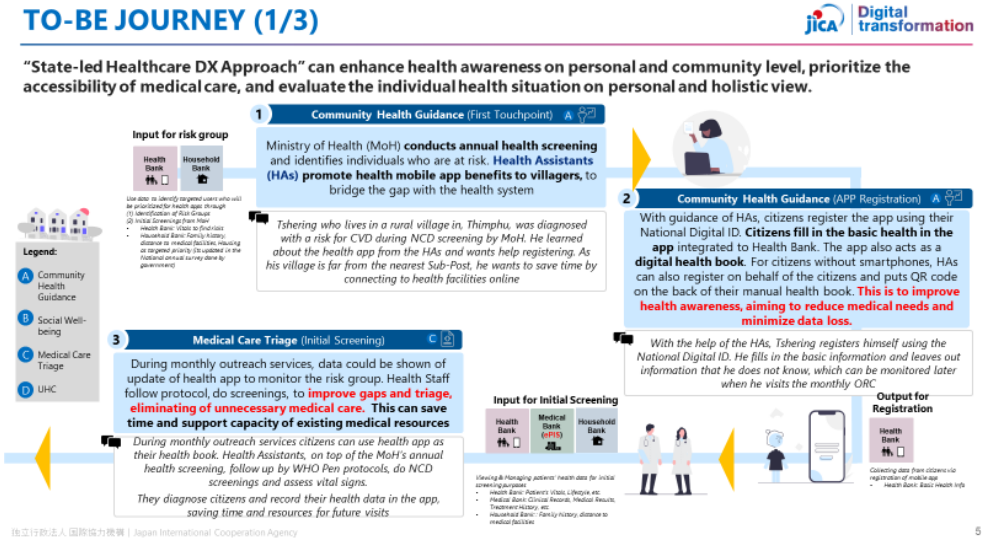


Figure 28: As-Is vs To-Be

- Based on this premise, we have outlined the "To-Be Journey" for the aspects of "Nation-led Healthcare DX Approach with a total of nine steps. The details of this journey are depicted in the figure below. The following summarized steps are as follows:
  - **In Step 1,** MoH typically carries various NCD screenings, whether they are annual screenings within the communities and outreach clinics, opportunistic screenings through events, or routine screenings within hospitals. During these occasions, Health Assistants (HAs) as a community guidance, can use this opportunity to introduce the Health Application to the citizens and encourage them to download it, discussing the benefits of the application.
  - **In Step 2,** citizens who have downloaded the application can effortlessly register by integrating with the existing National Digital ID (NDI Wallet), which is an initiative by the Bhutan Government to simplify the authentication and registration process. During the registration, citizens can enter their basic health-related information and health assessment, allowing the application to function as their personal digital health book. This access to personal health information can also help enhance citizens' awareness of their health and personal health records. For those citizens who are unfamiliar of how to use the application, Health Assistants or other NCD Focal Points will serve as a community health guidance to assist in the registration and data entry process.
  - **In Step 3,** medical triage is involved, where data input by citizens or Health Assistants in the application will assist healthcare providers to assess the severity of the patient's condition. They can decide whether a hospital visit is necessary or if visitations to primary healthcare centers is adequate. This process aims to reduce unnecessary hospital visits, which aims to help reduce workload of healthcare providers.
  - **In Step 4,** patients diagnosed with severe hypertension cases (estimated to be around 5% of total hypertensive population within Bhutan) are provided with the IoT device, specifically health wearables, to monitor daily vital signs and assess risks. Patients can sync data like daily step count, sleep patterns, and physical activity to the application. This intention is to foster behavioral changes among citizens through tracking of health data, which will create preventative measures for NCDs.
  - **In Step 5,** the goal is to encourage individuals to join online community on social support, which will allow citizens to motivate each other towards their health goals. Here, citizens can share their synced data such as step goals, and push each other to reach their goals. By creating a supportive environment where people can encourage each other, it helps to foster positive health behaviors and reduce feelings of isolation. Ultimately this step will eventually build a stronger and healthier community and sustain citizens towards healthier lifestyle.
  - **In Step 6,** if patients show no signs of improvement, they can be directly referred to a hospital or receive teleconsultation. By utilizing the data collected within the Citizen Health Application, healthcare providers can perform medical triage more accurately. The efficient use of data can

reduce both time and resource required for repetitive health screenings, which enables faster interventions.

- **In Step 7,** when faced with a difficult or persistent hypertensive case, healthcare providers will also have the option to send DNA Samples to RCDC for more detailed investigation. Here, blood samples will be taken for genomic sequencing and interpretation. This approach enables personalized medicine which will allow healthcare providers to create treatments that are tailored to the patient's root cause which foster personalized healthcare.
- **In Step 8,** patients experiencing less severe case or improved conditions can opt for follow-up consultations through telemedicine rather than hospital visits. This approach is both beneficial for healthcare providers as well as citizens. Here, patients can avoid the inconvenience, cost, and wait times at the hospitals. Healthcare providers can also work more efficiently as the wait times and in-person treatments are reduced as physical visits to the hospital is not necessary.
- **In Step 9,** Bhutan government can utilize the aggregated data from the Citizen Health Application to make more informed decisions through EBPM. For instance, they can analyze controlled and uncontrolled hypertensive cases, identify those locations and investigate underlying causes, and create targeted interventions. This data-driven approach enables the government to understand the underlying patterns of health issues within the population, which will lead to a more effective healthcare policy.



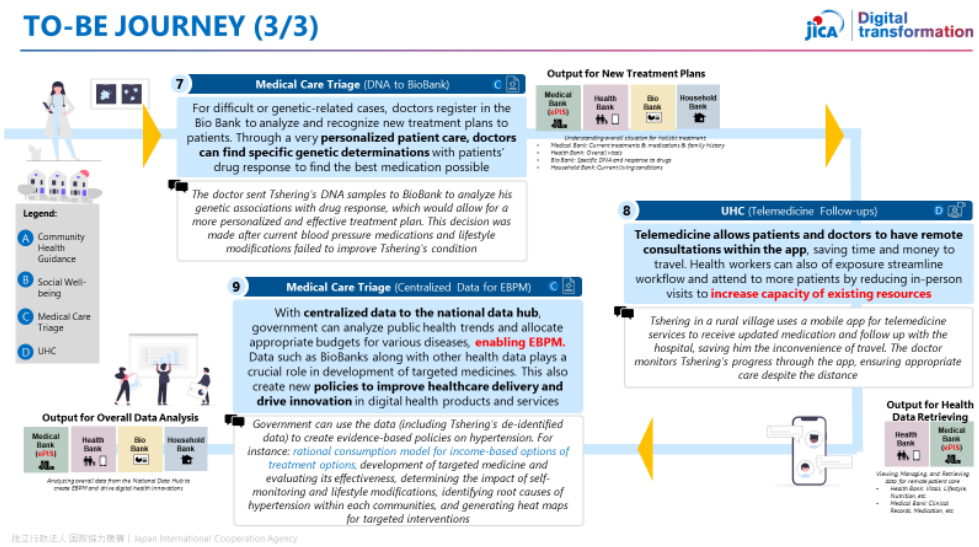


Figure 29: To-be Journey

- The data items necessary to realize this to-be journey were then discussed. There were two main issues in considering the data items. The first was what kind of health-related data handling system would extract useful insights for stakeholders such as the public, healthcare professionals, government, and private companies. Therefore, under the supervision of a project member who is also physician, the project team and the Bhutanese side, including MoH, decided to handle not only basic health-related information, but also data on lifestyle habits that may affect hypertension. With such data, medical professionals will be able to make high-level decisions and provide more data-based health-related advice. It is also expected to bring about a change in the public's awareness of both their own health data and lifestyle data. By assuming that statistical data will also be handled, it is envisioned that the government will analyze the relationship between individual health and macro statistics for use in EBPM. The amount of data items to be handled is an important point in defining system requirements. Thus, we have just drawn a to-be journey and finalized the corresponding system requirements.
- The second issue is whether the data being handled is PII. Details are given in "3 Lessons learned in the detailed planning phase." In this project, the issue was how to store PII and ensure the security of the data. Unlike Japan, Bhutan does not have a public cloud region in its territory. Therefore, when using public cloud for the convenience of data utilization, data centers located in regions in other countries will be used. In this case, it is difficult to apply the national laws of the home country to other countries for data protection. Therefore, it was decided to classify the data into PII and other categories, and to begin with, PII will be stored in the government data center located in Bhutan. This combination of on-premise environment and public cloud is called hybrid in this project. In a hybrid environment, authentication is an important aspect of designing system requirements definitions. In this regard, this project has designed a system to solve this problem by issuing system-specific IDs in addition to the use of National IDs, and linking the two through an ID mapping master.
- In addition to these issues, the project team and the Bhutanese side discussed points that would affect the definition of system requirements, such as how long data should be stored and how quickly the system should be able to recover in the event of a system failure, while expanding the image of the system. However, the Bhutanese side indicated that they would like to reflect the suggestions obtained during the actual pilot activities in the full-scale development of the system. Therefore, the schedule for the technical cooperation phase is designed based on this intention.

2.8 Confirm the connection with 4 Banks, Data hub, National ID, and application in the service layer through the common API.

- When using a hybrid on-premise and cloud environment as described above, one consideration was the extent to which the project team should intervene in the on-premise environment. What emerged during the discussion of this point was the cultural differences between Japan and Bhutan. In Japan, prior to the actual development of the system, a detailed requirements definition is designed and details regarding functional and non-functional requirements, etc., are summarized in the form of documents. On the other hand, Bhutan does not seem to prepare as detailed a requirements document as Japan does. Therefore, even though the project team requested that the existing system design documents be shared, the project team could not gather enough documents to

fully understand the existing system. We do not know if this is the case here, but in general, there may be psychological resistance to disclosing details of existing systems to foreign governments or foreign companies.

- Based on these points, it was agreed that the project team side would develop the system mainly related to the public cloud, while the Bhutanese side would develop the on-premise environment at the government data center.

2.9 Preparing the documents for the technical cooperation phase

- The JCC held a meeting on July 26, 2023. The "Overall Picture and Scope of the Project," "Roles and Responsibilities," "Overall Schedule," and "Implementation Structure were discussed. Please refer to the Appendix “A-4. 2nd JCC Meeting: Presentation Deck, Minutes of Meetings” for the documents and minutes of the meeting.
- On July 28, 2023, the Minutes of Meetings of the meeting was signed; the PDM and PO were established, and the revision points of the Record of Discussions, signed on November 16, 2022, was described.

2-3. Activities not mentioned in the PDM

- Although not necessarily related to Outcome 1 and 2 of the PDM, JICA's SNS and website were updated and shared by the Bhutanese C/P in terms of external publicity of the project results.
  - JICA Bhutan SNS: https://www.facebook.com/JICABhutan/posts/pfbid02aYE97WmZZY796BBEqDrrrFtBSbapqKvBa3DS2ai4u1j2g1wYbFS6kqa5dZyxyhbxl

Picture 2: JICA Bhutan Office Facebook

  - JICA Project Page (Japanese): https://www.jica.go.jp/Resource/project/bhutan/016/news/20230726.html

Picture 3: JICA Project Page (Japanese)

- JICA DX Homepage (Japanese): https://www.jica.go.jp/activities/issues/digital/jicadx/interview_2/

Picture 4: JICA DX Homepage (Japanese)

3 Lessons learned in the detailed planning phase

3-1. Online meetings

- The Bhutanese government is accustomed to online meetings. Therefore, during the delayed planning phase, online meetings were held weekly in principle to lead the subcommittee discussions. Online meetings were also used during the delegation's on-site business trip, so that Japanese staff and others who could not travel to the site could grasp the discussions in real time. This facilitated rapid information sharing.
- On the other hand, the online meeting made it difficult to have a dynamic exchange of opinions, and communication was basically one-sided, with the Japanese side explaining and the Bhutanese side listening. Therefore, it was difficult to elicit ownership from the Bhutanese side.

3-2. Intensive workshop

- The retreat was held at the request of the Bhutanese side in response to the above reflections. Officials from a wide range of ministries and agencies gathered at a hotel in Paro, the venue of the retreat, and actively exchanged opinions on important issues such as concrete images of use cases and policies for cloud utilization in pilot activities, and made necessary decisions based on the background paper provided by the Japanese side.
- According to the Bhutanese side, when meetings are held in the capital city of Thimphu, it is inevitably difficult for staff to concentrate. Conversely, it is believed that the staff was able to concentrate on the project in Paro, which is about 50 km away from Thimphu, away from other duties, which led to effective decision making.
- Based on the lessons learned, intensive stakeholder discussions will be held in Paro once every two months during the technical cooperation phase.

3-3. eHealth Strategy Workshop

- The most important task in updating the eHealth Strategy was to make concrete the overall goal, which was not always clear. If the Japanese side presented a proposal, the Bhutanese side would not be convinced that they had conceived the idea. Therefore, the Japanese side concentrated on facilitating the discussion, while the Bhutanese participants actually discussed the goal to be achieved based on their own ideas. This workshop was effective in getting opinions from the Bhutanese side, and was the session in which the most active exchange of opinions took place during the detailed planning phase.
- The Bhutanese side is willing to lead the project on their own, in cooperation with the Japanese side, rather than ever leaving the project to the Japanese side. The Bhutanese side does not like communication in which Japan explains and Bhutan listens, as in online meetings. In the technical cooperation phase, it is important to proceed with the project while respecting the willingness and motivation of the Bhutanese side, including the selection of Bhutanese vendors with which to collaborate, and to promote project management that is satisfactory to the Bhutanese side.

3-4. Increase counterpart personnel

- This is a project that aims to achieve development effects related to health. On the other hand, it is also a project to build a digital system. It is also a project aimed at utilizing statistics. In other words, there are a lot of stakeholders.
- The project manager on the Bhutanese side spent a lot of time on communication among the stakeholders.
- In the technical cooperation phase, the Japanese side intends to collaborate with local coordinators to support the Bhutanese side's project management unit.

3-5. Capacity building

- Discussions were held with the Bhutanese side on what activities to emphasize during the technical cooperation phase considering also the budget constraints.
- As a result, it was found that the Bhutanese side is not satisfied with having the Japanese side produce a high-quality system, but is placing particular emphasis on human resource development in Bhutan through collaboration with the Japanese side. Therefore, system development involving local Bhutanese vendors and device development involving Bhutanese universities are planned for the technical cooperation phase.
- The project team understands that carefully listening to the Bhutanese side's intentions was important in implementing the project, at least in terms of bringing about the development effects that the Bhutanese side was looking for.

3-6. Japan visit as a motivator

- The Japan visit was a very important motivator for the Bhutanese government, and was attended by key members of the project, led by MoH and GovTech's Acting Secretaries. After returning to Bhutan, the Japan Visit participants continued to participate in meetings with great enthusiasm, and were very active in sharing their ideas and opinions to make the project more fruitful. In contrast, the ministries that did not participate in the Japan Visit seem to be relatively less motivated by the project.
- The fact that the Japan Visit was conducted so early in the project's development left room for improvement in terms of the maturity of program in Japan. On the other hand, it was very effective in terms of motivating key stakeholders from the very beginning of the project.
- In the technical cooperation phase, the possibility of third country training on cybersecurity is also being considered. Bhutan's C/P also mentioned that this would be a motivating factor for the participants.

3-7. Digital architecture for small countries

- Countries like Japan, which have public cloud region(s) within their own country, can apply their domestic laws to protect data in the public cloud while promoting a "cloud first" policy. Therefore, it is relatively easy to balance the promotion of industry through data utilization and the protection of data.
- On the other hand, many developing countries do not have a public cloud region within their own territory. If such countries try to promote data utilization by using public cloud, they will need to store their own data in regions in other countries. In such cases, it is difficult to apply their domestic laws to other countries for data protection. Therefore, it is relatively difficult to balance the promotion of industry through data utilization and the protection of data.
- In this project as well, it is extremely difficult to balance industrial promotion through data utilization and data security in Bhutan, a country that does not have a public cloud region in its territory. Therefore, the key points of discussion were the examination from the legal perspective of data sovereignty and the design of a system architecture to realize the secure flow of data.
- The data sovereignty perspective is not a simple comparison of the security level of on-premise or public cloud. The Bhutanese government also believed that public cloud had certain advantages in terms of security level. Rather, the Bhutanese government was strongly concerned about the legal perspective, such as the extent to which its domestic laws would apply in the event of a data breach or other incident in a region in another country where a public cloud was present. Therefore, a lawyer will be hired to discuss data sovereignty in the technical cooperation phase.
- In terms of system architecture, the basic approach is to store personally identifiable information (PII) in the government data center or on-premise environment and non-PII in the public cloud, but it was difficult to find a way to achieve identity authentication in the cloud while keeping PII in on-premise environment, especially National ID. In other words, the challenge was to find a way to achieve identity authentication in the cloud while keeping PII on-premise. For this, an agreement was achieved on an architecture in which a unique ID for the platform is established and an ID mapping master for the unique ID and the national ID number is placed in the on-premise environment.
- If the separation of on-premise and public cloud can be used for both industrial promotion through data utilization and data security, it would be a useful insight for countries that do not have public cloud regions, especially developing countries.