



Overcoming
Barriers to
Cloud Adoption
in Public Healthcare
in Asia Pacific

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1. Executive Summary

The cloud has often been called a game-changer for digital health, but its true benefits have only come to the fore since the onset of the COVID-19 pandemic.

In the Asia-Pacific, as in other parts of the world, the pandemic requires an immensely coordinated and timely response from governments and society at large to protect public health and the economy. The cloud, specifically hyperscale cloud, with its highly scalable data storage and computing capabilities, has played an instrumental role in the response and in helping develop national health systems' resilience to the pandemic. From contact tracing to population disease surveillance, cloud services have helped healthcare ministries and public and private health systems rapidly set up informational technology (IT) infrastructure and deploy applications that can scale up and down with the number of COVID-19 cases. Cloud-powered telehealth services have taken critical healthcare services to densely packed cities as well as underserved rural areas.

Governments are using the cloud to stay on top of COVID-19 case data – with the collection, monitoring, and exchange of data at local, national, and global levels driving crucial policy decisions. Moreover, the rapid rollout of COVID-19 vaccines would not have been possible without cloud infrastructure supporting vaccine development, manufacturing, and distribution.^{1,2,3}

However, COVID-19 is only one of the many public healthcare challenges that the Asia-Pacific is facing. A large and rapidly growing aging population, rising healthcare costs, an increasing chronic disease burden, and a shortage of healthcare personnel are putting pressure on national health systems. Digital healthcare has been widely recognized as an important tool in health systems – throughout the Asia-Pacific region, most governments have put forward national digital health strategies to guide health system practitioners into digital adoption. However, few digital health strategies have fully outlined the guidelines and mechanisms for cloud adoption.

Given the cloud's important role in strengthening health systems, ACCESS Health, in collaboration with AWS Institute, carried out a study to better understand the enablers and barriers to cloud adoption in public healthcare in the Asia-Pacific, and how these challenges can be overcome. We examined the extent and patterns of cloud adoption in 12 Asia-Pacific countries: Singapore, Australia, New Zealand, South Korea, Japan, Malaysia, Thailand, Indonesia, Vietnam, Philippines, India, and Bangladesh. We analyzed each country's digital healthcare landscape – digital health policies, systems, solutions, and notably the policies applicable to and uses of cloud technologies and services in health systems. We interviewed nearly 40 policymakers, healthcare Chief Information Officers (CIOs)/Chief Medical Informatics Officers (CMIOs), and digital health experts in these countries to understand their perspectives on cloud adoption for public healthcare.



Methodology

We began our analysis by identifying and studying the key factors that enable the adoption of the cloud for public healthcare. The Asia Cloud Computing Association (ACCA) lists the following four factors as being critical enablers of a country's cloud readiness: infrastructure, security, regulation, and governance. Based on our research, we identified four additional factors that are important enablers for the use of cloud in public healthcare: national policies and mandates for digital health, cybersecurity, and privacy policies specific to healthcare data, the nature and maturity of the health system, and the maturity of its digital health system.

To further calibrate our findings, we classified the 12 countries into three groups based on their income as we observed that countries' adoption of Information and Communications Technology (ICT) was closely linked to their GDP.

- **High-income:** Singapore, Australia, New Zealand, South Korea, Japan.
- **Upper-middle-income:** Malaysia, Thailand.
- **Lower-middle-income:** Indonesia, Vietnam, Philippines, India, and Bangladesh.



Findings

On further analyzing these countries based on the readiness factors identified, we found readiness and adoption were largely linked to the country's income group. We found that within the high-income group, Singapore, Australia, New Zealand, and South Korea are the most advanced in their readiness and adoption of cloud for healthcare. In the second group, Thailand has seen wider adoption than Malaysia. However, the latter is more forward-looking in terms of policies, having adopted a Cloud First Policy for the public sector. In the lower-middle-income group, India, and Vietnam have seen greater adoption of cloud than their peers.

Cloud services benefit public healthcare systems at three levels: at the health system level as a whole, at the healthcare organization level, and at the individual patient level. To fully realize the potential for cloud services to benefit health systems, and the opportunities to unleash further innovation in the healthcare industry through successful cloud adoption, we outline four strategies for national policymakers and health system practitioners to consider:

R1. Countries should adopt a Cloud First Policy for healthcare driven by a central digital health authority.

A Cloud First Policy for healthcare directs government health agencies to consider using cloud-based technology solutions ahead of other IT solutions. This will allow public healthcare organizations to optimize infrastructure cost and access scalable IT resources while building a connected healthcare ecosystem. A well-crafted Cloud First policy leads to cost savings, greater security, and flexibility in adjusting IT usage.

R2. Use a range of policy tools to realize the full potential of the cloud in the digitalization of healthcare.

The right policy tools, built around critical enablers such as interoperability, regulations, and procurement, can help overcome organizational resistance to digitalization and enable quicker and wider adoption of the cloud.

R2.1. Develop data governance policies and regulations that support healthcare innovation for better health outcomes. Data privacy and protection policies and regulations are a key building block of digital health. Clear data governance policies and principle-based regulatory frameworks must be built that ensure risk-appropriate governance based on internationally recognized standards.

R2.2. Establish open standards for data interoperability and data exchange for a patient-centered connected healthcare system. The establishment of standards and mandating interoperability can enable the collection and use of healthcare data to its full potential.

R2.3. Design policies to seed a digital health innovation ecosystem. Many governments, particularly in Group 2 and Group 3 countries, use conventional financing models to provide funding to startups instead of venture capital-based structures. For digital health systems to mature, governments will need to create a strong innovation ecosystem supported by policies and incentives, including procurement policies that are startup-friendly, and a better support system for startups.

R2.4. Build trust in the cloud by streamlining and standardizing procurement. Guidance on procurement along with the establishment of minimum service standards for cloud service providers (CSPs) can help organizations adopt cloud with greater confidence. Such policies will also help to mitigate concerns around cloud data governance, vendor-concentration risks, and business continuity.

R3. Assess and invest in creating a foundational ICT ecosystem that furthers cloud adoption.

All lower-middle-income countries cited the need for more adequate supporting ICT infrastructure. Governments must establish policies and create an investment plan that addresses the required physical ICT infrastructure as well as the human resources needed.

R4. Address capacity building as a priority to overcome the key barriers to cloud adoption.

Educational programs and training are needed to close knowledge gaps and to design and build human-centred digital health applications. A designated body for capacity building such as a Centre of Cloud Excellence or equivalent must be empowered to drive such initiatives in partnership with the private sector and in line with international best practices.

Collectively, these strategies can help accelerate innovation in public healthcare by addressing seven key barriers that key stakeholders perceive are holding back cloud adoption. These were identified through our analysis of the enablers and detailed interviews with public healthcare decision makers and experts.

KEY PERCEIVED BARRIERS TO CLOUD ADOPTION IN HEALTHCARE

> **Misperceptions around security and privacy of cloud-based data:**

Respondents cited that due to a lack of awareness or understanding of the cloud, policymakers, and/or healthcare organization management often held misperceptions around security and privacy of cloud-based data, which showed a gap in understanding the benefits and security capabilities of the cloud. The lack of personal data protection and healthcare regulations in some countries has also added to this perception.

> **Resistance to organizational change:**

In the absence of mandates or incentives to drive digitalization, factors such as an insufficient understanding of cloud services' benefits, fears of revenue loss, and opposition to changes in clinical workflows have been cited by respondents as barriers for healthcare facilities considering cloud adoption.

> **Low clarity on cloud data governance regulations:**

Complexity and ambiguity in data governance regulations, along with little to no training imparted to healthcare IT staff on the application of regulations to healthcare data, were cited as obstructing cloud adoption.

> **Inadequate infrastructure:**

Respondents considered weak foundational ICT infrastructure, including inadequate internet bandwidth, poor hardware quality, and poor mobile connectivity in rural areas, as impacting cloud adoption, especially in Group 3 countries.

> **Budgetary constraints:**

Respondents cited the cost of cloud migration in terms of planning, implementation, and the training of IT staff and clinicians as a major barrier for public healthcare organizations with already strained budgets.

> **Shortage of cloud skills:**

Respondents in three out of 12 countries cited the shortage of cloud skills as among the top 3 barriers to cloud adoption, specifying that few professionals could understand both cloud technologies and their application to the healthcare sector.

> **Low awareness of cloud benefits:**

Respondents in all countries perceived the understanding of cloud services, their use, and range of benefits to be limited, impacting the uptake and adoption of cloud services across the health system.

2. Introduction to the Cloud

Cloud computing is the on-demand delivery of information technology services such as computing power, storage, and applications via the internet, based on a pay-as-you-go pricing model. Cloud is not a new form of technology but a new model for delivering computing resources. It offers significant benefits for the health sector because of these key advantages:

- the availability of scalable computing resources and the latest technology on-demand
- the ability to integrate data and provide real-time access to data across geographical boundaries that allow collaboration and interoperability
- no upfront commitment on hardware or its management, and
- the ability to pay only for what is used

Types of cloud services:

There are three types of cloud services offered with the Infrastructure as a Service (IaaS) and Software as a Service (SaaS) models being the most relevant for this report.

1. Infrastructure as a Service (IaaS):

These services provide the basic building blocks for cloud IT.

2. Platform as a Service (PaaS):

PaaS offers a platform for building, testing, and deploying applications and is mainly used by software developers and software companies.

3. Software as a Service (SaaS):

This is a complete product that is run and managed by a service provider.

While cloud services can be deployed fully in the cloud (hyperscale), fully on-premises, or as a combination of both, governments, and national healthcare organizations such as the UK's NHS are increasingly adopting a Cloud First policy for the advantages listed above.⁴⁵

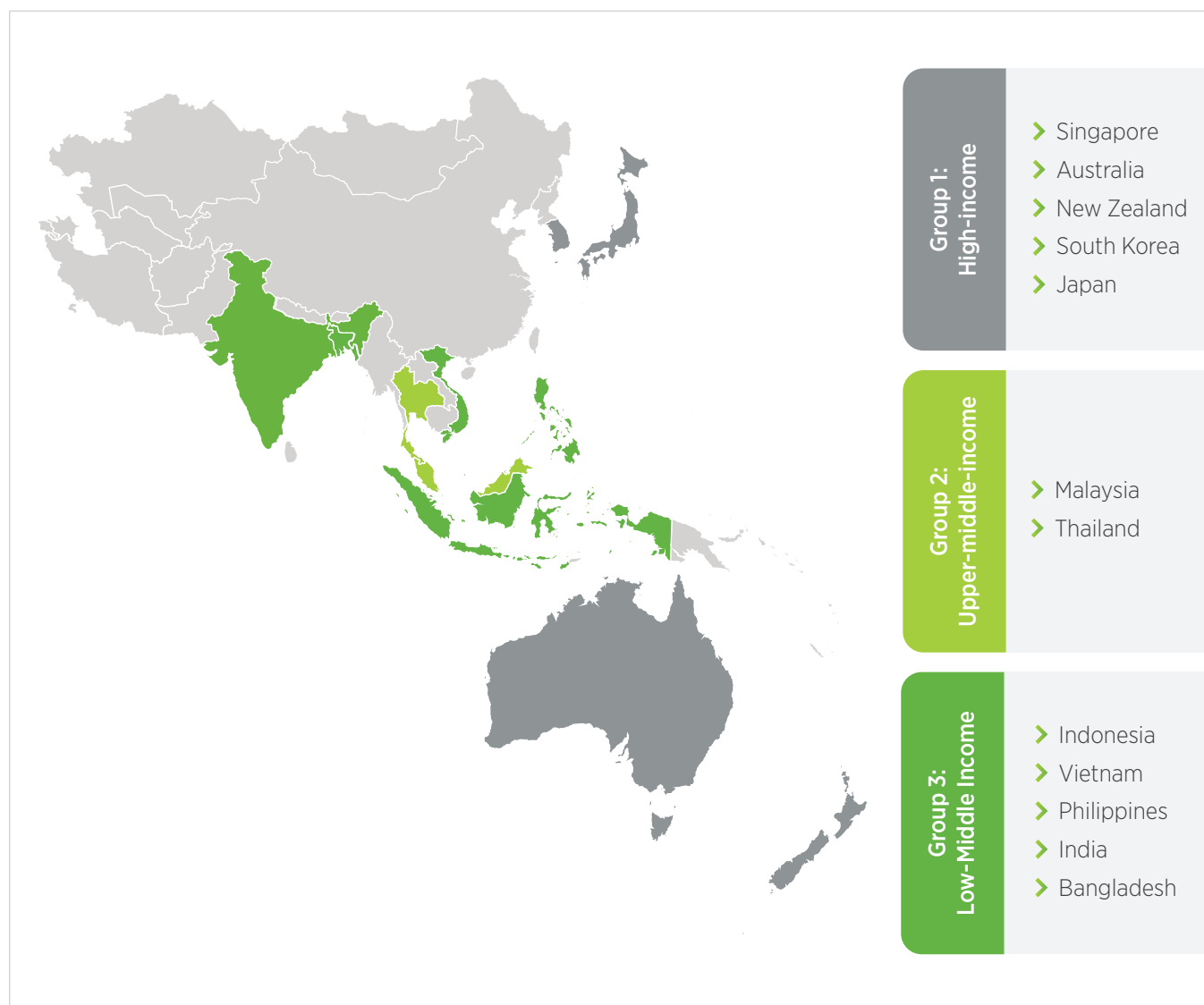


For more information on cloud deployment models and services, please see Appendix 2.

3. Key Research Findings on Cloud Adoption for Public Healthcare in 12 Asia-Pacific Countries

Introduction

The following sections bring together our findings from primary and secondary research sources for 12 countries in Asia Pacific as listed below. Since countries' ICT spending is highly dependent on their GDP, we divided the countries into three groups based on their GDP to understand the variation of cloud adoption within and across groups.



The research was carried out through a review of existing literature and 40 interviews with policymakers, public and private hospital CIOs and CMIOs, health-IT experts, and advisors to governments on digital health in these 12 countries.

The following sections present key insights gathered from our research on the enablers of, drivers of, and barriers to cloud adoption.

3.1 Cloud for Public Healthcare – a Readiness Framework

National policies and mandates for digital health initiatives, healthcare data security and privacy regulations, the nature and maturity of the health system, and the maturity of digital health initiatives are healthcare-specific factors that influence a country's readiness and adoption of cloud.

According to the Asia Cloud Computing Association (ACCA) that annually publishes the Cloud Readiness Index,⁶ the following are the key enablers of a country to be cloud-readiness for a country:



Infrastructure

International Connectivity: International bandwidth is key to developing cloud services while also enabling domestic users to access international cloud services.

Broadband Quality: Average download speeds are indicative of fast and reliable access to the cloud.

Power Grid, Green Policy and Sustainability: Stable, continuous access to power, water, and sustainable energy enables the building and maintenance of data centers.



Security

Data Center Risk: This parameter assesses risks to data centers in a country including infrastructure, legal capabilities, the tax environment, and exposure to natural disasters.

Cybersecurity: This parameter assesses cybersecurity technologies, technical frameworks, standards, initiatives, ICT education, and infrastructure for data in the cloud.



Regulation

Business Sophistication: Governments' facilitation of setting up businesses and supporting new players is important to developing the cloud industry.

Freedom of Information: The flow of data across borders is essential for unleashing the full potential of the cloud.



Governance

Privacy: The assurance that users' information is held securely and protected, the adherence to international data privacy standards and a central enforcing authority is key for cloud adoption.

Government Regulatory Environment: Strong regulatory frameworks that enable the use of cloud and e-governance technologies enable cloud adoption.

Intellectual Property Protection: Robust protection and enforcement of intellectual property rights are important for innovation, which is especially important for cloud as an emerging technology.

Over the following pages, we used the ACCA cloud readiness framework to derive a framework for the adoption of the cloud in public healthcare and identified the following additional readiness factors that are specific to healthcare. We also identified specific parameters for each factor and analyzed countries based on these parameters to understand their readiness for cloud adoption. The analysis uses both available quantitative data from secondary sources as well as our qualitative assessment based on primary and secondary research.

Each comparison table also shows how cloud is being used in public healthcare in each country. For detailed information on the readiness factors in each country, please see Appendix I.

Readiness Factors for Cloud Adoption in Healthcare	Parameters
<p>1 Nature and maturity of the public health system: Basic healthcare infrastructure, national schemes such as universal health coverage and national health insurance schemes help centralize public healthcare data and ease the way for cloud adoption.⁷</p>	<ul style="list-style-type: none"> • UHC Service Coverage Score • Nature of system
<p>2 National policies, mandates, or incentives for cloud-enabled digital health initiatives: National mandates and incentives for digital health initiatives are needed to drive cloud adoption as our research has shown that the healthcare sector is more conservative than other public sectors in its adoption of digital technologies.⁸</p>	<ul style="list-style-type: none"> • Cloud First Policy • Cloud for Public Healthcare Mandate/Policy
<p>3 Sophistication and maturity of the digital health system: Digital readiness of healthcare systems have a strong influence on the use of cloud technologies.</p>	<ul style="list-style-type: none"> • Maturity of digital health initiatives*
<p>4 Data protection and privacy regulations for personal data, with separate provisions for healthcare data. With healthcare data accounting for the largest share of publicly disclosed data breaches in 2020, it is not surprising that adequate regulations need to be in place to enable cloud adoption in the sector.⁹</p>	<ul style="list-style-type: none"> • Legislation on personal data protection • Data Protection & Privacy Legislation for Healthcare Data • Data governance regulations for healthcare data in the cloud

* While we have analyzed and presented every subject country's notable national and regional digital health initiatives, in Appendix I, a maturity rating is beyond the scope of this report.



Cloud Readiness Enablers for Public Healthcare

National Policies and Mandates <ul style="list-style-type: none"> • National Policy/Mandate for Adoption • Incentives for Digital Health Initiatives 	Healthcare Data Security & Privacy Regulations <ul style="list-style-type: none"> • Data Security Regulations • Data Protection & Privacy Regulations
Nature & Maturity of Health System <ul style="list-style-type: none"> • Basic Healthcare Infrastructure • Universal Health Coverage Scheme • National Health Insurance Schemes 	Maturity of Digital Health System <ul style="list-style-type: none"> • Digital Health Leadership • Digital readiness of healthcare systems • Digital Literacy of Healthcare Staff



Cloud Readiness Enablers for a Country [ACCA]

Cloud Infrastructure <ul style="list-style-type: none"> • International Connectivity • Broadband Quality • Power Grid, Green Policy, and Sustainability 	Cloud Security <ul style="list-style-type: none"> • Data Center Risk • Cybersecurity
Cloud Regulation <ul style="list-style-type: none"> • Business Sophistication • Freedom of Information 	Cloud Governance <ul style="list-style-type: none"> • Privacy • Government Regulatory Environment • Intellectual Property Protection

3.2 Readiness of High-Income Asia-Pacific Countries: Key Findings



The countries in this region vary greatly in their development, in their healthcare systems, and the adoption of technology which together has led to varying rates of cloud adoption. The following are some key findings based on the comparison above and a detailed analysis of the 12 countries' digital health landscape, policies, cloud adoption, and corresponding legislation as presented in Appendix I:

- Cloud readiness, the extent of cloud adoption, and its uses are greater in Group 1 (High-income) countries. These factors drop with a country's income group.
- Only six out of 12 countries have a Cloud First policy, with five having a cloud for healthcare mandate or policy.
- In Group 1, Japan lags behind its peers despite showing high readiness. A conservative mindset has led to resistance to newer digital technologies.
- In Group 2, Thailand is slightly ahead in terms of cloud adoption despite Malaysia showing more readiness.
- Most Group 3 countries show low readiness due to the absence of conducive policies, data privacy, and security legislation, and lower ACCA cloud readiness scores.
- The pandemic has been a key driver of cloud adoption, especially in Group 3 countries, with their largest cloud-enabled health initiatives being launched post-COVID-19.
- Vietnam is ahead of other Group 3 countries, except India, in cloud adoption despite the lack of enabling legislation due to its higher digital health maturity.
- India and the Philippines are ahead of their peers in enabling policy and legislation. However, India is making progress at a more rapid pace when compared to its peers, including the Philippines.



3.2.1 Cloud Adoption for Public Healthcare: Readiness of High-Income Asia-Pacific Countries

READINESS FACTORS	SINGAPORE	AUSTRALIA	NEW ZEALAND	SOUTH KOREA	JAPAN
UHC Service Coverage Score (out of 100)	86	87	87	86	83
ACCA Cloud Readiness Index Rank (2020)	81.5	71	77.1	72.7	71.3
Cloud First Policy	✓	✓	✓	✓	✓
Cloud for Public Healthcare Mandate/ Policy	✓	✓	✓	✓	✗
Legislation on Personal Data Protection	✓	✓	✓	✓	✓
Data Protection & Privacy Legislation for Healthcare Data	✓	✓	✓	✓	✓
Cloud: Data Privacy/ Security Legislation for Healthcare Data	✓	✓	✓	✓	✓
Nature of system	Multi-payer program providing national health insurance.	Universal health coverage through Medicare.	Single-payer, tax-funded program providing universal health coverage.	National health insurance covers 97% of the population.	Universal health Insurance system.
How is the cloud being used for healthcare?	Singapore's public hospital network has fully adopted cloud with diagnostics & imaging not yet fully on cloud. Precision medicine is developing, and AI/ML applications are also in use.	Teleconsultations, research, public portals, health data storage, and precision medicine, are some areas of use.	Patient administration and management systems, clinical portals, laboratories, picture archiving and communication, radiology, pharmacy, eReferrals, and ICU systems.	EMRs, precision medicine, insurance services, research, and data analysis.	Cloud is mainly being used for research and recently for managing COVID-19 vaccinations.

3.2.2 Cloud Adoption for Public Healthcare: Readiness of Upper-Middle-Income Asia-Pacific Countries

READINESS FACTORS	MALAYSIA	THAILAND
UHC Service Coverage Score (out of 100)	73	80
ACCA Cloud Readiness Index (2020)	68.5	60.2
Cloud First Policy		
Cloud for Public Healthcare Mandate/Policy		
Legislation on Personal Data Protection		
Data Protection & Privacy Legislation for Healthcare		
Cloud: Data Privacy/ Security Legislation for Healthcare Data		
Nature of system	Universal health coverage through the National Health Insurance scheme.	Universal health coverage through social health insurance.
How is the cloud being used for healthcare?	Diagnosis & imaging, supporting national health data warehouse MyHDW.	Telehealth, Patient administration, patient access, office productivity solutions, CRM.

3.2.3 Cloud Adoption for Public Healthcare: Readiness of Lower-Middle-Income Asia-Pacific Countries

READINESS FACTORS	INDONESIA	VIETNAM	PHILIPPINES	INDIA	BANGLADESH
UHC Service Coverage Score (out of 100)	57	75	61	55	48
ACCA Cloud Readiness Index Rank (2020)	55	46.2	55.3	56.7	—
Cloud First Policy	✗	✗	✓	✓	✗
Cloud for Public Healthcare Mandate/ Policy	✗	✗	✗	✓	✗
Legislation on Personal Data Protection	✗	✗	✓	✗	✗
Data Protection & Privacy Legislation for Healthcare Data	✗	✗	✓	✗	✗
Cloud: Data Privacy/ Security Legislation for Healthcare Data	✗	✗	✓	✗	✗
Nature of system	National health insurance	Universal health coverage through national health insurance.	Universal health coverage through national health insurance.	Mixed health system	Mixed health system
How is the cloud being used for healthcare?	BCDR for less-sensitive healthcare information.	Some parts of the HMIS, population monitoring systems, telehealth.	COVID-19 surveillance.	Some parts of the HMIS incl. patient registration, patient admissions, billing, labs, pharmacy, disease surveillance.	Telemedicine, data analytics.

3.3 Interview Insights: Drivers and Benefits of Cloud Adoption

Our research into cloud adoption indicates that the key drivers of cloud adoption come in two forms – internal to a public healthcare organization and external forces.

Internal Drivers for Cloud Adoption

➤ Improved data reliability and security

Healthcare organizations are moving to the cloud to ensure that their data is available and accessible when they need it. Hyperscale cloud services enable this by building multiple redundancy measures into their systems to ensure 99.9% server uptime with multiple data backups.

➤ Scaling data storage

Public health organizations benefit from the scalability of cloud-based data storage when the number of patient visits fluctuate, as was the case when the COVID-19 pandemic overwhelmed healthcare systems. The flexible “pay-as-you-go” IaaS model can offer secure and flexible solutions to help healthcare organizations quickly and strategically scale data storage.¹⁰

➤ Scaling computer power

Cloud services allow public healthcare systems to ramp up IT infrastructure quickly to implement new projects, test new projects, and carry out research by utilizing other highly advanced and sophisticated tools such as artificial intelligence, machine learning, and blockchain in an agile manner.¹¹

➤ Enabling remote work and collaboration

Cloud computing removes the barrier of geographical location, enabling remote working and solutions such as telehealth and remote care through real-time data access.¹²

➤ Lowering infrastructure costs/moving to the variable cost model

Cloud-based systems optimize costs and shift health-IT budgets from capital expenses (Capex) to operating expenses (OpEx). Cloud computing helps optimize IT infrastructure and server costs.¹³

➤ Data-powered decision-making and automation (machine learning, predictive analytics, IoT, AI)

The relationship between AI and the cloud can be especially useful for improving public health outcomes by bringing in productivity and efficiency to research, diagnoses, and drug discovery, to name a few.¹⁴ An AI-powered cloud environment learns from the data it collects, makes predictions, and solves potential problems before the user even notices them.¹⁵

External Drivers for Cloud Adoption

➤ Cloud First policies/mandates

Digital transformation policies for the public sector, and specifically the healthcare sector, such as Cloud First policies in Group 1 countries or as mandates driving national digital health, can be a key driver of cloud adoption.¹⁶

➤ Continuity of care

Patient-centered national health systems and schemes adopt cloud technology as a key enabler of healthcare information exchange for continuity of care.¹⁷

➤ Insurance/reimbursement models

In many Asian countries (Japan, South Korea, Singapore), countrywide National Health Insurance Systems (NHIS) have often led to enhanced adoption of cloud-enabled processes and systems, including automated claims processing, electronic health and medical records, and information exchange. Such initiatives call for centralization and standardization of healthcare data, the availability of which speeds up claims processing, provides a basis for regular data audits, and leads to risk stratification and population health management.

➤ The COVID-19 pandemic

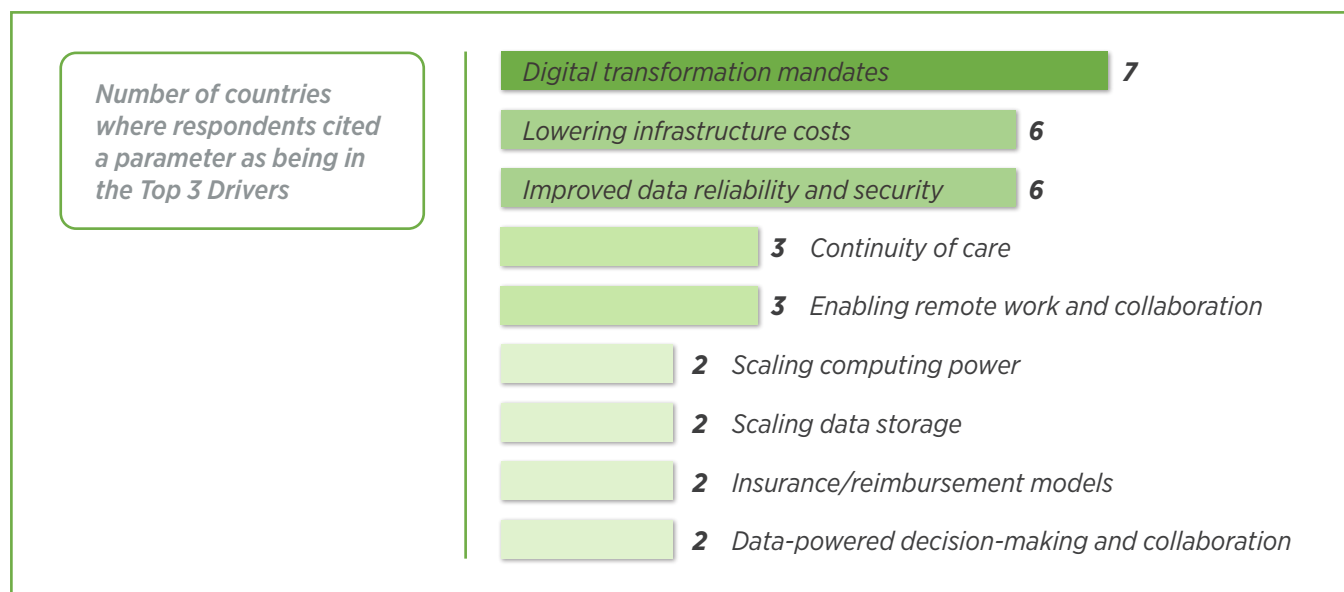
The pandemic has inadvertently been instrumental in driving up cloud adoption across all three groups. However, it is Group 3, the lower-middle-income countries, which have seen the greatest growth in cloud adoption for this reason.

3.3.1 Top 3 Perceived Drivers of Cloud Adoption for Public Healthcare

Respondents in these 12 countries identified the following as being among the top 3 drivers of cloud adoption for public healthcare.**

1. Digital transformation of healthcare policies/mandates
2. Lowering infrastructure costs
3. Improved data reliability and security

Drivers of Cloud Adoption in Public Healthcare based on interviews



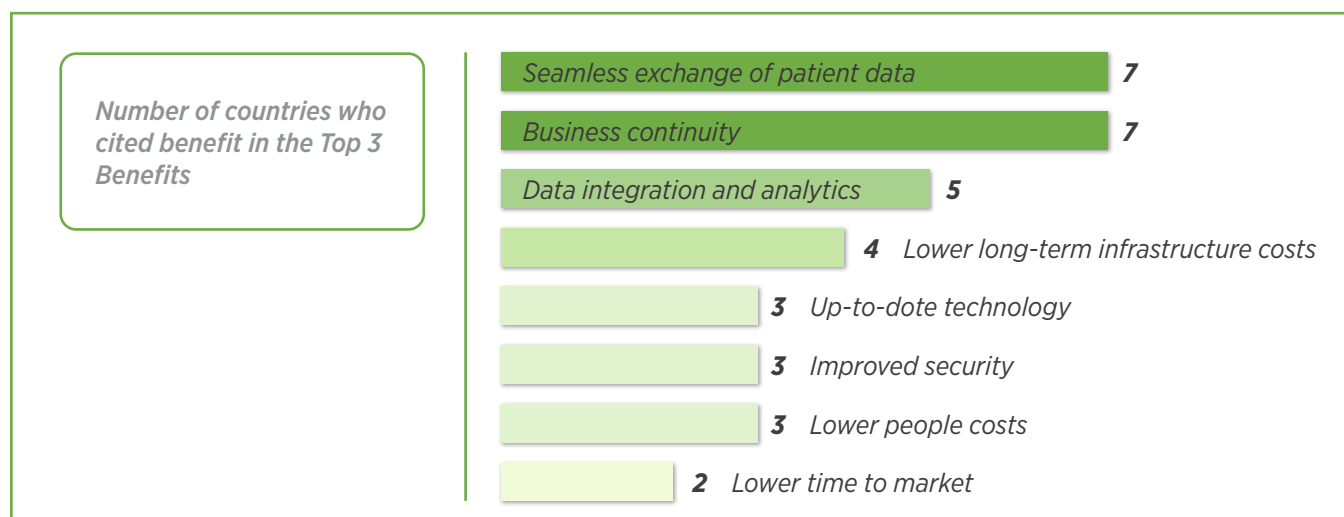
**The COVID-19 pandemic was not included as a driver for this survey.

3.3.2 Top 3 Perceived Benefits of Cloud Adoption for Public Healthcare

Respondents in these 12 countries identified the following as being among the top 3 benefits of cloud adoption for public healthcare.

1. Seamless exchange of patient data
2. Business continuity
3. Data integration and analytics

Drivers of Cloud Adoption in Public Healthcare based on interviews



3.4 Interview Insights: Barriers to Adoption of Cloud for Public Healthcare

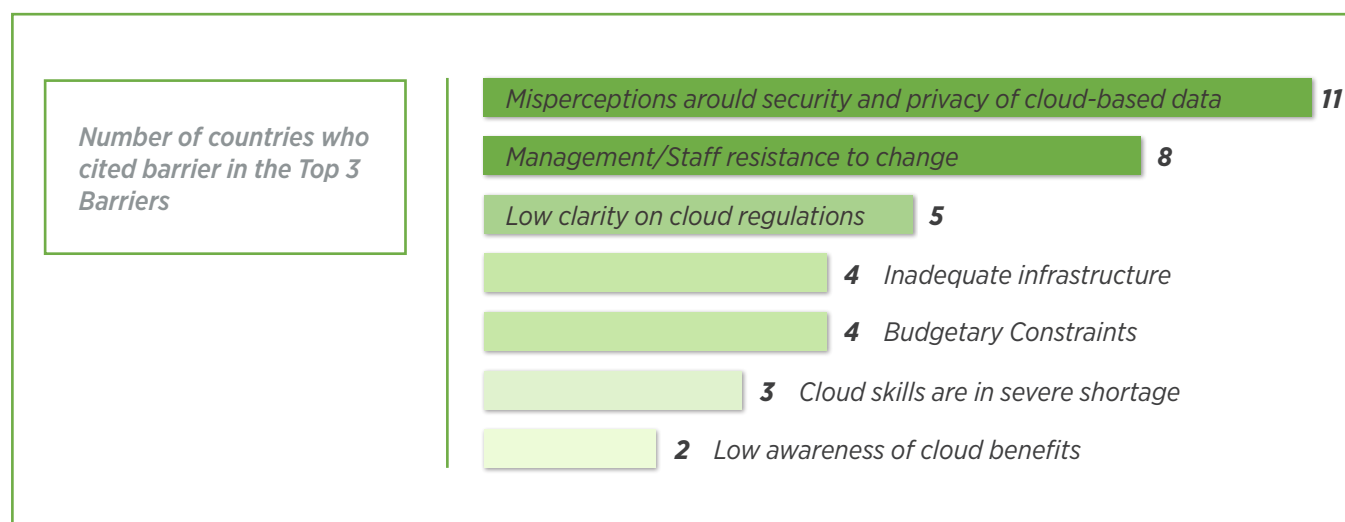
The following insights are derived mainly from the interviews we carried out to understand the barriers—both perceived and existing—and attitudes towards the adoption of the cloud for public healthcare. The research was supported by a review of existing literature.

3.4.1 Top 3 Perceived Barriers to Cloud Adoption for Public Healthcare

Respondents in these 12 countries identified the following as being among the top 3 barriers to cloud adoption for public healthcare.

1. **Data security and privacy concerns**
2. **Management/staff resistance to change**
3. **Low clarity on cloud regulations**

Barriers to Cloud Adoption in Public Healthcare based on interviews



It is interesting to note that respondents in three out of 12 countries considered ‘improved security’ as a key benefit of cloud adoption while ‘data security and protection concerns’ were cited as the overwhelming barrier for nearly all countries. This goes to show that there are knowledge gaps and a lack of clarity as to the data security and privacy risks of healthcare data in the cloud.

3.4.2 A Detailed Look at Barriers to Cloud Adoption in Public Healthcare

The following section looks closely at the existing and perceived barriers to cloud adoption in public healthcare. While some of these barriers are the result of inadequate supporting infrastructure, policies, and regulations, a significant number stem from a poor understanding of cloud technologies and a lack of clarity around cybersecurity in the cloud.

Barrier 1: Misperceptions around the security and privacy of data in the cloud

Data security and privacy concerns were overwhelmingly cited as a top concern—apprehensions grounded more in a lack of information than fact and driven by the high sensitivities attached to healthcare data. While some governments and national healthcare organizations have recognized the security benefits of the cloud and therefore subscribed to a Cloud First policy, the lack of awareness and misperceptions around these capabilities amongst policymakers and healthcare organization management in most of the surveyed countries has become a significant barrier to cloud adoption.^{18 19} In 11 out of 12 countries, it was cited among the top three barriers to cloud adoption.

This concern was driven by the following factors:



1. Data storage

Respondents reported that stakeholders perceived not being able to physically point to or see exactly where data was being stored raising concerns that the data was not secure. Additionally, respondents mentioned that uncertainty around where healthcare data is being stored has driven fears of citizens' private data being accessible by parties in the host country.



"[The] number one (barrier) is the public's perception of security and the second is respect for the national sovereignty of the citizens' dataset and how to ensure that."

— Dr. Robert Grenfell, Health Director, Health & Biosecurity, CSIRO, Australia

"Governments are highly concerned about the use of cloud services because they don't want their data going out of the country. This localization aspect is particularly relevant when it comes to personal health data."

— Dr. Peter Drury, Digital Health Transformation Consultant, Health IT Expert

2. Data breaches and privacy concerns

Reliance on a third party for securing or storing the data at a location that was not visible drove the perception that the data may be more open to data leaks and breaches of privacy. Additionally, the multi-tenant nature of hyperscale cloud with data centers being shared among many clients is perceived as a security risk.

Some interviewees equated the security of healthcare data in the cloud with that of mainstream office productivity SaaS software such as Office 365 and held the perception that both were equally insecure.



“It’s important to understand the concerns of governments – they are concerned about cyber-attacks, data breaches, misuse, apart from other concerns.”

— **Dr. Hishamuddin Badaruddin, Adjunct Assistant Professor (CoRE, Duke-NUS), Health IT Expert**

“There is a growing movement and demand from patients to be able to control which data goes into which systems.”

— **Stella Ward, ICT leader in the public sector, New Zealand**

“The government is slowly adopting cloud for healthcare in Indonesia, but people still believe that their data is not safe and secure in that digital system.”

— **Digital Transformation Consultant, Indonesia**

“There is no such thing as utilization of public cloud because healthcare data should be in a private cloud to preserve data privacy.”

— **Health IT Expert, Malaysia**

“Most hospitals have concerns about allowing their data to go outside the hospital even though the law allows it. They have concerns about security on the cloud because they are not yet confident it is fully secure.”

— **Health IT Expert, Malaysia**

3. Lack of personal data protection regulations

Personal data protection regulations are key to enforcing security in cloud-based environments. However, in some countries, such as India and Vietnam, the regulations around personal data protection and healthcare data protection are still in the draft stage. With the cloud perceived as a riskier, shared environment, the lack of personal data protection legislation becomes a further barrier to cloud adoption.



“There is a lack of confidence in the security of the cloud as health records are critical data, and they should not be hacked or accessed by unauthorized users. Moreover, the Personal Data Protection bills have not yet been passed by the government.”

— **CIO, super-specialty public hospital, India**

4. Low confidence in cloud service providers

Some respondents mentioned that the lack of guidelines around cloud services' standards has led to lower trust in the capabilities and security of cloud services.



"The biggest barrier towards cloud adoption in Malaysia is the lack of regulation explicitly stating the standards and on the utilization of cloud-based solutions."

— **Matthew Yong, Health IT Leader, Malaysia**

"Government cloud services need to undergo major improvements and have to comply with international standards."

— **eHealth specialist, Philippines**

Barrier 2: Management and/or staff are resistant to change

IT-related change management is difficult in any sector, but it is particularly challenging in a high-touch, high-impact setting such as healthcare. Respondents in eight out of 12 countries cited resistance to digitalization among the top 3 barriers. There are multiple factors that lead to resistance from healthcare organizations' management and staff:

1. Revenue and loss-of-business concerns

Respondents cited that healthcare organizations' management sometimes fears that the digitalization of healthcare will require them to share patient data with other healthcare organizations, and this will lead to a loss of business and revenue cuts.



"Japan has been behind other countries in digitization, especially in medical care. Each hospital has its own data center or data server, which may not be connected to cloud services. This is because data sharing is not well-established in Japan even now. The government promotes such data sharing but based on the business model or medical [model] provided, data sharing may reduce their revenue. This element delays all data sharing and digitalization in the medical field."

— **Health-IT expert and MOH Advisor, Japan**

2. Moving from a capital expenditure (CAPEX) to an operating expenditure (OPEX) model

Most healthcare organizations have relied on heavy capital expenditure investments to set up their own data centers, purchasing space, equipment, software, and a workforce for operating and maintaining these systems. While an advantage of cloud systems is the flexibility of the pay-as-you-go or operating expenses (OPEX) model, the change in procurement and expensing becomes a barrier for hospitals who perceive the IT budget cuts as a financial loss.

In some health systems, procurement of non-physical assets such as the cloud is not completely developed.



“The concept of hiring (resources) in the government has not been completely developed. When we go for cloud, [the] inventory management team would ask for the name of the equipment, proof of purchase and infrastructure. But the cloud is not [a] physical [asset]. It is resources you are hiring. These misconceptions still remain in the mindset of public administration people.”

— CIO, super-specialty public hospital, India

3. Concerns about being locked into a vendor

Some respondents cited vendor lock-ins as a barrier, with respondents in Singapore and New Zealand mentioning that their policy is oriented towards a multi-cloud model to avoid such a situation.



“The challenge [in cloud technology] would be to ensure that there is no vendor lock-in. When we start adopting cloud technology, moving from one cloud services provider to another is challenging because of vendor lock-in.”

— Manisha Mantri, Joint Director, Centre for Development of Advanced Computing (CDAC), India

4. Changes in workflow

Re-engineering applications for the cloud may result in a change to workflows that clinical staff find takes away their time from attending to a patient and adds to their work.



“Change management has become a major issue as doctors are reluctant to change the workflow and the software that they are accustomed to using.”

— Dr. Zafar Hashmi, Former Head of Technology, Healthdirect Australia

5. Concerns about data ownership

Some healthcare organizations perceive storing data in the cloud as giving control and ownership of the data to the cloud service provider and are concerned about CSPs deriving value from this data without the healthcare organization or the public sector benefiting.



“Organizations also know that having data gives them more power. They don’t want to share that power and send the data out of the organization.”

— Ji Sun, Deputy Director, HIRA, South Korea

6. No mandate or incentives to use the cloud

Some respondents felt that without a mandate from a central authority or policies supporting incentives, there would be limited adoption of the cloud.



“Incentives are needed as a motivator for hospitals to adopt the cloud.”

— Dr. Raymond Sarmiento, Director, National Telehealth Center, University of the Philippines, Manila, Philippines

7. Migration-related productivity concerns

Disruptions to work due to the migration and the risks of data loss during the transition were also key concerns.



“Continuous operations are another barrier for cloud adoption. Should hospitals decide to adopt cloud, they are worried that the transition phase would entail the creation of guidelines for the new system, training of personnel, provision of enabling infrastructure, and an increase in security protocols that need to be put into place.”

— Healthcare Digital Transformation expert, Thailand

“Migration to the cloud is not easy, and extra efforts have to be taken to ensure that data is secure because it is then not on-premises.”

— Dr. Zafar Hashmi, Former Head of Technology, Healthdirect Australia

“There is still contingency planning that is required as far as having data storage is concerned. For, e.g., backing up health information in two data centers so that vital health information is not lost.”

— National Digital Health expert, India

8. Limited digital literacy of healthcare staff

The cloud is a key enabler of the digitalization of healthcare. However, healthcare staff in developing and high-income countries alike may struggle to use digital technologies – the switch required to a more digital way of working is perceived as a barrier.



“Aside from regulations, the mindset of doctors and healthcare providers is very conservative relative to other sectors. Their competencies in technology are relatively low – mindset is a big problem.”

— Health Data expert in the public sector, Japan

“Cloud is an emerging technology in the last 2-3 years in Vietnam where transitioning from a visible IT infrastructure to something abstract is new to hospital management. This is why I think it will take a long time for the cloud to be embraced and trusted completely.”

— Tam Phan Hong, Director of Cloud Infrastructure (FPT Smart Cloud), Vietnam

“Government-provided platforms have software that support EMR applications. The issue is that clinicians are not using this system for generation of electronic medical records, but rather only for lab reports, patient demographics, and visit episodes.”

— National Health IT Expert, India

Barrier 3: Low clarity on cloud regulations as applicable to healthcare data

Respondents in five out of 12 countries cited the lack of clarity in data protection regulations, specifically how healthcare data should be transmitted through and stored in the cloud, in the top three barriers to cloud adoption.

The lack of clarity stemmed from any of the following cases:

1. Missing regulations and/or enforcement

The country's personal data privacy and protection regulations did not specifically mention the cloud.



“In order for South Korea to shift towards the use of public cloud, the regulations surrounding cloud-based solutions and data privacy must be reviewed and revised. Currently, I don't see this happening anytime soon due to practical and realistic reasons as well as public clamor for data security.”

— Dong Jae Yang, Digital Health Expert, South Korea

“The fact of the matter is that these regulations are silent about the cloud. Truthfully, the real concern here is that the Personal Data Privacy Act (PDPA) is silent about the security of healthcare data.”

— Health IT Expert, Malaysia



“There is no specific healthcare data security regulation for electronic data in place. The government must put this in place. More regulations should be developed, especially on how data can be protected and the limitations of its implementation. The government must also educate the public about the regulations surrounding cloud and how this type of technology can benefit them.”

— Dr. Agus Mutamakin, Chief Information Officer, Dr. Cipto Mangunkusumo Hospital, Indonesia

“The main problem is not the lack of regulation but its apparent lack of clarity and enforcement. In most instances, the government provides guidelines for the use of technologies in public hospitals. But since this field is dominated by doctors, the compliance is very low due to the apprehensions of these healthcare professionals and that their main priority is patient care and not these digital technologies.”

— Healthcare Digital Transformation expert, Thailand

2. Unclear or complex data classification

Data classification regulations specify which class of sensitive data can be migrated to the cloud. When these regulations are ambiguous or too complex, there is confusion around which datasets could move to the cloud.



“Every country has its own data security regulations; there is no harmonization around data security. Within a country, hospitals have different regulations. There is a need to unify regulations.”

— Dr. Roberta Sarno, Head of Digital Health (APACMed), Health IT Expert

“In order for more organizations to adopt cloud, the government has to step in and make the regulations easy to follow and straightforward for users.”

— Digital Transformation Consultant, Indonesia

3. Inadequate training

While data privacy and protection regulations applicable to healthcare data have been legislated, their complexity, along with a lack of training and awareness, has resulted in low understanding and application. Healthcare organizations also fail to clearly establish data security and data protection policies and procedures.



“Regulations are very well-classified – healthcare data are arranged according to sensitivity (4-5 classifications) with some overlaps. However, I don’t think everyone from the IT staff has clarity about these. Their competency and literacy in handling the data is not very high.”

— Health Data expert in the public sector, Japan

“Data classification and security are well defined. Yet [in piecemeal] they are not clearly understood. Standardized implementation and capacities remain a challenge.”

— Stella Ward, ICT leader in the public sector, New Zealand

Barrier 4: Inadequate infrastructure is a significant barrier to cloud adoption

The lack of adequate internet bandwidth and sub-standard hardware is a key barrier to cloud adoption in developing countries such as Indonesia, the Philippines, India, and Bangladesh. In countries such as Bangladesh and India, power cuts are a frequent occurrence that often disrupt data transfers. Rural areas in some high-income countries such as Australia are also lagging in cloud adoption as they lack the connectivity required.



“Most of the cloud services are accessible only through level 3 and level 4 cities or towns apart from the metros. In rural areas, it is still not fast enough even though they have a dedicated line provided by the Ministry. This is the main challenge hindering cloud adoption and development. There are huge non-government organizations who are still not using IT services.”

— **Policymaker, Health Technology in Public Healthcare, India**

“There needs to be a bridging of the digital divide across segments of the society in order to realize digitization in this time and age.”

— **Fabian Bigar, Chief Executive Officer (Strategic Change Management Office, MyDIGITAL), Malaysia**

“IT systems are poorly implemented, which leads to many operational problems with hardware being sub-standard. Internet bandwidth, too, is a big challenge – it is needed for the cloud, and when the government doesn’t have the bandwidth set up, we face problems. Our servers, internet and electricity services are regularly disrupted which leads to work getting interrupted. We have to wait till the service comes back on. We don’t have any backup servers.”

— **Health IT Consultant to Government, Bangladesh**

Barrier 5: Budgetary constraints

As most public health organizations already have overstretched budgets, the cost of human resources and tools required to move to the cloud can be a major deterrent to cloud adoption.

These costs can arise due to any of the following situations:

1. Re-engineering legacy applications

In countries like Australia and South Korea, where public health organizations have been using on-premises-based solutions, the cost of re-writing applications to optimize them for the cloud can be daunting. The figures are even higher for complex or custom applications.



“How do you take care of the huge cost of the transformation to the latest technology? This is another challenge because there is already an existing setup. Catering to the fresh requirements comes at a cost. The challenge of how this cost can be borne by different stakeholders of the health system needs to be addressed.”

— **Manisha Mantri, Joint Director, Centre for Development of Advanced Computing (CDAC), India**

2. Fresh cloud migrations

While many emerging economies in the early stages of healthcare digitalization are free from the baggage of legacy applications, employing technical experts and cloud specialists can be an expensive exercise. Many of these countries also prioritize building more healthcare facilities in their budget allocations, which leads to a paucity of funds when it comes to their IT budgets.



“Cloud service providers should think about how they can lower the costs for the government as the cost is a big issue.”

— **Health IT Consultant to Government, Bangladesh**

“Funding for cloud migration is key and should be addressed first before plans can materialize.”

— **Dr. Raymond Sarmiento, Director, National Telehealth Center, University of the Philippines, Manila, Philippines**

“One of the main barriers by these public hospitals is the imminent budget cuts and reallocation they would experience once they adopt the private cloud from the government. In hindsight, it will lessen the burden from their end in terms of work efficiency, but the idea of budget cuts prevents them from transitioning towards this kind of digital technology.”

— **Healthcare Digital Transformation expert, Thailand**

“The government hasn’t built enough of a system to compensate the providers for moving to cloud or to reduce the cost. Clinics and smaller institutions are not motivated to use the cloud because there is no reason for them without a separate compensation from the government.”

— **Ji Sun, Deputy Director, HIRA, South Korea**

“There is limited availability of budget for migration from traditional systems given that resources are mostly diverted to manage the COVID-19 pandemic – vaccines, testing facilities, and hospital services.”

— **Fabian Bigar, Chief Executive Officer, Strategic Change Management Office (MyDIGITAL), Economic Planning Unit**

3. Low interoperability

In most of the countries included in this report, respondents mentioned that healthcare data is siloed and fragmented. Collecting and standardizing data is costly since multiple systems need to be able to talk to each other, both inside and outside the healthcare organization.²⁰



“The public healthcare system has a lot to do to ensure interoperability of health records even within the public health system.”

— **Fabian Bigar, Chief Executive Officer, Strategic Change Management Office (MyDIGITAL)**



“One problem I am trying to solve at the moment is to get people’s national COVID record matched to their local health record. That sounds easy to do, but it’s not because of the way the system is structured... So, it means the harmony of the record is not necessarily there yet.”

— **Dr. Robert Grenfell, Health Director, Health & Biosecurity, CSIRO, Australia**

“There is a fragmented implementation of Health Information Systems in Indonesia with limited interoperability. There are many HIS implemented by institutions across the board, but due to the absence of regulations, technical standards, and poor design, implementation has been limited – it has been at the discretion of the management and has been taking place in silos. Moreover, there seems to be a disconnect in terms of HIS being utilized, given the varying preferences of both national and local hospitals due to decentralization. The variations in systems without a central policy and coordination between different levels of government and districts have made it difficult to integrate data.”

— **Prof. Surahyo Sumarsono, Health-IT Consultant, Indonesia**

“EMR and other standards are not enforced properly for adoption to take place, and this is a trend that is not just limited to government hospitals.”

— **CIO, super-specialty public hospital, India**

Barrier 6: Cloud skills are in severe shortage

The shortage of advanced cloud and security skills across all sectors and across the globe remains higher than ever – however, according to respondents, the situation is even direr when it comes to a highly conservative sector such as healthcare. The use of the cloud in healthcare requires policymakers, cloud architects, security experts, and healthcare-IT staff to have a good understanding of both the healthcare domain and cloud technology, the rarity of which has become a significant barrier to cloud adoption.



“Skilled professionals for implementing IT services are lacking in Japan. There are not many talented people who can do that in the country.”

— **Health Data Specialist in the public sector, Japan**

“When it comes to the cloud in a healthcare setting, there is a knowledge and skills gap. The centralization of healthcare that is now being planned/underway is expected to bring together various departments and ensure a standardized approach, so skills and awareness come up to speed.”

— **Stella Ward, ICT leader in the public sector, New Zealand**

“Even many technical people are not confident about the cloud. If I want to move one application to the cloud, then I need to look at what changes are required and people require training to do so. Many people are not trained to do this.”

— **CIO, super-specialty public hospital, India**



“There is a requirement for competent and capable human resources. An entire cadre of human resources, including privacy experts, security experts that will check on vulnerability, technical experts for subject matter are needed. Not a lot of human resources are knowledgeable in putting systems on the cloud.”

— **Dr. Raymond Sarmiento, Director, National Telehealth Center, University of the Philippines, Manila, Philippines**

“The most difficult challenge to overcome is the openness and willingness of the staff and management of hospitals to adopt cloud technologies. Even if it is provided for them, they will not utilize it until they are not ready and equipped with the necessary skills to operate them.”

— **Digital Transformation Consultant, Indonesia**

Barrier 7: Low awareness and understanding of cloud benefits

With the cloud being a more abstract form of technology, people at all levels, from policymakers and healthcare management to staff and end-users, find it difficult to understand how the cloud works and how organizations can benefit.

1. The return on investment (ROI) in moving to the cloud isn't clear

With a limited understanding of the cloud, procurement agencies and policymakers are slow to recommend its use.



“People don't understand what the difference between a server and the cloud is. CSPs talk about what the cloud is but don't explain the benefits. How is the new solution different from what they currently have? What will the ROI be? All of these are missing.”

— **Michael Stahl, Digital Health Advisor and Consultant to APAC Governments**

2. Unmet expectations

Overselling by CSPs leads to dashed expectations as organizations do not fully understand what resources are needed to migrate and maintain systems in the cloud.



“Overselling to the decision-makers in public and private organizations who have limited understanding of the cloud is eclipsing the reality of the purpose of cloud, its design considerations, and therefore, the return on investment.”

— **Arvind Sivaramakrishnan, Chief Information Officer (Apollo Group of Hospitals), India**

“There is poor understanding of the cloud amongst policy makers. CSPs need to make decision-makers more aware of the benefits.”

— **Health IT Consultant to Government, Bangladesh**

“

“The government has to strengthen its information dissemination campaign on the benefits of cloud so it would be welcomed by end-users and the public.”

— Dr. Raymond Sarmiento, Director, National Telehealth Center, University of the Philippines, Manila, Philippines

3. Data sharing concerns

Many ministries and agencies are either reluctant to share data or aren't aware of the benefits of sharing data, which makes them reluctant to use the cloud for solutions that require data sharing.

“



“There is little demand for scalability or cost reduction because so far, data utilization is really poor. There is a lot of data being captured for every citizen; however, there is low awareness on how this data can be utilized, there are no plans to utilize this data. The government has no incentives to focus on utilization.”

— Health-IT expert and MOH Advisor, Japan



4. Recommendations

Despite the widely varying contexts—economic, social, and political—our assessment showed common barriers across countries that affect the extent to which a country has or can adopt cloud-based systems for healthcare. To a large extent, the barriers arise out of fundamental gaps: information, stakeholder engagement, financial resources, and policies regarding the use of the cloud for public sector-driven healthcare services. These gaps are not unreasonable given that the cloud is an emerging technology, and cloud services, its applications, and risks are evolving quite rapidly. Government agencies and regulatory bodies are challenged to keep pace with innovations that provide significant public value while ensuring they do not harm public interests.

Based on a comprehensive review of cloud adoption practices in the region and globally as well as insights from expert interviews, we put forward a series of recommendations that countries can adopt to reach the clarity needed to assess and deploy appropriate cloud-based solutions for healthcare services.

The purpose of the recommendations is to provide a series of options for countries to consider for implementing the cloud effectively in service of national health goals.

RECOMMENDATIONS FOR HEALTHCARE POLICYMAKERS

- R1:** Countries should adopt a Cloud First Policy for healthcare driven by a central digital health authority
- R2:** Use a range of policy tools to realize the full potential of cloud in the digitalization of healthcare
 - R2.1:** Develop data governance policies and regulation that ensure healthcare data protection while enabling innovation for better health outcomes
 - R2.2:** Establish open standards for data interoperability and data exchange for a patient-centered connected healthcare system
 - R2.3:** Design policies to seed a digital health innovation ecosystem
 - R2.4:** Build trust in cloud services through streamlining and standardizing procurement
- R3:** Assess and invest in creating a foundational ICT ecosystem that furthers cloud adoption
- R4:** Address capacity building at priority to overcome the key barriers to cloud adoption

R1: Countries should adopt a Cloud First policy for healthcare driven by a central digital health authority

What

A Cloud First policy for healthcare pushes government health agencies to consider using cloud-based technology solutions ahead of other IT solutions when a new IT project or a refresh is initiated.

Why

A Cloud First policy will help federal and state health ministries and healthcare organizations save on IT infrastructure costs and access scalable IT resources at a level of security generally higher than on-premises solutions. The use of the cloud helps build a connected healthcare ecosystem that is necessary for the realization of inclusive, efficient, and cost-effective public healthcare.

Cloud adoption can also spur advances in public health as its scalable nature is more suitable for data-driven innovative solutions such as analytics, AI, and machine learning solutions that are now driving innovation across sectors. The cloud is also vital for helping healthcare startups scale.

How

- **Fully commit to the cloud** through a Cloud First strategy enforceable at all levels of government.
- **Empower a new or existing Digital Health Authority** to drive national strategies for cloud adoption in healthcare.
- **Establish a multi-stakeholder consortium** to advise on developing a roadmap for migration and implementation.
- **Formalize budgeting and procurement processes.**
- **Establish timelines for cloud migration along with implementing the appropriate training and education programs required for digital upskilling for healthcare personnel.**



The UK's NHS has declared 'Public Cloud First' to be a part of its architecture principles, stating that digital services must move to the cloud unless there is a clear reason not to do so.²¹

New Zealand's Chief Digital Officer helps drive ICT and specifically cloud adoption in the government through the issuance of guidance on procurement and implementation of cloud services.²²

R2: Use a range of policy tools to realize the full potential of the cloud in the digitalization of healthcare

What

Introduce a range of policy tools, including mandates, financial and non-financial support, incentives, and shared risk models at the central and sub-regional levels to overcome resistance to cloud adoption.

Why

The lack of an enforceable mandate has stalled digital health transformation initiatives in countries such as India and Thailand. Unclear ownership of digital health initiatives and the absence of a clear chain of command have further led to fragmented and siloed implementation. The right policy tools, built around critical enablers such as interoperability, regulations, and procurement, can help overcome organizational resistance to digitalization and enable quicker and wider adoption of the cloud.

How

The following mechanisms may be built into national digital health strategies and policies to improve cloud adoption:

- **Mandate** the digital transformation of healthcare enforceable at all levels of public healthcare systems. Mandates should be supported by budgetary and technical assistance.
- **Improve the adoption of the cloud through financial incentives** such as reimbursement schemes, extrabudgetary grants, and non-financial incentives such as shorter reimbursement cycles.
- **Shared-risk models** may lower the risk of adopting a digital solution by having the government bear a portion of the risk.
- **Consider the use of disincentives** such as exclusion from participating in national insurance programs and/or reduced service fees.

In the US, the Health Information Technology for Economic and Clinical Health Act (HITECH) introduced incentives related to healthcare information technology, including financial incentives for the use of electronic health record (EHR) systems among providers.

The Act increased the rate of adoption of EHRs from 3.2% in 2008 to 14.2% in 2015. By 2017, 86% of office-based physicians had adopted an EHR, and 96% of non-federal acute care hospitals had implemented certified health IT.²³

In Singapore, nursing homes that subscribe to NHelp—an IT system offered free to them by the Ministry of Health (MOH) for three years, and at subsidized rates after that—will also be hosted on its healthcare cloud, H-Cloud. Such nursing homes will no longer need to buy and maintain their own systems, as NHelp provides all the programs they need, such as those for finance and rostering.



R2.1: Develop data governance policies and regulation that ensure healthcare data protection while still enabling innovation for better health outcomes

What

Data privacy and protection policies and regulations are key building blocks of digital health. Clear data governance frameworks must be built that ensure risk-appropriate governance based on internationally recognized standards.

Why

Given the sensitivity of health data, it is necessary to ensure its integrity, availability, privacy, and protection. Health data breaches and misuse will only increase as the volume of health data grows. However, some Asia-Pacific countries, including India and Vietnam, have not yet passed data protection regulations. At the same time, it is important to ensure that regulations do not hamper innovation through overly restrictive regulations preventing data sharing and use. Governments must develop a clear framework that allows secure collection and sharing of data between people, healthcare organizations, and the government while ensuring data protection and privacy.

How

- The Digital Health Authority must work with regulatory bodies and stakeholders to **develop, update, and provide training on regulations** pertaining to data security, data privacy and protection, and data localization policies.
- **Establish a central authority for the monitoring and accreditation of CSPs**, such as the FedRAMP in the US, developing mechanisms and policies for oversight and compliance, including the selection of monitoring tools, SLA violation, audit types and frequency, and accreditation procedures.
- **Regulations must be in accordance with the risk profile of the datasets** in question and in line with international standards and best practices.
- Policies should **address reporting and transparency requirements** for organizations that collect, use, and store health data. **Individuals should be given greater access and control over their data.**
- Develop and implement accountability-based instead of jurisdiction-based regulations that ensure that businesses responsible for storing and transferring a country's health data continue to follow the country's data protection rules regardless of where the data is stored.



In 2016, Singapore's Ministry of Health (MOH) completed a study mapping the world's first Multi-Group Cloud Security (MTCS) Singapore Standard to the healthcare sector. The private healthcare sector was also given guidance on the mapping between the different security groups and healthcare datasets.

The mapping guidelines showed, for example, that MTCS Level 1, the base group, could be used to host publicly available information such as clinical standards and terminology systems; Level 3, the most stringent, could be used to host clinical, administrative support systems such as billing and admissions data.²⁵

R2.2: Establish open standards for data interoperability and data exchange for a patient-centered connected healthcare system

What Fully interoperable systems enable the exchange and use of health information across organizations, regional, and national boundaries. Open standards allow users greater choice in adopting a solution that meets their needs while allowing portability across vendors.

Why Health data is needed for three critical purposes: for healthcare financing, for epidemiology & disease management, and for enabling resource optimization and e-governance. Respondents in a majority of the countries that have been the subject of this report have seen fragmented implementations of digital health solutions, which is more pronounced in large countries such as India and Indonesia. This obstructs the collection, sharing, and analysis of health data across health systems, severely limiting the benefits of digital health solutions.

When interoperability standards are established and implemented, allowing the exchange of standardized health data via the cloud securely and in real-time, the full potential of digital health systems can be unleashed, boosting not just national but global health outcomes.

How Policymakers must build interoperability into their digital health frameworks from the beginning and take the following steps:

- **Establish common open standards for data interoperability** and data standardization in electronic health records (EHRs) and health information exchange (HIE) services that are internationally recognized and design a roadmap for stepwise implementation.
- **Mandate interoperability** for payers, providers, and healthcare organizations.
- **Establish incentive programs** for compliance with standards and the adoption of EHRs.
- **Provide training in the tools, standards, and regulations applicable** through national and regional cloud centers of excellence or equivalent capacity-building bodies.
- **Participate in data-transfer agreements** such as the Asia-Pacific Economic Cooperation's Cross-Border Privacy Rules (CBPR) that enable international interoperability while ensuring the respective country's privacy rules are enforced.



In 2020, the US Centers for Medicare and Medicaid Services (CMS) mandated the use of the FHIR (Fast Healthcare Interoperability Resources) standard among many CMS-regulated payers and providers by July 1, 2021.

How interoperability improves digital medicine²⁶

AI and Big Data

- provide algorithms with clear data structure and semantics
- ensure validity of analysis results
- create trust in digital technologies

Medical Communication

- enable easy information retrieval
- avoid medical errors caused by communication barriers
- reduce documentation burden
- empower patients

Research

- improve the use of real-world data (e.g. for large-scale observational studies)
- create new research hypotheses (with data mining and AI)
- enable remote development of analysis scripts

International Cooperation

- pool data across organizations (e.g. rare diseases, precision medicine)
- tackle global public health issues (e.g. infection control, epidemics)
- provide global access to new technologies

R2.3: Design policies to seed a digital health innovation ecosystem

What

Policy and budgetary support is needed to boost digital health innovation that can help support the government in tackling public healthcare challenges.

Why

Many Asia-Pacific governments are struggling under the burden of large public health challenges. Digital health technologies and services can be a game-changer in improving health outcomes by enabling more efficient, cost-effective, and inclusive healthcare. However, the innovation ecosystem in most developing countries has not evolved to serve today's digital economy.

Governments in these countries still look to traditional financing models that require collateral to provide funding support to startups, a requirement that most startups cannot meet. Procurement is often archaic – tilted heavily towards companies that have an established track record, leaving little room for startups to work with public sector providers. In the interest of safety, governments also tend to over-regulate the digital health space, which stifles innovation. Governments should instead look to nurture their fledgling innovation ecosystem through restructuring policy changes and financing for startups. Comprehensive regulations can be put in place at this stage once the digital health system has scaled and matured.

A big share of startups' cash burn is typically in the area of online platforms and infrastructure costs, which continues for several years prior to monetization occurring. By partnering with cloud service providers and offering cloud credits, governments can play an important role in helping digital health startups scale.

How

- **Government financing for startups should be restructured** towards a venture capital model.
- **Design policies that support digital health startups with financial and non-financial incentives**, including investor matching, capital injections, and funding assistance, as well as dedicated entrepreneurship programs such as accelerators and incubators. Tax subsidies for startups, especially refundable R&D tax credits as offered by the UK, Canada, and SME grants, can go a long way.
- **Develop more inclusive procurement policies** that support smaller players and startups as opposed to turnkey vendors of a certain size and scale.
- **Build startup support networks** along with the private sector, including cloud service providers, R&D centers, academic institutions, and entrepreneurship agencies.
- **Attract, retain, and build a talent pool in cutting-edge specializations** such as AI/ML and in emerging healthcare areas such as genomics and precision medicine.
- **Set up cloud pilot sites** to test and scale the adoption of cloud services.
- **Foster data-driven innovation** by encouraging 'open data' practices and data sharing by and between public and private players.

Singapore's Government Technology Agency of Singapore (GovTech) has made procurement more inclusive by inviting smaller companies to submit proposals and allowing them to partner with other companies as the procurement process proceeds further. It has also made the procurement period more flexible by allowing companies to submit proposals later in the procurement cycle.²⁷

In 2017, ACCESS Health Digital worked with India's National Health Authority (NHA) to launch the Social Entrepreneurship Accelerator (SEA) to help Indian HealthTech startups and vendors implement Open Digital Health Standards that are applicable globally. As an AWS Activate provider, SEA worked with AWS to provide healthtech startups with free AWS credits, technical support, mentorship, and market access to help startups grow their business.²⁸

A research fund set up by the Australian government, the **Medical Research Future Fund**, injected \$19.8 million in a digital health accelerator, **ANDHealth**, the government's largest investment in digital health. 10 companies selected in its initial pilot program raised over \$70 million, created 300 jobs, and undertook 44 clinical studies over four years.²⁹



R2.4: Build trust in cloud services through streamlining and standardizing procurement

What

The digital health authority should establish policies and issue guidance that enables streamlined and standardized procurement of cloud services.

Why

Budgetary concerns and a limited understanding of cloud services have hindered the adoption of the cloud. Guidance on procurement along with the establishment of minimum service standards for CSPs can help organizations adopt the cloud with greater confidence. This will also help mitigate concerns around cloud data governance, vendor-concentration risks, and business continuity.

How

- **Issue procurement guidance** specific to the risk profiles of applicable datasets, cloud computing service types (IaaS, PaaS or SaaS), cloud deployment models (public, private, community, hybrid) in line with internationally accredited security and privacy standards.
- **Issue a list of certified CSPs** that meet the minimum level of standards as outlined in the procurement guidance. Alternatively, allow organizations to self-assess or appoint an independent third-party assessor to identify a suitable cloud service based on the procurement guidance issued.
- **Allow 'smarter procurement'** by buying as a single enterprise at the central or sector-level and standardizing contracts.
- **Define detailed Service Level Agreements (SLAs)** that address data governance in the cloud, service and data availability, risk management and remedial measures, exit management, and other service considerations.
- **Mitigate vendor-concentration and lock-in risks by modifying requirements to include** hybrid and/or multi-cloud models, cloud portability, and technology-neutral architecture as appropriate.



The New Zealand government has negotiated commercial agreements with CSPs to create a marketplace that enables government organizations to access cloud services with a single price book and standard terms and conditions. The government is also developing a marketplace to give government organizations access to a catalog of cloud services.³⁰

The Australian Cyber Security Centre and the Digital Transformation Agency have released guidance to help government agencies assess CSPs and their services.³¹ Its Infosec Registered Assessors Program (IRAP) initiative provides assurance that ICT systems meet the Australian government's cyber security standards.³²

R3: Assess and invest in creating a foundational ICT ecosystem that enables cloud adoption

What

The central government must establish policies and create an investment plan to build a strong ICT foundation for cloud adoption spanning both:

1. The physical resources needed, such as international and domestic broadband connectivity and newer digital technologies, broadband quality, and reliable power.
2. A sustainable talent pool for bringing the country's ICT strategy and vision to life.

Why

The COVID-19 pandemic has highlighted the importance of core ICT infrastructure for rapid, convenient, and affordable delivery of essential national services such as teleconsultations, remote diagnosis and monitoring, secure health data storage, exchange, and transfer. Our research shows that developing countries such as Indonesia, India, and Bangladesh are lacking in such infrastructure, impeding the use of digital health technologies, including the cloud.

Moreover, in countries as varied as New Zealand, Japan, and the Philippines, interview respondents noted a significant skills gap both in IT technologies and cloud services in the local workforce. Investing in this ICT foundation will be key to the growth of cloud-enabled digital technologies. Moreover, a national Cloud First policy will help governments reduce taxpayer spending on IT infrastructure and adopt a more scalable pay-as-you-go approach to IT while enabling improved service delivery.

How

- **Assess gaps in ICT infrastructure and skills in the existing ICT strategy and create an investment plan**
- **Mobilize sustainable financing** by establishing a dialogue between all stakeholders, including multilateral organizations and development banks, to mobilize the financing and investments needed.
- **Establish a national plan for ICT upskilling:** A multi-pronged approach may be needed to reduce the gap, including both short-term intensive re-training and upskilling courses as well as IT skill programs in primary, secondary, and tertiary education.
- **Adopting a national Cloud First strategy** will speed up cloud adoption.



New Zealand's Cloud First Policy: The New Zealand government requires public sector organizations to accelerate their adoption of cloud services—in a balanced way—so they can drive digital transformation. The Cloud First policy requires organizations to:

- adopt public cloud services in preference to traditional IT systems.
- make adoption decisions on a case-by-case basis following a risk assessment.
- only store data classified as RESTRICTED or below in a cloud service, whether it is hosted onshore or offshore.³³

R4: Address capacity building at priority to overcome the key barriers to cloud adoption

What

Narrow the cloud services knowledge and implementation gap through education coupled with technical assistance.

Why

Resistance to digital technologies by hospital management and administration was cited as one of the major barriers to cloud adoption. Knowledge gaps in understanding how cloud technologies work and its benefits, a shortage of cloud in healthcare skills, along with the poor design of cloud-enabled digital health applications, have all contributed to this reluctance and need to be addressed with high priority.

How

The ministry of health, digital health leadership, regional and multilateral health organizations, donors, and other stakeholders should develop a coordinated strategy for capacity building. A designated body for capacity building such as a Centre of Cloud Excellence or equivalent can play an important role in addressing gaps through the following:

Education, training, and awareness:

- A Massive Open Online Course (MOOC) based model can be used for education and training on a large scale.
- Develop module-based curricula for healthcare professionals on digital adoption and training with a specific focus on cybersecurity risks and implications.
- Guide healthcare organizations to clearly set out data protection and privacy regulations in line with policy guidelines.
- Healthcare IT personnel should be trained in developing the skillsets and expertise needed to design and manage the use of cloud services in healthcare applications according to their respective security classifications.
- Decision-makers at all levels of government must also be groomed to understand technology use and its implications, including the use of the cloud.
- Best practices, success stories, and lessons from failure using the cloud should be disseminated not only among policymakers but across the healthcare ecosystem nationally and across borders.
- Change management models such as ADKAR and ADOPTS should be implemented to overcome resistance to the cloud and digital technology adoption.

Digital Health Applications:

- Guide organizations in the best practices applicable to migrating legacy applications to the cloud and adopting cloud-native approaches – these are crucial to realizing greater returns on investment in the cloud.
- Consider the use of PaaS and SaaS-based digital health for small and medium-sized hospitals that together cater to a majority of the population, as these require relatively lower training. Technology neutrality is also an important principle to be implemented to lower time spent on training if switching to a new vendor.
- Stakeholders and end-users must be brought together to design digital health applications in keeping with best practices such as the UNDP's design principles for digital applications.³⁴ This will address end-users' concerns and improve attitudes towards digitalization.



The African Alliance of Digital Health Networks' Digital Health Leadership Program aims to build capacity in digital health leaders through training, mentorship, and providing support through peer networks. This is intended to drive confidence, better management and improvements in the planning and execution of digital health initiatives.³⁵

The Malaysian Digital Economy Blueprint aims to develop "Digital Transformers" to groom highly skilled civil servants comprising technical experts and professional ICT-related talent.³⁶

5. How Can Public Healthcare Benefit from the Cloud?

Cloud technology offers a multitude of benefits for healthcare, a sector that is generating ever-increasing volumes of data, with new clinical breakthroughs coming at a rapid pace. At the same time, the sector is also facing challenges in terms of data and operational fragmentation. Cloud technologies can help maximize these opportunities and address these challenges through their hyper-scalable data storage and computing power, by facilitating the exchange of real-time data across devices and geographic locations and as an enabler of data-powered decision-making.

Throughout the sections below, we describe how the cloud brings benefits to the healthcare sector at three levels: health systems as a whole, hospitals and healthcare facilities, and to patients.

Cloud brings about benefits to healthcare systems at three levels



5.1 Cloud Drives Health System Transformation Through Data-Powered Solutions

Health systems throughout the Asia-Pacific region are grappling with the twin demographic shifts of aging populations and an expanding middle class, which mutually contribute to a rise in chronic conditions and a demand for high-quality services. Consequently, health systems are shifting from acute-care-centric models to chronic disease care that is patient-centered, personalized, and efficiently delivered. With this shift comes a high demand for data integration as value-based care gains traction and as health systems invest in long-term, community-based care models.

Cloud-based solutions support health systems to transform their care and financing models. Screening and diagnostics, health data exchanges, and connected care systems enable healthcare providers to right-site care: providing the right care at the right time and in the most appropriate location or facility. Medical research, population health management, logistics management, and financing services support health systems in responding to current healthcare needs while strategically planning for future needs.

The real-time health information of an entire population, coupled with advanced predictive tools such as AI and ML, are powerful tools for the public health system to monitor people's health and drive health-seeking behavior. Health systems can invest in innovation through cloud technology, as it provides access to important datasets in secure conditions.



The Thai Ministry of Public Health uses a cloud-based artificial intelligence system and mobile application data to predict public health risks and gastrointestinal disease hotspots, mitigating the risk of epidemics. With an accuracy rate of 80%-90%, the AI model analyzes photographs of public restrooms and brings sanitation issues to the notice of local restroom operations staff.³⁷

Due to its scalability, cloud technology can adapt to large amounts of data such as genomes and DNA sequences gathered from next-generation sequencing.³⁸ The information collected can promote earlier detection and prevention of diseases and develop better diagnostic and treatment plans.³⁹



The US National Cancer Institute implemented Broad Institute's FireCloud and Seven Bridges Genomics' Cancer Genomics Cloud in 2015. The cloud spaces were open to the public, who could analyze and develop analysis workflows to detect patterns and anomalies within genomic sequences. This improves access across medical research institutions, driving the pace for innovations and discoveries.⁴⁰

Since the beginning of the COVID-19 pandemic, there has been broad recognition of the importance of digital health infrastructure for resilient health systems. Countries that quickly developed and deployed secure digital health tools were better at containing SARS-CoV2 in 2020. Notable initiatives included applications for contact tracing, testing, and epidemiological analysis, along with the use of telehealth to reach patients who could not travel or for whom it was not safe to visit the clinic or hospital.



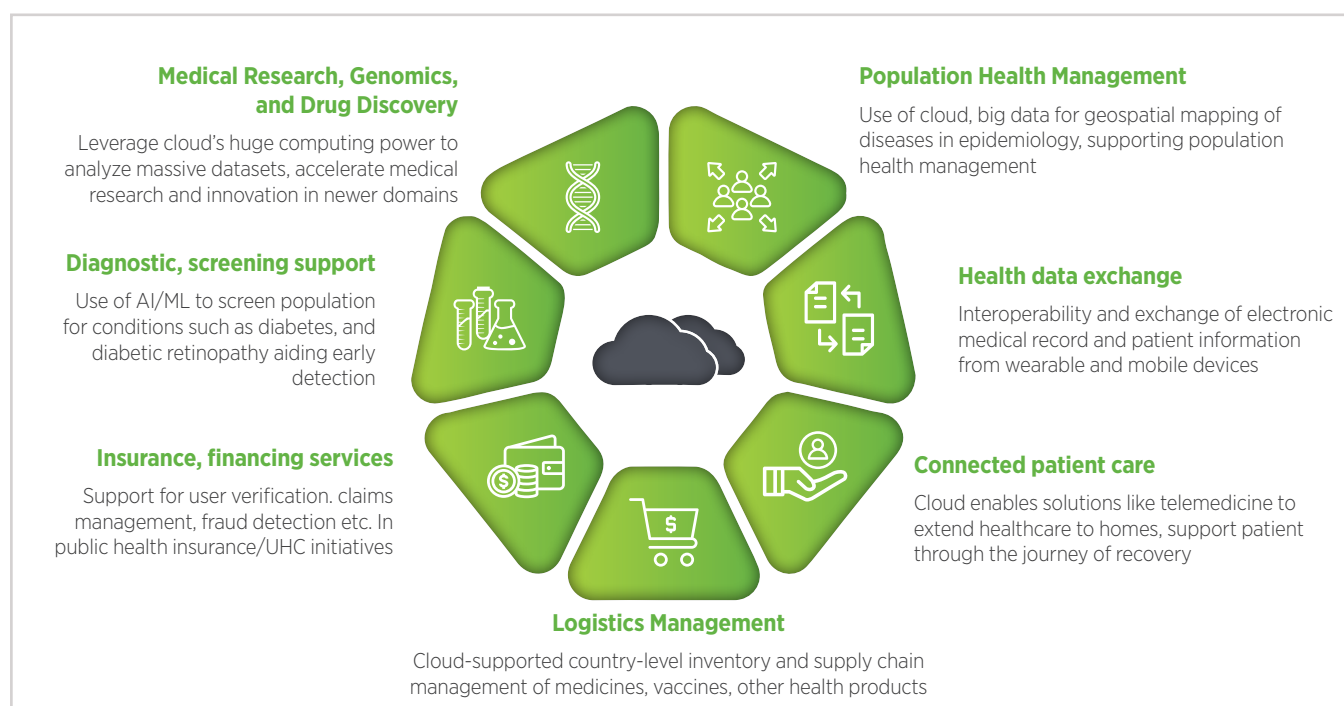
The Republic of Korea introduced the Epidemic Investigation Support System as a part of the COVID-19 response, which shortened the contact tracing process from 24 hours to 20 minutes for the South Korean population during the initial wave of the pandemic.⁴¹



The UK's automatic syndromic surveillance system scans National Health Service digital records to pick up clusters of a respiratory syndrome that could signal COVID-19.⁴²

The pandemic also shone a light on sub-national inequities in access to healthcare. The importance of digital health tools that are interoperable and universally available underpin the realization of universal health coverage (UHC); only with digital technologies will countries be able to achieve the iron triangle of UHC: access, cost, and quality. Doing so will require infrastructure and tools that are both secure and adaptive. Interoperability of data connects the entire health system with a click, and through cloud adoption, patient data becomes readily available for gaining insights to facilitate UHC healthcare planning and implementation.

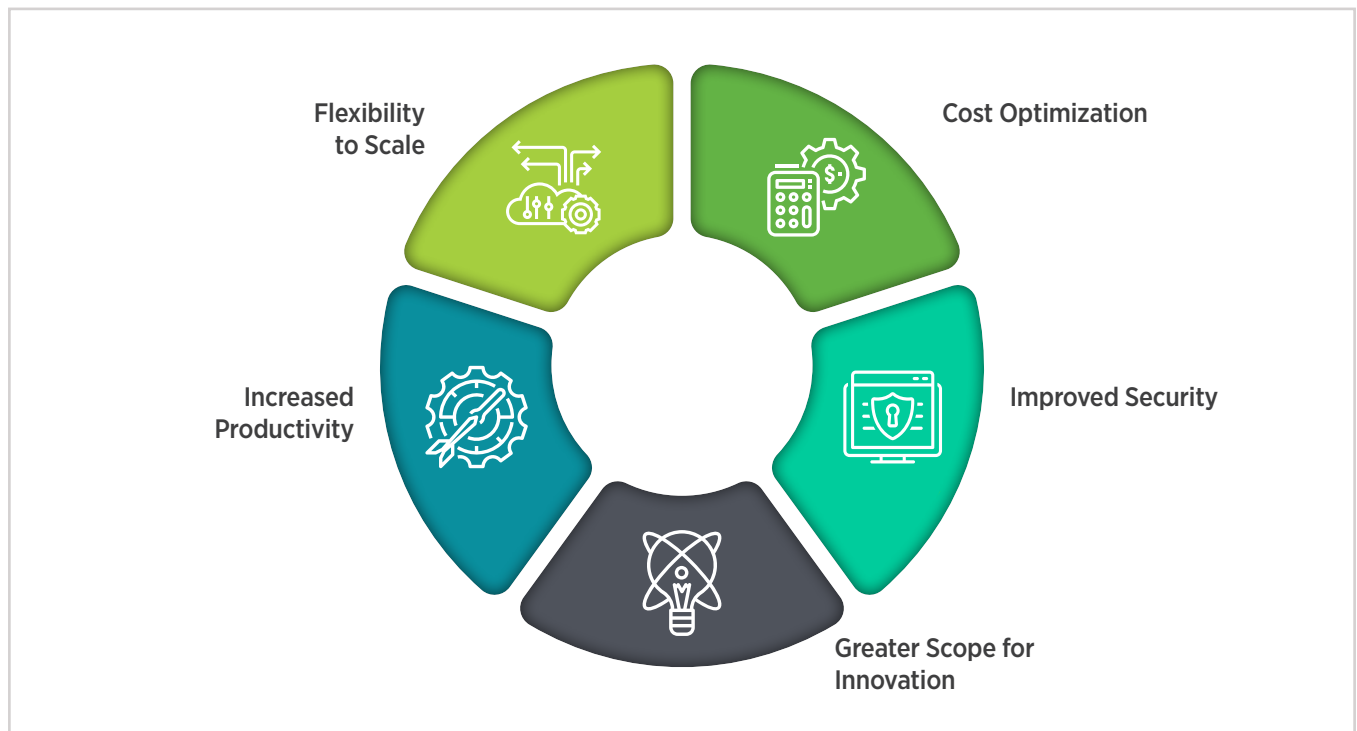
Benefits of cloud for health systems



5.2 Healthcare Organizations Benefit from Leaner, More Strategic Operations to Offer High-Quality Patient-Centered Care

By transferring the operational load of IT systems' procurement, upgrades, and maintenance to cloud service providers (CSPs), healthcare organizations can focus on their core services: patient care. The cloud provides a host of benefits to healthcare organizations, as shown below.

Benefits for government healthcare organizations



Flexibility to Scale

While on-premises systems require additional investment and implementation time, cloud computing allows healthcare organizations to rapidly scale storage and computing abilities up or down without any time delay at a marginal increase in cost. Cloud computing adapts to the needs of healthcare systems at all times, enabling organizations to handle varying scales of operations to implement national programs, store higher volumes of patient health records, and respond to crises such as the COVID-19 pandemic. By ensuring that services continue to be available even amidst high spikes in demand, cloud services ensure business continuity.



According to a study published by the *Journal of the American Medical Informatics Association*, during the pandemic, the country's telehealth services for urgent care grew by 683% and by 4,345% for non-urgent care.⁴³



Indonesian telemedicine startup Halodoc, which runs on AWS cloud, found that active users of its services have reached more than 20 million people in Indonesia, which was a 10-fold increase in the first quarter of 2020 from the year before.⁴⁴



Cost Optimization

Migration to the cloud reduces upfront investments in IT infrastructure, enabling access to scalable IT resources through a pay-as-you-go model. It reduces government investments in establishing data centers, which require upgrading, maintenance, and resources over time. Studies show that cloud computing is more cost-effective compared to analytics tools supported by local data centers, especially for data-intensive projects such as biomedical, translational research.⁴⁵



Singapore's Healthcare-Cloud (H-Cloud) is a nationwide private cloud that seeks to reduce operational costs by an average of 55% by 2025.



Improved Security

Governments often cite security concerns as a reason for hesitation in migrating from legacy IT systems to cloud-based systems. However, if designed and implemented correctly, cloud-based systems can be more secure than information held on-premises. For on-premises systems, any harm to the data center can result in losing valuable patient and organizational information. Robust cloud options include automatic backups and data recovery—which minimize loss in the event of a breach—and automatic upgrading to the latest security patches.⁴⁶

Cloud service providers are subject to strict and extensive security and compliance regulations across the globe, especially as more organizations dealing with highly classified data, such as the US Department of Defense, are migrating to the cloud.⁴⁷ Consequently, industry leaders such as AWS, Microsoft Azure, and Google Cloud invest heavily in ensuring the security and privacy of data through multiple physical and digital security measures. It would not be possible for a healthcare organization to achieve such high levels of security on its own without exceeding its IT budget.



In 2017, the Republic of South Korea launched the Precision Medicine Hospital Information System (P-HIS), a program to implement precision medicine in hospitals. The program aggregates sensitive information from multiple sources and thus needs to be secure. The Korea University Medical Center (KUMC) collaborated with Clinerion, a Swiss-based provider of “anonymized identification” technology. Clinerion's Patient Network Explorer anonymizes data at the source hospital and de-anonymizes the same data at the destination, ensuring the security of the data exchanged.⁴⁸



Greater Scope for Innovation

Cloud-based systems provide real-time health information and advanced predictive tools such as AI and sophisticated analytics, which can be used by healthcare organizations to carry out research across large datasets, and avail of clinical decision support tools. Data extrapolation and analysis across departments can help improve the patient experience, adhere to quality standards, and make use of new technologies and applications.



The U-health program is a unique health innovation by the Korean government that allows the monitoring of patient data collected from wearable healthcare devices. Under this program, the Seoul St. Mary's Hospital at the Catholic University of Korea undertook a pilot program that developed algorithms to monitor blood glucose levels for patients. Research suggests that innovation such as this can reduce physician time by 50% and reduce out-of-pocket costs incurred by the patient.⁴⁹



One of the largest private hospital chains in India, Apollo Hospitals, partnered with Microsoft's AI Network for Healthcare to apply machine learning and AI to cardio-vascular health records to develop an Indian-specific heart risk score. The heart risk score, along with Apollo Hospitals' AI model, helps predict a patient's risk for heart disease and allows doctors to establish an earlier diagnosis and create a patient health plan.⁵⁰



Increased Productivity

Cloud computing boosts productivity for both clinicians and IT teams. Post-migration to the cloud, internal IT teams do not have to procure or manage hardware or operating system requirements. The cloud allows for virtual collaboration between stakeholders, including hospital departments and government divisions.⁵¹ Its agile infrastructure enabled remote working during COVID-19, as it provided better flexibility to switch over to virtual interactions and deploy resources quickly.



The state of South Australia's Department for Communities and Social Inclusion provides health services for people with disabilities through a network of non-governmental organizations (NGOs). The Department deployed a single software-as-a-service (SaaS) cloud platform provided by Salesforce, which automates contract administration and processing of payments to NGO partners. After adoption, processing time was reduced from an average of five weeks to less than three days. The South Australian public agencies have employed whole-of-government contracts that enable access to DCSI's Salesforce platform.⁵²



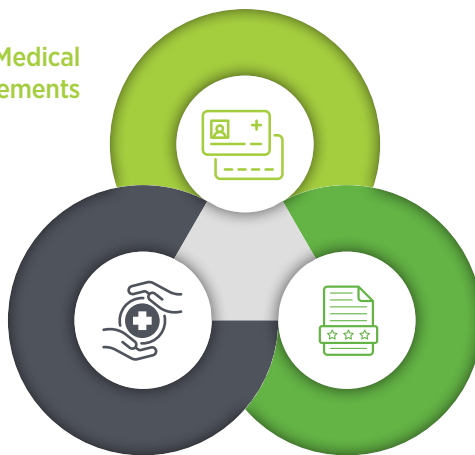
Accenture, in its 'The Cloud Imperative in Healthcare' report, observed that healthcare organizations implementing a multi-cloud operating model saw a 20% to 50% productivity spike and a 30% to 80% improvement in quality while leveraging a two to eight times increase in speed to market.⁵³

5.3 Patients Receive More Accessible, Personalized, High-Quality Care

Benefits for patients

Easier Registration, Access to Medical Reports, and Reimbursements

Continuity of Care



User Engagement and Patient Feedback

By creating a connected healthcare ecosystem, the cloud helps patients better manage their own health.



Easier Registration, Access to Medical Records, and Reimbursements

With cloud computing and its scalability, patient registration, outpatient processes, and billing are streamlined and far more efficient. Moreover, with their data stored in cloud files, patients can access their health records remotely at any time. This creates greater transparency in the healthcare system and helps patients take ownership of their own health.⁵⁴ Billing processes become well-connected to patient insurance, allowing for smoother transactions.



Singapore allows citizens to access hospital discharge summaries, test results for chronic diseases, health screening records, and upcoming medical appointments from its HealthHub.sg website and its app.



Continuity of Care

Cloud technology allows for secure exchanges of patient health records across hospitals and healthcare organizations. This makes patients' health data available to pharmacists, doctors, and financial entities, promoting continuous care of the patient. With a smooth exchange of information, patients can be given the best care no matter where they are. Cloud-based solutions also encourage medical personnel to collaborate and provide the best care possible for the patient.⁵⁵

The rise of telehealth has also allowed continuity of care, permitting the inclusion of patients who were otherwise unable to travel or get care services to also access healthcare services at a lower cost. It reduces travel time and reduces the risks of disease spread in hospitals while helping patients manage chronic diseases through remote patient monitoring.^{56 57}



Collaborate Health Cloud is a technology startup based in Greece that aims to improve patient care through team-based and patient-centric diagnoses. Through their Team-Based Diagnosis feature, the startup provides patients access to second opinions and reduces time costs for collaborative diagnosis to administer the best possible care for the patient.⁵⁸



Partners HealthCare is a US-based non-profit network of healthcare providers that offer remote monitoring and other programs for heart failure patients. The organization has enrolled over 1,200 heart failure patients since 2006 and has reduced hospital readmission among its clients by 50%. Patients send real-time data on heart rate, blood pressure, and weight on a day-to-day basis, improving patient analytics and promoting patient education and care.⁵⁹



The Smart Health Video Consultation (SHVC) initiative in public hospitals in Singapore enables patients to follow up with physicians virtually after being discharged from hospitals.⁶⁰



User Engagement and Patient Feedback

Through cloud solutions, user engagement and feedback portals can be managed to gain valuable insight into patient and user experience. This promotes better care and the provision of services for patients. Patient feedback and user engagement also improve communication between patients and medical personnel and improve personalized delivery of medical services. Moreover, the cloud also enhances patient inquiry systems, ensuring faster and higher quality responses to patients' administrative queries.⁶¹



Google Cloud provides a Contact Centre AI, a virtual agent that converses with patients and assists them with complex administrative or medical issues. They also released a cloud solution, Rapid Response Virtual Agent, which was created specifically for the COVID-19 pandemic.⁶²

6. Appendix I: Country Profiles

The following sections give a detailed overview of cloud adoption for public healthcare in the 12 Asia-Pacific countries listed below.

For each country, we cover the readiness factors as described in section 3.1 through an overview of the health system, current public health challenges, key digital health initiatives, key cloud initiatives, policies and legislation. We examine the barriers and challenges and end with brief recommendations for moving forward.

GROUP 1: HIGH-INCOME	GROUP 2: UPPER-MIDDLE-INCOME	GROUP 3: LOW-MIDDLE-INCOME
SINGAPORE — AUSTRALIA — NEW ZEALAND — SOUTH KOREA — JAPAN	MALAYSIA — THAILAND	INDONESIA — VIETNAM — PHILIPPINES — INDIA — BANGLADESH



SINGAPORE





SINGAPORE: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 86/100⁷⁰

Rank: **Progress on health-related SDGs (2015)** 1/188⁷¹

Rank: **Healthcare Access & Quality Index (2015)** 91/195⁷²

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 11/193⁷³

Cloud Readiness Index 81.5/100⁷⁴

UN ITU ICT Development Index 18/193⁷⁵

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✓ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

SINGAPORE — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Singapore is often recognized as having one of the best healthcare systems in the world due to its high-quality care delivered at a relatively low cost.^{63 64}

Healthcare Authority: The Ministry of Health is the primary authority governing health policies and programs. Recognizing the importance of a well-functioning and high-quality healthcare system, the government of Singapore has launched a digital transformation process led by the Ministry of Health Office for Healthcare Transformation (MOHT).⁶⁵

Health Financing: Singapore's health financing mechanism is a multi-payer financing model, known as the 3Ms, that emphasizes co-payment and shared responsibility among individuals, the government, and employers to pay for healthcare expenses. MediShield Life is the national health insurance program that covers every Singaporean citizen and permanent resident for qualifying hospital inpatient expenses. MediSave is a compulsory health savings account that combines contributions from an individual and their employer to fund co-payments, outpatient care, and supplementary insurance premiums. Finally, MediFund acts as a safety net for people who cannot afford their healthcare bills.⁶⁶

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging population: Singapore has one of the fastest aging populations in the world due to its high life expectancy and low birth rate.^{67 68} As a result, there is an accompanying rise in chronic diseases, increased government investments in healthcare, and rising consumer demand.

Rising Healthcare Expenditure: National health expenditure in Singapore increased from SGD 13 billion in 2012 to SGD 22 billion in 2017, equating to an average increase of 11% annually due to more utilization and higher manpower costs.⁶⁹

6.1 Singapore

6.1.1 Digital Transformation of Healthcare in Singapore: Context and Maturity

Singapore has seen significant success in its digitalization of public healthcare. The digital transformation journey of its health system is anchored within the national electronic health record (NEHR) system. Prior to 2011, each of the then six regional health systems had procured commercial electronic health record systems that could not “talk” to each other, leading to data fragmentation and disruptions to continuity of care across settings. NEHR was envisioned as creating “one patient, one health record” spanning all publicly operated regional health systems. The government has set a goal to onboard all healthcare facilities, including private sector clinics and hospitals, onto the NEHR by 2025.⁷⁶

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

The government has since designed and implemented the following patient-centric digital solutions for health:⁷⁷

HealthHub:

A web portal and mobile app that acts as a one-stop online health information and services portal. Patients can log in to HealthHub using their SingPass digital ID and access their health records, laboratory results, and prescriptions; make appointments and payments; and find information about their conditions, medications, and related services.

Telehealth:

In 2017, the Smart Health Telehealth program was launched in the public healthcare system, consisting of teleconsultation, vital signs monitoring, and telerehab.⁷⁸ The Ministry of Health launched a regulatory sandbox for telemedicine in 2018 to better understand the risks and benefits of teleconsultations. Starting in mid-2022 under the Healthcare Services Act, doctors who register as telemedicine service providers will be able to offer CHAS subsidies and submit MediSave claims for the follow-up of chronic conditions via teleconsultation.⁷⁹

Next-Generation Electronic Medical Record (NGEMR):

After the launch of its first EMR project in 2011, the NGEMR project was launched in 2018 with the aim to review and harmonize diverse IT systems in Singapore to achieve one single standardized, consolidated system.⁸⁰

Precision medicine:

The National Precision Medicine (NPM) strategy is a ten-year effort launched in 2017 that leverages advancements in data science and Singapore's genetic diversity to accelerate biomedical research, health outcomes, and economic growth. Through NPM, Singapore is ensuring that it can meet the healthcare needs of its aging population and provide personalized treatment for chronic diseases.⁸¹

6.1.2 Cloud adoption in public healthcare: Policies, Notable Initiatives, and Regulations

Singapore is one of the most advanced countries in the region in its adoption of the cloud for the healthcare sector.

Cloud policy for the public sector

As part of its Smart Nation strategy, the Singapore government officially adopted a commercial Cloud First Policy in June 2018 as it intends to migrate the majority of Government ICT systems to the commercial cloud over the next five years.

GovTech, the central agency driving IT adoption, developed a tech stack—the Singapore Government Tech Stack—that government agencies can use to build digital services quickly and securely⁸² while providing a seamless user experience. These technology solutions are housed on the Government Commercial Cloud (GCC) – a cloud specially developed for less sensitive data that offers organizations commercial cloud options that are scalable and customizable.

The Services and Digital Economy (SDE) Technology Roadmap, which guides the industry investments and regulatory approaches of Singapore’s Infocomm Media Development Authority (IMDA), named cloud-native architecture as being instrumental and essential to a thriving IT and media economy.⁸³ This architecture would catalyze and support the development and delivery of seamless digital services⁸⁴ that are cost-effective, scalable, accessible, and agile.

Cloud for Healthcare: Maturity and Notable Initiatives

H-Cloud: In 2016, Singapore committed USD 37 million toward developing a dedicated healthcare cloud, named H-Cloud, to underpin the evolving NEHR and allow providers to migrate all patient health records to the cloud within 10 years. This investment in H-Cloud is expected to reduce the overall healthcare expenditure by nearly 12-17% and enable innovation across the healthcare ecosystem. In the first major project under H-Cloud, a team of over 500 people “migrated more than 200 systems over 15 months with 99.95% success rate and minimal impact to hospitals’ operations and patient treatment.”⁸⁵

The H-cloud enables the exchange of patient information across nine public hospitals and other public healthcare facilities, including polyclinics and nursing homes. Artificial intelligence (AI) and machine learning (ML) are applied to the data for public healthcare initiatives.

Success Stories

Singapore’s H-Cloud: As a private cloud for the national health network, the platform currently supports over 50,000 healthcare providers and patient data across nine public hospitals, eight specialty centers, and 20 polyclinics and nursing homes are accessible and exchangeable. With the implementation of H-cloud, the key expected outcomes are reduced costs by 55% and improved infrastructure availability to 99.95% by 2025.⁸⁶

Battling COVID-19: Cloud infrastructure is being used to support COVID-19 monitoring and prevention for its population of 5.7 million.

- the country’s contact-tracing app, TraceTogether, for its 5.7 million population,
- digital check-in system “SafeEntry,” and
- a supply chain app named Sally through which mask distribution campaigns have been deployed and more than 4.2 million masks distributed.



“Cloud allows us to have an integrated system, the NGEMR project. So, whether you’re in a private hospital, GP, when you go to another patient, you just scan your IC and access your secure electronic medical records. The number of errors in medical diagnosis, for example, in terms of COVID prevention, we’ve had a much lower COVID death rate and other applications in terms of pandemic response. And the highest vaccination rates in the world. This has been enabled by seamless data flow from GP and between private and public entities.”

— CIO in the healthcare system, Singapore

Relevant Regulations

Singapore has sophisticated data security and privacy regulations. The Singapore Standard, commonly known as MTCS, is the world's first cloud security standard that covers multiple groups of cloud security.⁸⁷

Regulations on personal data protection, privacy, and data security

Cloud Security Standard: In 2013, IMDA launched the Multi-Group Cloud Security standard, the first such cloud security standard in the world. The following year, to encourage the adoption of cloud technologies, IMDA offered accreditation for cloud services companies that meet MRCS standards. Amazon Web Services (AWS) was the first cloud services company accredited under the MTCS standard.



“When the SingHealth Data Breach happened, the first thing to happen was that the hospitals’ connection to the internet was yanked, and everyone was forced to use the cloud as a de facto interface for all interactions, the Enterprise Services bus. With healthcare data, the policy initiative was that you must reach level three of the multi-tier cloud security standard. Requirements related to the qualifications of IT architects and auditors were also built into this policy.”

— CIO in the healthcare system, Singapore

Personal Data Protection and Privacy: The collection, storage, use, and sharing of personal data in the private sector is governed by the Personal Data Protection Act 2012 (PDPA).⁸⁹ This act covers all personal data, including healthcare data and biometric data. Under PDPA, only clinicians and allied health workers who need to access a patient’s data in order to provide care are able to do so. For internal process improvements, personal data is removed as much as possible.⁹⁰ Adjacent, sharing of data or information, including personal protection data, between public agencies is governed by the Public Sector (Governance) Act 2018.

Regulations specific to healthcare data in the cloud

While the PDPA is Singapore’s main personal data protection legislation governed by the Singapore Personal Data Protection Commission (PDPC), PDPC had released guidance on the use of cloud services in relation to PDPA as well. This includes guidance on the relationship between cloud service providers and their customers, transfer of personal data outside Singapore, and due diligence on the cloud service provider conducted by the cloud service user.⁹¹

6.1.3 Barriers & Challenges to Cloud Adoption

1. Data Security:

Singapore's H-Cloud has largely been a success; however, data breaches have made data security and privacy concerns the largest barrier to commercial cloud adoption. A 2018 SingHealth data breach of 1.5 million SingHealth patients, including Prime Minister Lee Hsien Loong, revealed that the Integrated Health Information Systems (IHIS), which is responsible for the national health IT and security, lacked sufficient cybersecurity awareness, training, and resources to respond to the attack. To prevent future cyber-attacks, the investigative task force formed immediately after the SingHealth data breach recommended the adoption of enhanced security structures and readiness, review of the cyber stack, regular security checks, staff education, and improved access control management.⁹² A respondent also said that knowledge of data security classifications can be improved, with many personnel unclear about how certain datasets should be handled.



"It is a matter of mindset – it doesn't matter whether it's on public cloud or private cloud. What matters is that you can assure the user it's secure. If it's secure, then there will be confidence in storing data there."

— Dr. Adam Chee, Chief, Smart Health Leadership Centre, Institute of Systems Science, National University of Singapore

2. Shortage of digital skills, including cloud skills:

A report commissioned by AWS found that Singapore will need 1.2 million additional digital workers by 2025 – a 55% increase from early 2021 levels.

6.1.4 Recommendations

1. Education and awareness of data security and privacy for citizens and healthcare IT personnel:

With its advanced digitalization, Singapore will need to make sure adequate safeguards are in place for citizens' healthcare data, especially where the government may wish to use healthcare data to improve public health and healthcare service delivery. In addition, Singapore's health information systems may be an attractive target for cyber threats, especially as cyber incidents are increasing across the globe. It is important that the healthcare sector continues to keep abreast of the latest cybersecurity measures, with a dedicated focus on helping clarify data security and privacy regulations for healthcare IT personnel. Awareness and training will also need to drive home the fact that IT systems' security cannot be guaranteed by the infrastructure alone. *[See Recommendation 2.1 and Recommendation 4 in Section 4]*



Data security policies will continually need to be updated as the threat vectors have only gotten bigger, more complex. The issues around running many hybrid ecosystems, as more and more things get integrated, will only increase.

— CIO in the healthcare system, Singapore

Data classifications are clearly defined but may not be completely understood by personnel. However, our AI ML has helped us red flag some human errors and anomalies. So sometimes, the clue to erroneous classification may be in terms of monitoring AI ML big data feeds and writing smarter and smarter decision tree algorithms as you learn more from the outputs of your health data.

— CIO in the healthcare system, Singapore

2. Cloud skills training for healthcare professionals:

Singapore already has a strong cloud skills training program; and the healthcare sector has been open to emerging technologies such as cloud and AI/ML. However, with a highly competitive market for these skills, the government needs to build homegrown talent in the healthcare sector through both short-term and long-term strategies.

[See Recommendation 3 and Recommendation 4]



AUSTRALIA



AUSTRALIA: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 87/100¹⁰⁰

Rank: **Progress on health-related SDGs (2015)** 35/188¹⁰¹

Rank: **Healthcare Access & Quality Index (2015)** 95.9/100¹⁰¹

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 5/193¹⁰³

Cloud Readiness Index 71/100¹⁰⁴

UN ITU ICT Development Index 14/193¹⁰⁵

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✓ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

AUSTRALIA — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Australia has one of the world's most advanced healthcare systems. Life expectancy in Australia is 83.4 years, making it the eighth highest in the world.⁹³ The total health expenditure on healthcare is 10.3% of the GDP, which is slightly above average compared to other OECD countries.^{94 95}

Healthcare Authority: There are three levels of government: federal Parliament, state and mainland territories, and local councils. The federal Department of Health provides funding and policy oversight, and states manage service delivery, public hospitals, ambulances, public dental care, community health, and mental healthcare.

Health Financing: The Australian government provides universal health coverage for its citizens through the Medicare program launched in 1984. The government bore 67% of the total health expenditure in 2015-2016.⁹⁶

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging population: The country's aging population has increased the demand for different types of health services and the staff trained to deliver such care. In 2015, persons aged over 65 years constituted 15.9% of the entire Australian population.⁹⁷

Increasing burden of chronic diseases: Chronic diseases are raising the need for person-centered treatment models and coordinated care between providers.⁹⁸

Health outcome gaps: According to research, lower socioeconomic groups have a higher incidence of obesity and other chronic illnesses such as type 2 diabetes.⁹⁹

Rising costs of medical research and technological innovations: Newer health technologies can improve patient outcomes but require significant investment, along with ethical and legal considerations.

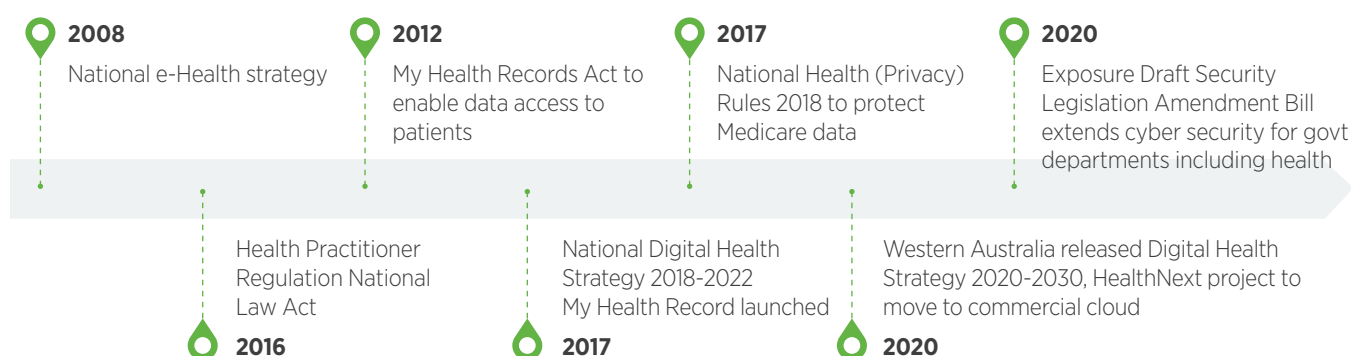
Making better use of data: Inadequate linkages among providers across the health system have obstructed the ability to glean meaningful insights from these data sources.

6.2 Australia

6.2.1 Digital Transformation of Healthcare in Australia: Context and Maturity

Over the past decade, the Australian government has acknowledged the futuristic role that cloud computing can play for the public and private sectors and has formulated some key policies to support the adoption of cloud computing. In 2016, The Australian Digital Health Agency (ADHA) has established policies to evolve digital health capability through innovation, the collaboration, and leadership to facilitate digital health integration in the health system. The ADHA has announced the launch of an online platform where healthcare providers in the country can place and update information about their services and practitioners.¹⁰⁶ The ADHA developed the National Digital Health Strategy after extensive consultation with the Australian public and thorough review of the evidence and was approved by the Council of Australian Governments in 2017.

Key milestones in the transformation of the healthcare sector¹⁰⁷



Notable Digital Health Initiatives

The following are some notable digital health initiatives in Australia:

HealthNext Project, Western Australia:

The Western Australian government is focusing on replacing the legacy infrastructure of the health system with Infrastructure-as-a-Service (IaaS) systems that are consumption-based and designed to improve the network performance and use of other cloud services. The WA Health Digital Strategy 2020-2030 acknowledges that this shift is more sustainable and 'future-proof' for the health system.¹⁰⁸

My Health Record:

My Health Record, formerly called the Personally Controlled Electronic Health Record (PCEHR), is the Australian Government's digital system that holds individuals' health records. It is a secure, consumer-controlled online service that improves health outcomes by improving information access. Authorized healthcare providers can view and add patient health information to My Health Record, which can help them make better clinical decisions and achieve better health outcomes.

My Health Records were created for each Australian on 21st February 2019, unless they opted out.

- By July 2021, the system held 23 million records, 91% of these, i.e., 21 million, contained data.
- More than 426 million documents uploaded by consumers or healthcare providers.¹⁰⁹

National Health Information Gateway, 2021:

In July 2021, the ADHA chose Deloitte as the vendor for replacing the existing API-based gateway of the My Health Record with a gateway based on internationally acceptable standards such as the Fast Healthcare Interoperability Resources (FHIR).¹¹⁰ The Health Information Gateway marks the first phase of modernization of the health system as outlined in the national infrastructure modernization program. This AUD 18 million deal marks the conclusion of a selection process started at the end of 2019.¹¹¹

6.2.2 Cloud Adoption in Public Healthcare: Notable Initiatives, Policies & Regulations

Australia was one of the earliest Asia-Pacific countries to establish a Cloud First Policy, which was launched in 2014.

Cloud policy for the public sector

In 2014, the Australian Government Cloud Computing Policy aimed at accelerating the uptake of cloud systems by government agencies was released. The Policy stated that “non-corporate Commonwealth entities are required to use cloud services for new ICT services and when replacing any existing ICT services, whenever the cloud services:

- are fit for purpose;
- offer the best value for money, as defined by the Commonwealth Procurement Rules, and;
- provide adequate management of risk to information and ICT assets as defined by the Protective Security Policy Framework.”¹¹²

In 2017, the Digital Transformation Agency launched a Secure Cloud Strategy that provides guidance to ensure that public agencies do not adopt an ad-hoc approach to transitioning to the cloud but rather collaborate such that the Australian Public Service derives the maximum benefit from this shift. The policy encourages the government to adopt a Cloud First approach. The strategy lays out seven principles that public agencies must consider while transitioning to the cloud.¹¹³

Cloud-related policies have been released by specific departments as well. In 2019, the Department of Energy and the Environment released a Cloud Strategy for the department, acknowledging that the adoption of the cloud allows for cloud adoption with the three-fold foci of business, tech, and the whole of government approaches in the sector.¹¹⁴

According to the Infosys Cloud Radar 2021 report, Australia and New Zealand (A/NZ) were ranked first for cloud adoption. About 43% of Information Technology systems in Australia and New Zealand moved to the cloud in 2020.¹¹⁵

Cloud for Healthcare: Maturity and Notable Initiatives

The private sector, government, and industry-academia have collaborated to establish various Health Information Systems (HIS) on the cloud, including medical services, medical support services, and insurance services, which allowed doctors to comprehensively understand patient status quickly, reducing patient information and time required for care. In addition, there are established systems for the integrated management of ward, intensive care, and emergency nursing, reducing the overtime of nurses by 30%, and improving the quality of nursing services.¹¹⁶ Private sector providers are using an integrated healthcare service utilization system that is not cloud-based but an on-premises system where all data is integrated and exchanged seamlessly.

In April 2020, the ADHA released *Cloud Services – Considerations for healthcare organizations*, a guide for healthcare organizations in assessing and adopting appropriate cloud services for their businesses.¹¹⁷ Although not a binding law, the guide is an initiative to support the acceleration of cloud adoption in the Australian health system.

Notable Cloud Initiatives

Several of Australia's healthcare functions and applications are on the cloud.

My Aged Care: A public portal for the aged care system that provides easy access to information about aging and aged care is hosted on the cloud. The platform offers online information and trained call center staff to help assess older people's needs and locate and access services.¹¹⁸

Teleconsultations under Medicare: The Federal Government revised the policies for doctor consultation after the COVID-19 pandemic. Australia added teleconsultations to Medicare and created incentives for healthcare providers to conduct telehealth appointments to contain the spread of the virus. The physicians use Skype, a cloud-based platform, for teleconsultation as it is HIPAA compliant.¹¹⁹

Primary Sense: The Gold Coast Primary Health Network has developed a cloud-based population management and audit tool, which has multiple features that enhance General Practice in the city of Gold Coast, Queensland. Primary Sense generates evidence-based medication safety alerts and provides patient information alerts for coordinated care by generating reports that support actionable, evidence-based primary care. The tool stores patient data in secure cloud systems and de-identifies it before the data leaves the GP practice.¹²⁰ The practice (GCPHN) is one of 31 Primary Health Networks of the Queensland government that manage general practice in the state.¹²¹

Remote-I platform: The Australian eHealth Research Centre at Commonwealth Scientific and Industrial Research Organisation (CSIRO) has developed many AIS and ML-based clinical tools that support medical diagnosis and treatment. The Remote-I technology is a cloud-based system that supports clinicians and health workers in eye screening programs through a “store and forward” mechanism. The health worker can use the Remote-I platform to capture an image of the patient, store it locally, and then forward it to an ophthalmologist for review. Remote-I has been widely used in teleophthalmology to support screening for eye diseases such as Diabetic Retinopathy.¹²²

Macquarie Launch Health Cloud: Macquarie Cloud Services, a division of the Macquarie Telecom Group, announced the launch of a new cloud service dedicated solely to health data storage. The Macquarie Launch Health Cloud was created in response to a Department of Human Services (DHS) policy decision to ensure the integrity of the data it holds. The DHS policy covers third-party software that connects with the department to provide online services like electronic claims payments for Medicare.¹²³

Provider Connect Australia: The ADHA has announced Provider Connect Australia, a program that maintains an up-to-date directory of healthcare services and practitioner contact details of the entire country. The initiative will reduce the red-tape burden of managing paper records, enable secure messaging among the stakeholders of the health system, and drive interoperability. ADHA estimates that Provider Connect will lead to economic benefits of over AUD 30 million by 2025. After an initial proof of concept in 2021, the nationwide rollout is scheduled for early 2022.^{124 125}

Success Stories

COVID-19 response call center:

NSW Health and Queensland Health needed to quickly deploy a contact center platform to assist clinical staff in responding to the COVID-19 pandemic. Both organizations used Amazon Connect, a cloud omnichannel contact center, as their contact center platform because of its enhanced capabilities and lower operational costs.

Peter Mac:

Peter Mac, an Australian public cancer institute, has deployed two new cloud-hosted systems to replace a number of legacy systems and boost precision medicine in the country. The cloud systems allow the consolidation of multiple sources of data into a single repository that is stored in Microsoft Azure and accessible by multiple users at the same time.

Relevant Regulations

Data security and privacy laws for personal information and healthcare data are well-established in Australia.

Regulations on personal data protection and privacy

1. Privacy Act 1988: Principal legislation that protects the handling of personal information concerning individuals. This includes collection, use, storage, and disclosure of personal information in the public and private sectors.¹²⁶

The Privacy Act 1988 governs the collection and use of healthcare data both by government agencies and private sector organizations. The Act provides extra safeguards around handling health data as it is considered one of the most sensitive types of personal information. For example, all healthcare providers need to obtain consent before collecting a person's health information.¹²⁷ The government agencies also follow the privacy law mandates, such as not sharing patients' health data unless consent is given.¹²⁸

Most of Australia's states and territories also have their own data protection laws in place.

2. The Telecommunications (interception and Access) Act 1979: The act governs access to telecommunications content in Australia. Interception or access to private telecommunications is an offense by the Act.¹²⁹

Regulations on data security

Personal information and sharing of individuals' data are governed by the following legislations in Australia. States also have policies and guidelines for cybersecurity.

- Australian Government Information Security Manual (ISM) 2021 outlines a cyber security framework for organizations to use within their risk management framework to protect their systems from cyber threats.¹³⁰
- South Australian Cyber Security Framework 2019 guides the protection of information assets and management of cyber security risks in South Australia.¹³¹
- New South Wales Cyber Security Policy (V4) 2020 provides the mandatory requirements for all NSW government departments and public service agencies to manage cybersecurity risks.¹³²

The Australian government released a discussion paper on cybersecurity in July 2021 titled 'Strengthening Australia's Cybersecurity Regulations and Incentives,' calling for views from the public.¹³³ The paper lays out multiple considerations for improved cybersecurity, including mandating the 'Code of Practice: Securing the Internet of Things for Consumers' guidelines released in 2020 as a step to improve security in IoT-based devices.¹³⁴

Regulations specific to healthcare data in the cloud

- The federal government also released National Health (Privacy) Rules 2018 to further protect information collected under the Medicare Benefits Schedule (MBS) and the Pharmaceutical Benefits Scheme (PBS). The fundamental objective of these rules is to secure the claims information collected under the Medicare Benefits Program and the Pharmaceutical Benefits Program by holding them on separate databases. The rules also establish the circumstances under which these data may be linked and retained in linked form.
- The My Health Records Act 2012 (My Health Records Act), My Health Records Rule 2016, and My Health Records Regulation 2012 create the legislative framework for the My Health Record system. The Act establishes the Australian Digital Health Agency's role and functions. Individuals and entities such as healthcare provider organizations can participate in the My Health Record system through a registration framework and a privacy framework that is aligned with the Privacy Act 1988.¹³⁵

6.2.3 Barriers & Challenges to Cloud Adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Budgetary constraints:

Cloud adoption holds much promise but requires significant investment. There are immediate costs associated with the migration itself and long-term financial risks associated with slow adoption and training post-migration. Given the high prevalence of legacy systems, the costs of migration include rearchitecting the software for the cloud, investing in people and tools to ensure migration success, and training users on the new systems. Agencies also need to earmark a budget to address performance issues such as latency, interoperability, dependencies on non-cloud apps, and downtime and bandwidth costs.¹³⁶



“Rearchitecting and producing software in keeping with cloud principles are money and resource-intensive. eHealth or digital health vendors have to comply with security regulations in a private data center. But moving the existing systems to cloud is not easy because they must rearchitect the system, storage, data usage, and ensure compliance with the principles of cloud computing.”

— Dr. Zafar Hashmi, Former Head of Technology, Healthdirect Australia

2. Change in the procurement process from the CAPEX to OpEx model:

During cloud adoption, agencies also face the challenge of not having a budget allotted for additional operational expenditure in place of capital expenditure. A move to the public cloud can also be expensive to manage. The funding source for such an IT transformation is unclear in some agencies, where IT capital budgets are set aside annually, but operational budgets are shared across the agency.

3. Lack of clarity around regulations:

As early as 2010, the Australian Centre for Health Research identified 22,600 pages of combined state and federal legislation across 305 different Acts of Parliament covering the health sector. These regulations have created disparities between states, sometimes causing confusion and increasing the barriers to cloud adoption.¹³⁷

4. Lack of trust in data security and privacy by users:

Past data breaches have led to Australians being concerned about their health data being stored in a database that is accessible via the internet and has the risk of being hacked. In 2016, a cloud service provider for the national health service accidentally exposed over 500,000 individuals' health data online. Both the CSP and the healthcare service were found to have not taken adequate steps mandated by the Privacy Act for securing the data.¹³⁸ Another concern is that citizens who are not tech-savvy may find it difficult to opt-out of the My Health Record even if they want to.¹³⁹



“The number one (barrier) is the public perception of security, and the second is respect for the national sovereignty of the citizens' dataset and how to ensure that.”

— Dr. Robert Grenfell, Health Director, Health & Biosecurity, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia

5. Resistance to change:

Moving applications and workloads to a cloud result in changes in roles, responsibilities, and new expectations for the health facilities, which is met by resistance from health workers. In the healthcare sector, staff is not ready for these changes.



“Doctors are reluctant to change the workflow, as they have become accustomed to the existing software and processes, and they don’t like to change. Change management has become a major issue.”

— Dr. Zafar Hashmi, Former Head of Technology, Healthdirect Australia

6.2.4 Recommendations

Cloud adoption has improved many of the digital initiatives by the government and has the potential to bring further efficiencies and innovation in the health sector.

1. Change management is needed for smoother migration to the cloud:

For a government already in an advanced stage of cloud adoption, such as Australia, effective change management can address resistance to change. Change management activities include generating awareness of the benefits of the cloud for health departments, building trust in data security standards, and handholding the departments through migration.

[See Recommendation 2, Recommendation 2.3, Recommendation 2.4, and Recommendation 4 in Section 4]

2. Design programs and impart training to build cloud skills:

It is necessary to understand skill gaps and design suitable programs for building healthcare IT staff’s capability in cloud skills. Governments must ensure that both IT and non-IT personnel (e.g., finance, procurement, health, and legal departments) are trained in the benefits of cloud computing and understand how cloud computing may necessitate changes to existing workflows or policies. Clinicians and other healthcare staff also need to be trained in new or revised workflows that accompany cloud adoption. [See Recommendation 3 and Recommendation 4]

3. A phased migration model may be easier to adopt:

For healthcare management staff reluctant to migrate sensitive data to the cloud, they may consider a hybrid model with more sensitive data stored on-premises. Larger agencies with more complex legacy systems can learn from other agencies’ successes, and the lessons and skills learned can be shared throughout the government sector.

[See Recommendation 2.3, Recommendation 3]

4. Use the right policy tools to drive cloud adoption:

Policy is the most significant lever in driving cloud adoption, although it is also the most time and resource-intensive measure. Policies governing how the health department should operate in the cloud should be updated and implemented to reflect the current health system requirements. The inclusion of teleconsultation is one such positive example. The government must remain agile to update policies further to enable the health sector to avail the full benefits of cloud adoption. [See Recommendation 2]



“There is a need for regulatory bodies and policymakers to provide some sort of a framework. Right now, those frameworks do not exist or are unclear. So, for example, for someone who wants to use AI in healthcare, although there is a big drive to do so, it is difficult because they must use patient data and share patient information.”

— Dr. Zafar Hashmi, Former Head of Technology, Healthdirect Australia

A photograph of a cable-stayed bridge at night. The bridge's white pylon and stay cables are illuminated with a blue light. The bridge deck has a white railing. In the background, a city skyline is visible, including the Sky Tower. The sky is dark with some clouds. The water in the foreground is dark.

NEW ZEALAND



NEW ZEALAND: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 87/100¹⁴⁷

Rank: **Progress on health-related SDGs (2015)** 23/188¹⁴⁸

Rank: **Healthcare Access & Quality Index (2015)** 92.4/100¹⁴⁹

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 9/193¹⁵⁰

Cloud Readiness Index 77.1/100¹⁵¹

UN ITU ICT Development Index 13/193¹⁵²

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✓ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

NEW ZEALAND — HEALTHCARE SYSTEMS MATURITY & CONTEXT

The healthcare system of New Zealand has undergone significant changes throughout the past several decades. About 9% of the country's GDP was spent on healthcare in New Zealand in 2017.¹⁴⁰

Healthcare Authority: The Ministry of Health develops national policy to oversee the delivery of healthcare. The Ministry allots over three-quarters of the tax money from the annual budget to the District Health Board network, which uses plans, purchases, and provides health services (including hospitals) within its territory.¹⁴¹ The Health and Disability System Review 2020 recommended the creation of a new crown entity, Health NZ, which will manage the delivery of health and disability services across the country. The Review recommends DHBs to be refocused to be completely accountable for Group 1 disability support services.¹⁴²

Health Financing: A universal, tax-funded national health service was established in New Zealand as early as 1938. The system operates as a single-payer healthcare system, which covers residents and work visa holders.¹⁴³

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging health workforce: 40% of doctors and 45% of nurses are over the age of 50. The sector also has a large unregulated workforce (approximately 63,000 people), including care and support workers.¹⁴⁴

Shortage of skilled providers in rural areas: Indicators show that health outcomes differ across the New Zealand population, both by region and ethnicity, with a significant rural-urban divide due to the unavailability of health workers.¹⁴⁵

Chronic diseases: Obesity affects about 10% of children (30% in the Pacific region). Additionally, people with disabilities experience worse health – 29% rated their health as poor.¹⁴⁶

6.3 New Zealand

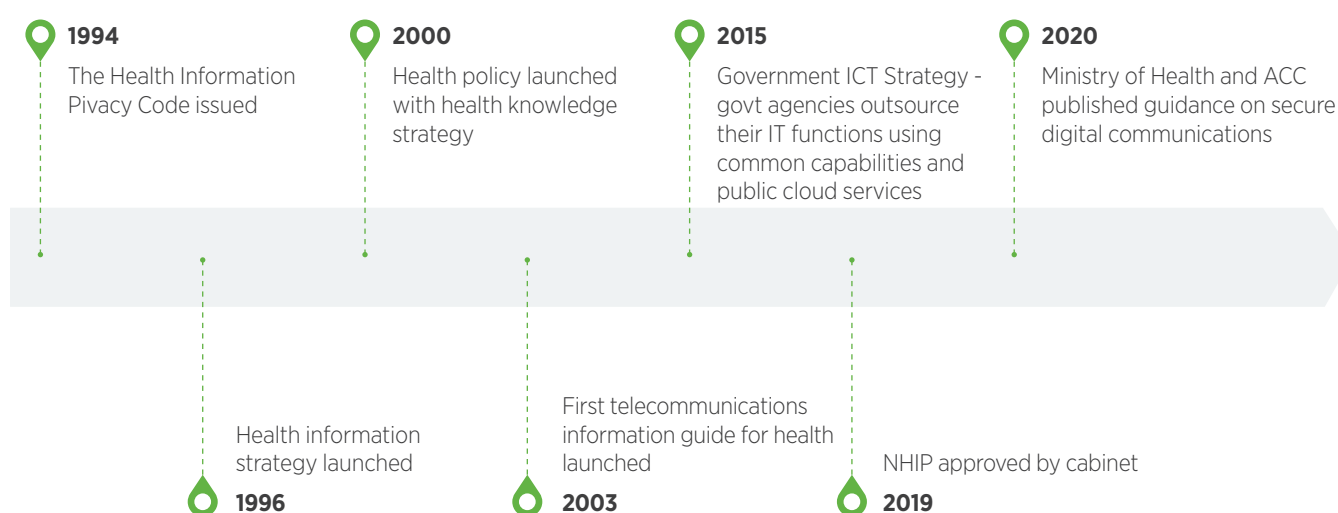
6.3.1 Digital Transformation of Healthcare in New Zealand: Context and Maturity

New Zealand's national government launched its first e-government program in 1999, with the aim of making New Zealand a world leader in e-government. The E-government Entry Portal Point of New Zealand (www.govt.nz) was launched in 2002. This portal provided access to a wide range of government services both at the national and local levels.¹⁵³

The government released the Digital Inclusion Blueprint in 2019, with the high-level vision that “*Everyone in New Zealand has what they need to participate in, contribute to, and benefit from a digital world.*” The blueprint outlined a five-year strategic plan for the government efforts toward digital inclusion. The 2019 Digital Inclusion Action Plan emphasized “building the foundation” to address many of the issues raised in the blueprint.¹⁵⁴

The Ministry of Health established Digital Health 2020 to advance the core digital technologies outlined in the New Zealand Health Strategy. It consists of five core components: electronic health records, health and wellness datasets, preventative health IT capability, digital hospitals, and regional IT foundations.¹⁵⁵

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

The NZHIT Virtual Health Industry Group (VHIG) was established in 2018. It consists of senior representatives from the health and IT communities, as well as a mix of primary health providers, community and non-governmental organizations, and industry partners in the delivery of smart technology and tools to New Zealand's health and wellbeing sector.¹⁵⁶

The following are some notable digital health innovations in New Zealand:

Patient portals:

Patients can access their health information and interact with their general practice through patient portals, which are secure online sites provided by GPs. Patients registering to use patient portals increased by 5.5%, practices offering patients access to clinical notes increased by 20%, and 267 practices reported booking 183,900 appointments online between October 1 and December 31, 2020.¹⁵⁷

eMedicines:

The eMedicines Program is a component of the National Medication Safety Program, which is co-sponsored by the Ministry of Health and the Health Quality & Safety Commission. Through the eMedicines Program, hospitals and the public will have access to electronic systems that promote medication safety and give healthcare providers accurate, up-to-date information about patients' medications.¹⁵⁸

The Sponsored Data initiative:

The high cost of mobile data in New Zealand can make it difficult for some people to get the health and wellbeing information and digital health services they need. Those with the greatest needs are frequently the most disadvantaged by a lack of access to resources. Through the Sponsored Data initiative, people can use their cell phones to access important health sector websites without paying for data usage.¹⁵⁹

Telehealth:

The Telehealth Forum of New Zealand facilitates the use of telehealth in the delivery of healthcare. It is led by a leadership group comprised of clinicians, consumers, policymakers, planning and funding managers, ICT experts, and industry representatives.¹⁶⁰

Manage My Health:

Manage My Health is an online platform to book appointments, view medical records, and carry out teleconsultations. The data is made available to both patients and practitioners, with recent medical conditions, lab results, immunization records, allergies, and prescriptions available at a glance. Currently, 1 million people and 600 health facilities use Manage My Health.¹⁶¹

Electronic Prescription Messaging Service:

The market-leading general practice and pharmacy software providers in New Zealand have collaborated to launch an integrated electronic prescription messaging service that will allow GPs to send signature-exempt eScripts directly to pharmacies. It was initiated by RxOne, Indici, and My Practice, who used Clanwilliam Health as the messaging service, and was later joined by market leaders in Toniq and Medtech.¹⁶²

Click to Tick:

Southern DHB launched a Click to Tick checklist to check for patients with Chronic Obstructive Pulmonary Disease (COPD) being discharged from Dunedin Hospital. The checklist is embedded in the online discharge summary and can be accessed through Health Connect South, the clinical portal. Through this portal, patients will receive referrals and advice for proper medicine and inhaler usage and a follow-up visit to their GP. While it was initially launched in Ward 7A at Dunedin Hospital, it is now available for use in all of the district health board's hospitals for patients in internal medicine and respiratory wards.^{163 164}

6.3.2 Cloud Adoption in Public Healthcare: Policies, Notable Initiatives, and Regulations

On a global scale, New Zealand is already at the forefront of the digital transformation of healthcare.

Cloud policy for the public sector

In July 2016, the New Zealand cabinet moved to actively encourage the use of public cloud services for government agencies.¹⁶⁵

Cloud for Healthcare: Maturity and Notable Initiatives

In April 2017, the Ministry of Health released its policy on cloud computing (in conjunction with the Department of Internal Affairs' Government Chief Information Office). Health providers were allowed to use public cloud services without obtaining an exemption as of early 2016, provided that they had been reviewed and approved by the Ministry as fit for purpose prior to their use. The policy states: "Hosting cloud solutions, that will store personally-identifiable data (patient or staff information), in a public cloud facility in Australasia is preferable to hosting outside of the region."¹⁶⁶ This has been ascribed to the trust in data security and privacy laws overseas, loss of control, and uncertainty over hosted service providers.¹⁶⁷

Across the country, cloud services are supporting essential hospital applications such as patient administration systems, clinical portals, laboratories, picture archiving and communication, radiology, pharmacy, eReferrals, and ICU systems. The Indici patient management system, as well as the Manage My Health patient portal, hosts some primary and community data in the cloud. New Zealand's Seventeen District Health Boards (DHBs) are using cloud services to store some of their clinical and non-clinical data. On top of that, DHBs are using cloud-based collaboration and communication tools such as BoardBooks and Zoom Health (videoconferencing) and Skype as well as eText and SafeNet alongside hosting their corporate websites and intranet in the cloud.¹⁶⁸

Notable cloud for healthcare initiatives

NZ COVID Tracer: The COVID-19 contact tracing application for New Zealand was developed by Rush Digital on the Amazon Web Services platform. The app traces the movement of users while ensuring data safety and privacy. The information is stored in the mobile device and shared only with the user's consent. The data being shared is encrypted before it is shared with the Ministry of Health.¹⁶⁹

Cloud-based transcription system: Under the pressure of the COVID-19 pandemic, the Southern District Health Board has completed phase one of its implementation of the iMedX's cloud-based transcription platform, which was introduced to replace the legacy MedDocs system.¹⁷⁰



“Less than 30% hospitals are fully on cloud, a third of the organizations are still planning to get on cloud, while the remaining third are quite far from doing so.”

— Stella Ward, ICT leader in the public sector, New Zealand

Success Stories

Canterbury District Health Board's adoption of cloud

The Canterbury District Health Board started migrating to a hybrid cloud environment in 2019. The DHB has worked with technology partners since the New Zealand earthquake in 2011 to support electronic clinical information systems. The systems were initially on-premises (or private cloud), with the approach now changing to a hybrid model for deployment of the cloud.¹⁷¹ The Human Resources portal of the DHB, called max, has taken the paper out of recruitment, expense claims, and leave processes and has saved time as a result. Three more applications have been identified to be hosted on the cloud.¹⁷²

Relevant Regulations

Data security and privacy laws for personal information and healthcare data are well-established in New Zealand.

Regulations on data protection and privacy

Office of the Privacy Commissioner (OPC) is the primary body responsible for administering the Privacy Act 1993 and issues sector-specific Information Privacy Codes, including the Health Information Privacy Code (HIPC). HIPC sets specific rules for agencies in the health sector. It covers health information collected, used, stored, and disclosed by health agencies.¹⁷³

The Health Information Privacy Code 1994 and its successor, the Health Information Privacy Code 2020 (HIPC), specify requirements on the collection of health information, usage, disclosure, and storage. A minimum retention period for which health information can be retained is specified by The Health (Retention of Health Information) Regulations 1996.¹⁷⁴

Regulations on data security

In early 2016, the Ministry permitted health providers to use public cloud services without obtaining an exemption if they had been reviewed and accepted as fit for purpose by the Ministry.

In April 2017, the Ministry collaborated with the Department of Internal Affairs' (DIA) Government Chief Information Office (GCIO) to update the Ministry's approach to the use of cloud-based services.

Now that the use of public cloud services is becoming more common, and the Ministry's previous concerns about the privacy and security of personal health information stored or processed offshore have been greatly alleviated, the cabinet decided in July 2016 to actively promote the use of public cloud services by government agencies.¹⁷⁵

Regulations specific to healthcare data in the cloud

The majority of New Zealand statutes are drafted to be technologically neutral, so there is no legislation that specifically governs the provision of digital health services in the cloud.¹⁷⁶

6.3.3 Barriers and challenges to cloud adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Uncertain data sovereignty rules and jurisdiction of data:

Most of the global cloud service providers' data centers are not located in New Zealand, leading to uncertainty about the legal requirements and implications of storing data with offshore cloud service providers.

2. Citizens are concerned about the privacy of data on the cloud:

There are also concerns about the privacy of cloud-stored data. Five hospitals were down for a week after a ransomware attack disrupted their IT network in the New Zealand district of Waikato in May 2021. Such incidents have caused concern among the public that private patient information may have been exposed.¹⁷⁷

3. Knowledge and skill gap:

Healthcare management's knowledge of cloud migration and the skills of healthcare IT staff need to be further strengthened.



"There is a knowledge and skills gap. The centralization of healthcare that is now being planned/ underway is expected to bring together various departments and ensure a standardized approach, so skills and awareness come up to speed."

— Stella Ward, ICT leader in the public sector, New Zealand

4. Budgetary constraints:

With a number of hospitals saddled with legacy applications, a significant re-engineering budget is needed to further cloud adoption.

5. Healthcare management personnel are reluctant to adopt the cloud:

Respondents cited that some healthcare management personnel have found that the returns from cloud adoption were below their expectations, partly due to overselling by cloud service providers.



“There is a perception of cloud adoption being costly and not delivering the benefits as promised. The lack of complete understanding of the business model before the migration to cloud means that users do not realize that constant monitoring and management may be needed.”

— Stella Ward, ICT leader in the public sector, New Zealand

6.3.4 Recommendations

Cloud adoption has improved many of the digital initiatives by the government and has the potential to bring further efficiencies and innovation in the health sector.

1. Address knowledge and skill gaps:

Organizations need to encourage and incentivize current employees who are less knowledgeable about cloud computing to take up training offered on cloud computing. Accelerating cloud adoption will enable a significant reduction in the growing healthcare costs, which is estimated to become almost 11% of the GDP owing to the growing costs.¹⁷⁸

[See Recommendation 3, Recommendation 4]

2. Allocate a budget and a range of policy tools to improve cloud adoption:

With a third of public healthcare facilities yet to initiate cloud adoption, the allocation of a budget and specific incentives is needed to accelerate cloud options. Re-engineering legacy applications will also require additional financial resources.

[See Recommendation 2]



“Health sector is still in legacy systems and to ensure that cloud adoption is complete the country still needs significant re-engineering.”

— Stella Ward, ICT leader in the public sector, New Zealand

3. Additional procurement guidance may need to be issued:

The New Zealand government has already standardized cloud procurement and published procurement guidance resources. There is a need for continued education and awareness on the use of cloud, cost optimization, and cybersecurity. An independent assessment from a third party to identify which parts of a health information system are most suitable for cloud migration can help alleviate concerns of cloud adoption not delivering the expected returns.

[See Recommendation 2.4]

SOUTH KOREA





SOUTH KOREA: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 86/100¹⁸⁴

Rank: **Progress on health-related SDGs (2015)** 6/188¹⁸⁵

Rank: **Healthcare Access & Quality Index (2015)** 90/100¹⁸⁶

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 2/193¹⁸⁷

Cloud Readiness Index 72.7/100¹⁸⁸

UN ITU ICT Development Index 2/193¹⁸⁹

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✓ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

SOUTH KOREA — HEALTHCARE SYSTEMS MATURITY & CONTEXT

South Korea is a mountainous peninsula with about 3,600 islands lying on its south and west coasts. It has a population of 49 million, dominated by middle to older ages, and with a declining birth rate.

Healthcare Authority: Public health policies and programs remain largely centralized with the Ministry of Health and Welfare (MHW).

Health Financing: National Health Insurance (NHI) finances the Republic of Korea's health system. The NHI covers about 97% of the population, and the remaining 3% is covered by the Medical Aid Program, a tax-funded program to ensure access to healthcare for low-income citizens.¹⁷⁹

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging population: The rapidly aging population and a predominance of chronic disease in this increasing population poses a burden on the healthcare system, including healthcare workers and resources.¹⁸⁰

Lack of access and coverage: Regional inequalities to access in medical care services continue to plague the South Korean healthcare system. Most private medical facilities, 92% of physicians, and 90% of hospital beds are in urban areas, while 20% of the population lives in rural areas.¹⁸¹

High Out-of-Pocket spending: Out-of-pocket (OOP) payment still accounts for a significant portion of total healthcare expenditure in Korea, potentially leading to insufficient financial protection.¹⁸²

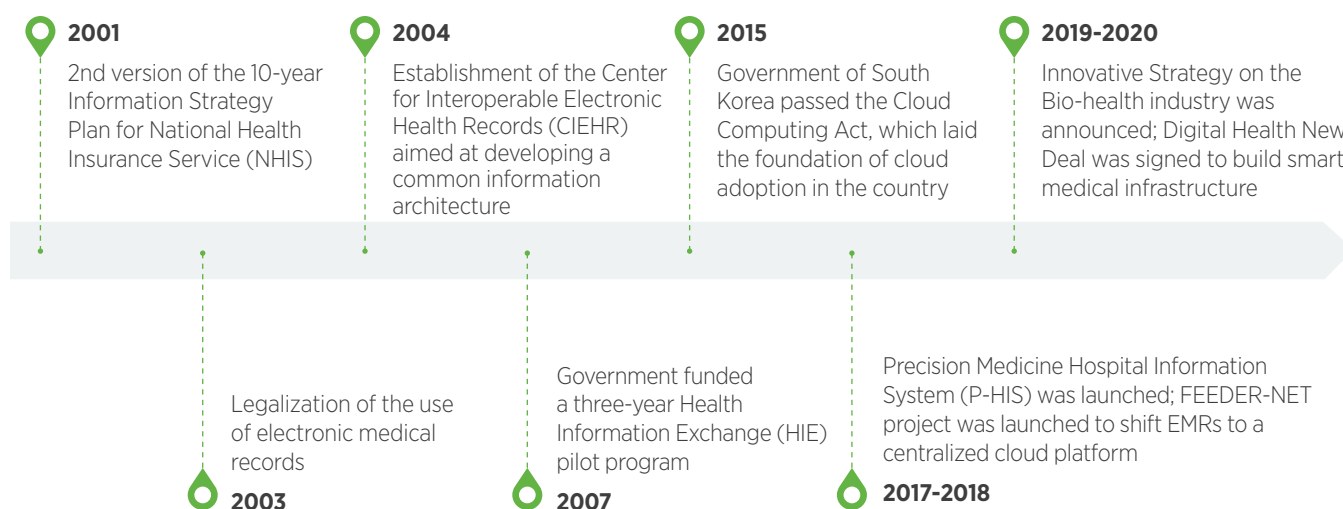
Dominance of private healthcare sector: The referral system does not function well in the private sector-dominated delivery system, and patients prefer tertiary care hospitals. Now the Republic of Korea has an oversupply of hospital beds.¹⁸³

6.4 South Korea

6.4.1 Digital Transformation of Healthcare in South Korea: Context and Maturity

As one of the most developed countries in the region, South Korea introduced its national health insurance system as early as 1977 and achieved universal healthcare in 1989.¹⁹⁰ As a result, vast amounts of data have been generated, which have been regularly used to assess the efficiency of the healthcare system in the country.

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

The following are some notable digital health innovations in South Korea:

U-Health:

U-health, also known as ubiquitous health, provides the monitoring of patient health remotely through wearable devices. The Korean government has been working with local governments on this initiative to deliver remote care.¹⁹¹

AI+X - (Examination work):

Using the medical video data held by the Health Insurance Review and Assessment Institute (HIRA) and medical institutions, the initiative converges AI with medical care support and screening support to make medical diagnosis more efficient and strengthening the competitiveness of Korean medical AI companies.¹⁹²

Smart Hospital Leading Model Support Project:

This initiative aims to provide ICT support to medical care through developing a leading model for smart hospitals that can enhance patient safety and improve medical quality that will be tested and then scaled.¹⁹³

EMR Standardization:

This project aims to strengthen patient safety, lay the foundation for the production and utilization of high-quality medical data and improve EMRs by introducing an EMR-certification program.¹⁹⁴

6.4.2 Cloud Adoption in Public Healthcare: Policies, Notable Initiatives & Regulations

The Korean government has been promoting various projects, directly and indirectly, related to digital healthcare, such as public big data dam projects and projects related to medical AI, personal data, and cloud-based initiatives, among others. As a result, the public sector has been successful in introducing digital transformation and in building next-generation medical technologies.

The private sector, government, and industry-academia collaborated to establish various HIS on the cloud, including medical services, medical support services, and insurance services, which allowed doctors to comprehensively and quickly understand a patient's health condition. In addition, systems have been established for the integrated management of wards, intensive care, and emergency nursing, reducing the overtime of nurses by 30%, and improving the quality of nursing services.¹⁹⁵

Cloud policy for the public sector

Over the past decade, the South Korean government has acknowledged the futuristic role that cloud computing can play for the public and private sectors, and has formulated key policies to support the adoption of cloud computing. The Cloud Computing Act was passed in 2015 to promote and develop cloud computing in the public sector. The Act also contains detailed industry-specific measures in accordance with privacy laws.¹⁹⁶

In 2021, the government announced it will change its existing 'Cloud First' to 'Private (Public) Cloud First.' Cloud services such as software as a service (SaaS) and platform as a service (PaaS) will be fostered and expanded from the current infrastructure as a service (IaaS). Cloud-based data centers will also be classified as separate industries, and their growth will be supported.¹⁹⁷

Incentives to cloud service providers: Evaluating use across government, local governments, and public institutions, private cloud service organizations will be awarded extra points depending on the extent of use.¹⁹⁸

Cloud for Healthcare: Maturity and Notable Initiatives

Cloud computing in the healthcare sector was allowed through an amendment to the Standards on Facilities and Devices for Administration and Retention of Electronic Medical Records in 2016. The amendment revised the requirement to store electronic medical records inside hospitals and allows the administration and storage of medical records with external companies or at remote locations that meet certain qualifications.¹⁹⁹

Cloud adoption has grown slowly despite 90% of service providers using EMRs. From 2016, the exchange of health service data between service providers was allowed and led by the government, and the number of participating providers has been increasing since then.²⁰⁰

Cloud-Based EMR: In 2017, the Ministry of Health and Welfare led a cloud-based project which allowed hospitals to utilize EMR and EHR (electronic health records) on the cloud. Initially, it was available only for selected hospitals such as the Korea University hospital that utilizes Naver Cloud but lately, it has been open to more hospitals.²⁰¹

Private Cloud Adoption: The Seoul National University Hospital has established its private cloud for the storage and utilization of patient data, but it isn't utilizing the public cloud. Advanced hospitals in Korea such as Bundang SNU, University Hospital in Korea, and other large hospitals have their own hospital information system and have achieved an advanced level of digitization. While technically they can easily be moved to the cloud, cloud adoption has been slow because of the restrictions on the healthcare sector.²⁰²

Research & Data Analysis: Currently, the Health Insurance Review & Assessment Service (HIRA) uses the cloud for research and data analysis purposes through a separate network with a separate account (put-off service).²⁰³

Success Stories

Precision Medicine Hospital Information System (P-HIS):

Launched in 2017, P-HIS is an important innovation that has resulted from large-scale data collection and the more recent cloud adoption. P-HIS has been designed and developed to be operational in a variety of IaaS and SaaS environments. By uploading HIS services to the cloud, the program has helped bring about precision medical care at medical sites. New products, including AI Solutions, Big Data Solutions, and Blockchain Solutions, are being developed based on P-HIS.

Dr. Answer:

The private sector, industry, and government worked together to apply the cloud to the public health sector and improve South Korea's quality of healthcare through Dr Answer, an AI-based CDSS. As a result, service durations were reduced by nearly 70% using cloud-based AI software, and the quality of hospital services was enhanced by developing the HIS functions needed throughout hospital operations, e.g., care, medical support, insurance work, analysis testing, and mobile EMR.²⁰⁴

Relevant Regulations

Data security and privacy laws for personal information and healthcare data are well-established in South Korea.

Regulations on data protection and privacy

The Personal Information Protection Act (the PIPA) applies for the collection, use, provision, delegation, destruction, and storage of personal information in the cloud. Accordingly, the processing of data by cloud computing is subject to the PIPA. The PIPA contains stringent provisions to ensure the protection of data subjects with corresponding heavy penalties.²⁰⁵

On 9 January 2020, the Korean National Assembly passed amendments to three major data privacy laws to streamline the regulatory framework for data protection and governance. These address the need for efficient use of data for the emerging economy based on new technologies such as artificial intelligence, cloud computing, and big data:²⁰⁶

- (i) Personal Information Protection Act ("PIPA") enacted in 2011 that regulates general matters of data protection.
- (ii) Act on the Promotion of the Use of the Information and Communications Network and Information Protection (the "Network Act") enacted in 1999 applies to data protection for online service users.
- (iii) Credit Information Use and Protection Act (the "Credit Information Act") enacted in 1995 regulates credit information protection.

The Amendments largely aim to:

- Minimize the burden of redundant regulatory activities and confusion among regulated persons stemming from previously overlapping data privacy regulations and multiple supervisory bodies.
- Develop a 'data economy' by introducing the concept of 'pseudonymized data' and the legal basis on which data may be used in a more flexible way to an extent reasonably related to the original purpose of collection.

Health data: Health information is categorized as a type of sensitive information under article 23 of PIPA and requires separate consent from the data subject, apart from other general personal information. Sensitive information is also provided stronger legal protection compared to regular personal information.

Medical Records: in the case of medical records, MSA specifically defines and regulates matters related to its recording, access, provision to third parties, electronic medical records, etc. Violation of such provisions of PIPA and MSA may result in administrative sanctions and even imprisonment. Electronic medical records cannot be stored outside of Korea.

Other relevant legislation:

- A cloud computing service provider could become subject to criminal penalties if the user's data is provided to a third party by the cloud computing service provider. Any provision of user data to third parties without consent or the use of user data beyond the agreed purpose will be subject to criminal penalties. Any incident of leakage of user information must be notified to the user and the Ministry of Science and ICT to enable remedial measures.
- If a user's data is stored overseas, the user can demand disclosure of the country where data is stored and the fact that cloud computing is being used, after which recommendation measures can be issued with respect to which recommendation measures for disclosure can be issued.²⁰⁷

Regulations on data security

The following data security regulations are applicable to cloud service providers:

- **Cloud Security Assurance Program (CSAP):** Cloud services for the public sector in Korea must pass the Security Review of the National Intelligence Service by default and pass the Cloud Security Assurance Program (CSAP), a security certification system organized by Korea Internet & Security Agency. Currently, an organization must use CSAP-authenticated companies to use the cloud for EMR. So far, only eight domestic cloud service providers—KT, Naver Cloud Platform, Gabia, NHN, Smileserve, Samsung SDS, Douzone, and Kakao—have acquired the certification for their IaaS services. No global CSPs have acquired such certification.²⁰⁸
- **Cloud Computing Standards:** The Ministry of Science and ICT has issued the 'Standards for Information Protection by Cloud Computing Providers' (Cloud Computing Standards). These standards are not binding, but compliance is recommended.²⁰⁹

Regulations specific to healthcare data in the cloud

The processing of healthcare data by cloud computing is subject to the PIPA, as mentioned earlier. Another policy that protects healthcare data in the cloud is the Medical Service Act of 2002. This Act was the foundation that allowed the storage of EMR in the cloud. More specifically, it allows medical personnel or medical institutions to create electronic medical records and contains detailed regulations on the preparation, storage, and electronic transmission of EMRs.

6.4.3 Barriers and challenges to cloud adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Lack of financial incentives and support:

Respondents felt that the government hasn't built sufficient incentives to compensate providers for moving to the cloud or to reduce the cost. Hospitals and higher-level institutions can afford the investment but not at the clinic level – they just purchase software from a software vendor, and re-engineering is provided by the software provider. But more than the issue of re-engineering, clinics, and smaller healthcare organizations are not motivated to go to the cloud because they see no reason to without compensation from the government.



"There is no big motivation for the utilization of public cloud for healthcare despite great strides in using private cloud of EMR."

— Policymaker

2. Data security concerns:

Data security is a primary concern for many providers. Patients' data is mostly stored within the hospital, i.e., there is no separate center that has integrated patient information in one place.



"Experts have strongly pointed out that institutional improvements must be made at a higher level so that the business of personal data utilization may spread further."

— Dong Jae Yang, Digital Health Expert, South Korea

"In terms of cloud adoption, we are basically ready technology-wise, but awareness and policy are the areas we lack, and that needs to be strengthened."

— Policymaker

3. Legacy systems:

Many large hospitals have their own data centers within their facilities, either on-premises or have established a private cloud. Migrating these massive applications is a formidable challenge for any established organization.

4. Citizens are concerned about data privacy:

Citizens are concerned about healthcare institutions having access to their sensitive information and that it might be held over them as a source of power.

5. Shortage of cloud skills:

There is also not enough cloud-native talent to meet the growth in demand for specialists who are equipped in the day-to-day practicalities of running applications on the public cloud.

6. Digital literacy gaps:

Many hospitals are looking positively at digital transformation, but there are still fears when it comes to adopting new technologies that may adversely affect patients' lives.

7. Lack of clear understanding of data privacy features:

While South Korea's policymakers are considering a series of data privacy policy revisions, businesses are erring on the side of caution when it comes to storing sensitive data on the public cloud.



"I think the healthcare sector will slowly move towards the cloud, but in a limited manner, and all with the service providers who can be certified by the government."

— Policymaker

6.4.4 Recommendations

Overall, policy direction and limitations from the existing policy should be the first thing to be addressed. These will address concerns related to budget and legacy systems. [See Recommendation 2 in Section 4]

1. Smaller healthcare organizations should be included in digitization efforts:

Digitization has only been done at a higher level, and it needs to trickle down to clinics and smaller healthcare facilities. More programs on cloud awareness and stakeholder dialogues are needed for the benefits of cloud adoption to be felt down the line. [See Recommendation 2.3 and Recommendation 4]

2. Find a middle ground for innovation based on healthcare data:

Respondents in Korea have noted that the stringency of data privacy law has hampered innovations, including those that make use of the public cloud. Regulators, researchers, and healthcare organizations must identify a common minimum and allow the innovation ecosystem to mature before passing stringent regulations.

[See Recommendation 2.3 and Recommendation 4]



“In order for South Korea to shift towards use of public cloud, the regulations surrounding cloud-based solutions and data privacy must be reviewed and revised. Currently, I don’t see this happening anytime soon due to practical and realistic reasons as well as public clamor for data security.”

— Dong Jae Yang, Digital Health Expert, South Korea

“HIRA has considered public cloud, but they are an organization handling patients’ sensitive data, so they need to form social consensus first to utilize public cloud for their organization.”

— Ji Sun, Deputy Director, HIRA, South Korea

An aerial photograph of the Tokyo skyline at sunset. The Tokyo Tower, a red and white lattice tower, stands prominently in the center-right. The city is filled with a dense collection of buildings, including modern skyscrapers and older structures. The sky is a mix of orange, yellow, and blue, with large, dramatic clouds. The word "JAPAN" is written in white, bold, sans-serif capital letters on the left side of the image, with a horizontal line underneath it.

JAPAN



JAPAN: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 83/100²¹⁷

Rank: **Progress on health-related SDGs (2015)** 21/188²¹⁸

Rank: **Healthcare Access & Quality Index (2015)** 94.1/100²¹⁹

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 14/193²²⁰

Cloud Readiness Index 71.3/100²²¹

UN ITU ICT Development Index 10/193²²²

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

JAPAN — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Japan is an archipelago with a total of 6,852 islands surrounding five main islands. It has a population of 126 million characterized by the dominance of an aging population, high life expectancy, and a declining birth rate.²¹⁰ Its high life expectancy can be attributed to the implementation of a universal health insurance system established in the 1960s.²¹¹

Healthcare Authority: The Japanese Ministry of Health, Labour and Welfare manages the universal health insurance system and provides technical supervision to local healthcare providers. In terms of drafting health policies and health system management, prefectural and municipal governments have autonomy over them.

Health Financing: Japan has a Universal Health Insurance system with the following key characteristics: mandatory coverage, no choice of health insurance programs, no restrictions on access, same benefit packages, same co-payments across all plans, and varying premium rates with out-of-pocket threshold.²¹²

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging population: In 2016, people aged 65 or older comprised 27.3% of the population, however, the share of medical care expenditure applicable to them was more than 50% of the total expenditure for the year. This poses challenges in health financing and affects the demand for types of care.²¹³

Lack of coordination between institutions: Due to the autonomous administration of prefectures and municipal government to health service delivery, the responsibility of health units is not clearly delineated.²¹⁴

Rising healthcare costs: The health expenditures related to the aging population and the high number of insurance-covered expensive drugs have led to a climb in healthcare costs.²¹⁵ Total Healthcare Expenditure (THE), as a share of gross domestic product (GDP), has risen substantially since 1995, from 6.3% to 10.9% in 2018.²¹⁶

6.5 Japan

6.5.1 Digital Transformation of Healthcare in Japan: Context and Maturity

Japan is considered one of the most advanced in Information and Communication Technology (ICT) in the world, landing within the top 10 countries in ITU's ICT Development Index measuring the level of ICT access, use, and skills in the country.²²³ As of 2020, 100% of the population has internet access—but only 93% utilizes it—and has access to at least a 4G mobile network. Disparities in rural and urban households in terms of access to the internet are not wide, with the percentage being 96% in rural areas and 98% in urban areas.²²⁴

Despite the advancement of ICT in the country, and although efforts have been made to digitize government transactions since the 1960s, internal processes in the government are stuck in a “paper-driven culture.” Paper documents and seals are still prevalent, and some persons in authority still prefer face-to-face meetings. According to the Japan Research Institute, in 2019, only 4,183 (7.5%) out of 55,765 administrative processes can be completed online.²²⁵ Adding to this dilemma, those that have computer systems in place are not optimized for interoperability – while vertically compatible, systems across ministries and local governments are not compatible with each other.²²⁶ To resolve this, a “Digital Government Execution Plan” was released in 2018. Under the plan, end-to-end government services will be made accessible online, data will be made available, and government platforms will be made participatory and interactive.²²⁷

Notable Digital Health Initiatives

Despite its early adoption of digital health initiatives, Japan's efforts in this area have been fragmented and unevenly implemented.

Hospital information systems in Japan originated as electronic order-entry systems bought from or developed by computer companies. Picture archiving and communication systems (PACS) and electronic medical records (EMRs) came into use in the 1990s.

E-Japan Strategy I and II:

E-Japan strategies I and II were launched in 2001 and 2003, which advocated for the wider adoption of EMR in hospitals. Five levels of EMR adoption were defined: departmental, inter-departmental, hospital-wide, inter-facility, and inter-facility, including care management information. By 2007, however, in contrast to the target of having 60% of hospitals adopt EMRs, only 10% had adopted them. In 2014, although it increased, the adoption rate was still at 27.3%.²²⁸

Data Health Project and PeOPLe:

In 2015, the Working Group on Information and Communication Technology Usage in the Area of Health Care was launched as part of the Data Health Project, and the Person-centered Open Platform for Wellbeing (PeOPLe) was conceptualized. The PeOPLe platform is a cloud-based storage of patient health data with the aim to be utilized to enhance and personalize medical service delivery.²²⁹

My ME-BYO Medical Project:

Another initiative to store patient data in the cloud was launched under the Healthcare New Frontier (HCNF) policy package of the Kanagawa government: My ME-BYO Medical Record Project.

The project aimed to create detailed Personal Health Records (PHR) to monitor and flag citizens' health status for the prevention of illnesses.²³⁰ A supporting program, Administrative Reform Promotion Office for Health Data, allowed seamless usage of data by healthcare professionals in 2017, and the Medical Big Data Law legalized them, with some considerations in handling healthcare big data and cloud-based applications.

MIDNET:

In 2018, the Medical Information Database Network (MIDNET) was operationalized. This allowed the sharing of patient data for the advancement of research in drug development, with the condition that the data was anonymized.

Intensive Data Health Reform Plan:

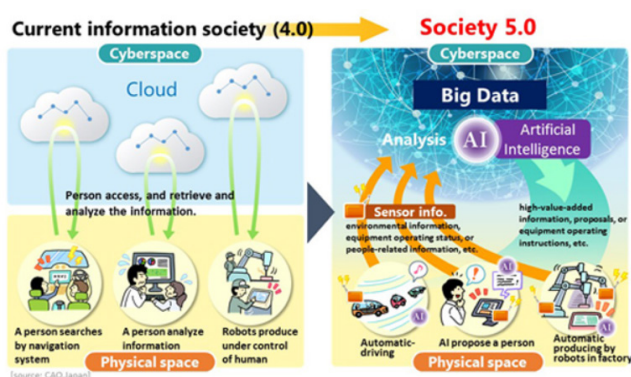
In 2021, an Intensive Data Health Reform Plan was drafted and announced, considering the changes in administrative operations brought about by the COVID-19 pandemic. The plan intends to accomplish two goals: to maximize existing infrastructure in the medical process and to enable patients to access their medical information. Maximizing existing infrastructure involves utilizing “My Number” ID cards—a social security and tax number system—in public health insurance.

6.5.2 Cloud Adoption in Public Healthcare: Policies, Notable Initiatives & Regulations

Despite being a pioneer in the digital world, Japan has been lagging in digital health initiatives compared to its peers.

Cloud policy for the public sector

Japan's cloud adoption journey began earlier than many of its peers in Asia Pacific. In 2011, the Ministry of Internal Affairs and Communications (MIC) launched a Joint Purchase of Cloud Service among Municipalities. In 2016, Japan announced its Society 5.0 vision through which it envisioned a Super Smart Society. The strategy's aim was to alleviate inconvenience in human processes through the convergence of cyberspace and physical space. It also aimed to move from the current society where information is dependent on upload and retrieval from cloud to AI-assisted information upload and retrieval, as presented in the illustration below.²³¹



In 2018, a “cloud by default” policy was enacted where all ministries and government units were encouraged to consider adopting the cloud in the utilization of their services. In 2018, the MIC allocated \$1.365 Billion (¥150 Billion) for the Promotion of Cloud Sharing Among Municipalities and for the Restructuring of Information Systems at the Municipal Government Project.

Relevant Regulations

Japan has sophisticated data security and privacy laws for personal information and healthcare data in place.

Regulations on personal data protection, privacy, and data security

Act No. 57 of May 2003, also known as “Act on the Protection of Personal Information” or APPI, guides data protection in the country. It was amended in 2020 to include transition clauses concerning requirements in data sharing with third parties and an increase in maximum penalties for violation.

Additionally, a 2021 amendment was released to ensure uniform application of the APPI in the public and private sectors. The agency responsible for monitoring the enforcement of this policy is the Personal Information Protection Committee.²³⁵

Cloud for healthcare: Maturity and Notable Initiatives

Japan has seen limited success in the use of the cloud for healthcare. However, in the last two years, Japan has announced more cloud regions and projects – these developments, along with the use of the cloud for COVID-19, may lead to faster growth in the adoption of the cloud for healthcare.

Patient Registry System: Tokumei Bank, an information management service providing various medical research institutions with a patient registry system for the secure collection and storage of clinical data, is stored centrally on the cloud along with patient clinical data and personal information. The service plays an important role in the management of clinical information on multiple system atrophy (MSA) at the University of Tokyo Hospital.²³²

COVID-19 Public Health Centre Business Support Cloud Package:²³³

In 2020, Deloitte Japan, together with the US SaaS company, Salesforce, Inc. supported the Japanese government in tackling the COVID-19 pandemic by providing the *COVID-19 Public Health Centre Business Support Cloud Package*.

The support package aims to reduce the administrative and operational tasks of public health centers while easing the sharing of information. Some of its features are inquiry management, PCR inspection, epidemiological survey management, close contact management, and data aggregation.

In May 2021, however, Salesforce encountered a failure in their cloud computing system, which led to the halt of the COVID-19 vaccination reservation system in Japan. Some issues that surfaced were the inability to confirm reservations and the inaccessibility of vaccine inventory.²³⁴

APPI principles revolve around purpose. The APPI limits collecting, processing, sharing, and storing of data to what is only needed for the purpose it will serve and to what the data subject has consented. Likewise, overseas transfer of personal data is prohibited unless consent has been given or precautionary measures and systems are at par with the quality the APPI demands.

Security regulations for cloud service providers: Multiple regulations have been published to guide cloud utilization across ministries and across different domains. One of the latest cloud regulation programs launched is the Information System Security Management and Assessment Program (ISMAP). The program includes the publication of a list of cloud services that meet ISMAP standards, as audited by a third-party organization.²³⁶

Regulations specific to healthcare data in the cloud

The “Two Guidelines from Three Ministries” (2G3M) guidelines govern medical information stored in a third-party service such as the cloud.

1. Guideline for the Security Management of Medical Information Systems version 5.1 issued in January 2021 by the Ministry of Health, Labor & Welfare.²³⁷
2. Safety Management Guideline for Information Systems and Service Providers Handling Medical Information issued by the Ministry of Economy, Trade & Industry and The Ministry of Internal Affairs and Communications (MIC) issued in August 2020.²³⁸

Storage of Healthcare Data: The Medical Information Guidelines require that medical information be stored in Japan to facilitate the health ministry’s supervision and audit of medical institutions. Copies of medical information may be stored overseas if a complete copy of the information is also stored within Japan. This restriction is only applicable to information collected by medical institutions rather than by other parties.²³⁹

6.5.3 Barriers & Challenges to Cloud Adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Reluctance in Adopting Technology:

While the government has introduced comprehensive sets of guidelines and programs to support technology adoption of health units in the country, the health sector itself is not ready for change. Respondents in the country cited that the reluctance partly comes from fear of leaking personal information while acknowledging that the fear is grounded more in a hesitancy to change. However, the government is now stepping up its use of the cloud with the technology expected to gain wider acceptance.



“If we’re looking at regulations, there is nothing stopping migration to cloud. Potentially everything can go on cloud. It’s just a mindset problem.”

— Health Data expert in the public sector, Japan

“The mindset around cloud is changing now. Even 5 years ago, clients would not allow us to use cloud. But 2-3 years ago, it started changing dramatically. I don’t know what triggered it, but Google started its cloud services, Microsoft, and AWS of course, that’s most well-known, so now our clients are getting used to it.”

— Health-IT expert and MOH Advisor, Japan

2. Lack of Understanding of the Cloud:

There are significant knowledge gaps when it comes to the cloud and the security and protection of data in the cloud. When combined with a low understanding of the benefits of health data collection, sharing, and utilization, there has been little impetus for cloud adoption.



“There is little demand for scalability or cost reduction because so far, data utilization is really poor. There is a lot of data being captured for every citizen. However, there is low awareness of how this data can be utilized; there are no plans to utilize this data. The government has no incentives to focus on utilization.

Each hospital has its own data center or data server, which may or may not be connected to cloud services. It is because data sharing is not well-established in Japan even now. The government promotes such data sharing but based on the business model of the provider, data sharing may reduce their revenue. This element delays all data sharing and digitalization in the medical field.

Government insurers have gradually realized the benefit of data digitization or cloud services, but most of the insurers and government bodies still have not yet realized the benefits and maybe overestimated the risks. The phantom of the security risk of cloud service is still quite wide.”

— Health-IT expert and MOH Advisor, Japan

3. Lack of IT professionals:

Like many other countries in the region, Japan is facing a shortage of IT skills, especially cloud specialists. This is a phenomenon present in Japan’s commercial technology sector as well, which has been bridged by hiring foreign talent. The government, however, is reluctant to hire foreign nationals as its civil servants, which means that unless the Japanese government invests heavily in grooming digital health experts for public sector leadership, the leadership needed to drive these efforts will be lacking.²⁴⁰



“Skilled professionals for implementing IT services are in shortage in Japan. There are not many talented people who can do that.”

— Health Data expert in the public sector, Japan

6.5.4 Recommendations

1. More Digital Health Advocacy is needed:

Dissemination of the immediate and longer-term benefits of digitalization may help with the wider adoption of technology and may help lower the hesitation surrounding technology – especially in the aspects of data security, data sharing, and data utilization. This is needed not only for the country's citizens but for policymakers too.

[See Recommendation 2.4 Recommendation 4]



“It is harder to show benefits to normal citizens but using applications [it] may be easier for showing their benefits to users, I mean citizens. So, if I were the head of a CSP, it's hard to show why a cloud service is good for citizens, but we can show the kind of benefits that will be provided to citizens or family members or communities. Data analysts and other professionals of course benefit, but for politicians to be convinced the technology's benefits and link to profits should be shown.”

— Health-IT expert and MOH Advisor, Japan

“Services could be more efficient if scalability was possible or with the use of more high-speed facilities, but there's very little incentive for government to provide that.”

— Health-IT expert and MOH Advisor, Japan

2. Use a range of policy tools to incentivize digital health initiatives:

The complexity of cloud regulations, a limited understanding of the benefits of health data sharing, and the lack of clarity around the ROI (Return on Investment) in cloud adoption are holding back adoption. Along with greater advocacy for digital health, policies should be established or restructured to introduce incentives and other levers that will improve the uptake of cloud services. These tools should be accompanied by upskilling and training programs in cloud technologies to bring more cloud professionals into the workforce. [See Recommendation 2, Recommendation 4]

3. Adapt, test, scale mindset:

The government's conservative stance and historically fragmented implementation of digital health initiatives have hindered Japan from keeping up with its peers. An agile mindset and the use of pilots may help the government take steps to bring innovation into the healthcare sector while ensuring patient safety.

[See Recommendations 1, Recommendation 2.3]

An aerial photograph of the Kuala Lumpur skyline, featuring the Petronas Twin Towers as the central focus. The image is overlaid with a green tint. The word "MALAYSIA" is written in large, white, sans-serif capital letters across the middle of the image, with a horizontal line underneath it.

MALAYSIA



MALAYSIA: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 73/100²⁴⁷

Rank: **Progress on health-related SDGs (2015)** 6/188²⁴⁸

Rank: **Healthcare Access & Quality Index (2015)** 68/100²⁴⁹

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 47/193²⁵⁰

Cloud Readiness Index 68.5/100²⁵¹

UN ITU ICT Development Index 23/193²⁵²

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

MALAYSIA — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Malaysia is an upper-middle-income country with a population of 32 million, dominated by young adults. The Malaysian healthcare system consists of tax-funded and government-run universal services and a fast-growing private sector.²⁴¹

Healthcare Authority: The Ministry of Health plans and regulates all public sector health services and the private sector. Legislation governing healthcare professionals requires them to register with statutory professional bodies.

Health Financing: Malaysia has achieved universal health coverage through its National Healthcare Financing Scheme, now rebranded as the National Health Insurance Scheme (Skim Insurans Kesihatan Kebangsaan, or SIKK).

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Rising out-of-pocket (OOP) expenditure: In 2018, OOP expenditure made up 35% of total health expenditure.²⁴² OOP payments have grown at the rate of 10% every year and if this trend continues, total OOP expenditure is projected to reach RM55 billion by 2027.²⁴³

Aging population: In 2020, an estimated 3.5 million people—or 7% of the population—in Malaysia are above the age of 65.²⁴⁴ Malaysia is expected to become an aging society by 2030, with 15% of its population aged 60 and above.²⁴⁵

Shortage of healthcare professionals: According to a report published by the country's National Audit Department, Malaysian hospitals are understaffed, overcrowded, underfunded, and do not have enough equipment to provide proper levels of care.²⁴⁶

6.6 Malaysia

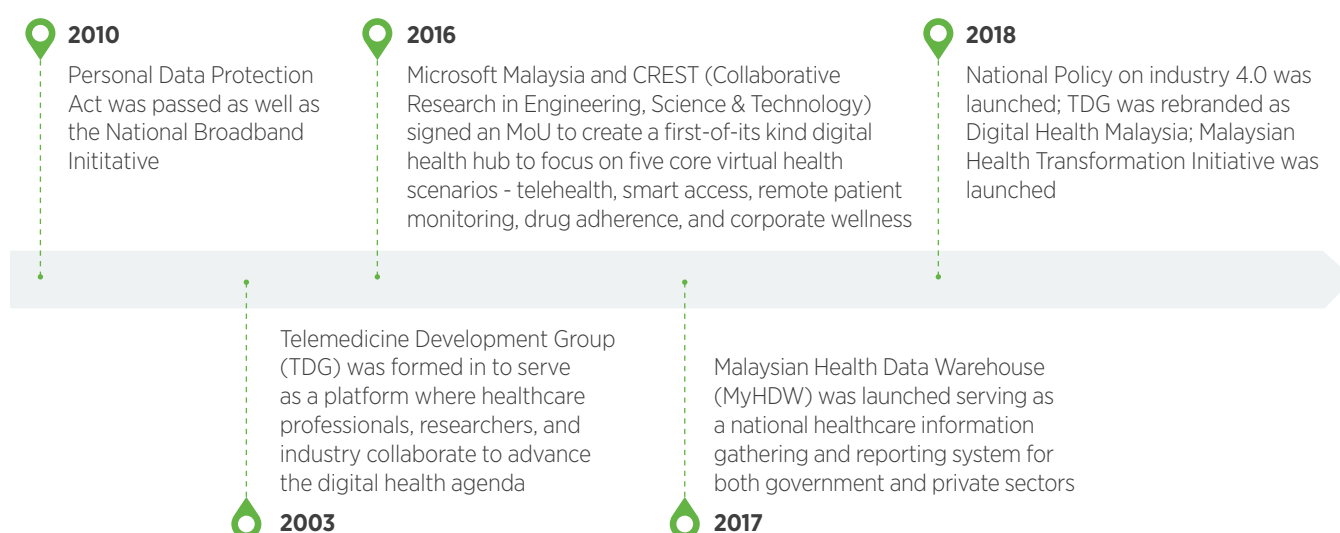
6.6.1 Digital Transformation of Healthcare in Malaysia: Context and Maturity

Malaysia aspires to be a developed nation by 2025. The Government of Malaysia has identified key digital areas, including the cloud, to drive the ICT sector, including its Industry 4.0 and Smart City Development goals.²⁵³

Malaysia's National Industry 4.0 Policy is the country's action plan for catalyzing the adoption of emerging technologies to increase productivity and competitiveness across industry sectors. The policy envisions Malaysia as a strategic partner for smart manufacturing, a primary destination for high-technology industries, and this creates opportunities for US providers to export services and solutions for the smart manufacturing sector in the region.

Malaysia's adoption of digital technologies for the healthcare sector has been slow. EMR adoption has seen some uptake, but most hospitals still do not use EMRs. There has, however, been an integration of hospital information systems with the finance and management systems as well as laboratories' systems.

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

Malaysia's health sector has seen slower digitalization when compared to sectors such as finance and retail.

Malaysian Health Data Warehouse:

This is a national healthcare information gathering and reporting system launched in 2017 by the Ministry of Health covering all government and private healthcare facilities and services. MyHDW includes a patient treatment information system (SMRP) and a patient registry information system (PRIS).²⁵⁴

Microsoft Malaysia and CREST (Collaborative Research in Engineering, Science & Technology) Digital Health Hub:

A Memorandum of Understanding (MoU) was signed between both parties in August 2016 to create a digital health hub to focus on five core virtual health scenarios – telehealth, smart access, remote patient monitoring, drug adherence, and corporate wellness.²⁵⁵

Dengue Outbreak Prediction platform:

The government uses this platform to support the management of dengue outbreaks. Conceived by the Artificial Intelligence in Medical Epidemics (AIME), the platform offers an algorithm-based approach to monitor dengue outbreaks based on epidemiological data estimating geo-locations and the timeframe of the next outbreak up to three months in advance. It has improved the average accuracy of 86.4%.²⁵⁶

6.6.2 Cloud adoption in public healthcare: Notable Initiatives, Policies & Regulations

With the unveiling of the Malaysian Digital Economy Blueprint in February 2021, Malaysia stands at the crest of a wave of digital transformation across sectors, including healthcare.

Cloud policy for the public sector

In 2013, the Public Sector Data Centre (PDSA) launched the 1GovCloud service, a cloud hosting service to agencies under its purview – managed by the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU).²⁵⁷

In 2017, Malaysia launched its Cloud First strategy for public sector agencies – 80% of public data is expected to be migrated to hybrid cloud systems by the end of 2022 through this strategy.²⁵⁸

In February 2021, the government announced conditional approvals to four cloud service providers, Microsoft, Google, Amazon, and Telekom Malaysia, to build and manage hyperscale data centers and cloud services for more effective and smoother data collection and management and lower long-term IT management costs.²⁵⁹

Cloud for Public Healthcare

While the Cloud First policy is applicable to all government sectors, there is a need to further elaborate and clarify the implementation of this Cloud First strategy for the healthcare sector as the sector is highly regulated.

There are several policies that govern digital health in Malaysia, such as the Health Information Management Systems Blueprint 2013, which called upon a holistic approach for healthcare organizations and the Information Technology Plan for the Ministry of Health (2016-2020). However, these policies do not provide any guidelines on the use of the cloud in the healthcare sector.

Regulations on personal data protection, privacy, and security

The Personal Data Protection Act 2010 (PDPA) came into force on 15 November 2013 and is based on data protection principles in the EU. Subsidiary legislations such as the Personal Data Protection Regulations 2013 had been enacted under the PDPA. In addition to legislation, the Personal Data Protection Standard 2015 (PDP Standard) sets out the minimum standards to be observed by data users when handling personal data.²⁶⁰

Stricter rules for medical or healthcare information: The processing of ‘sensitive personal data,’ which includes information relating to mental or physical health, political opinions, religious beliefs, and other beliefs of a similar kind, falls under ‘sensitive personal data.’ Processing sensitive personal data requires explicit consent unless an exemption applies.

Medical Records and Healthcare Information: The Private Healthcare Facilities and Services Regulations 2006 also govern the processing, management, and retention of patients’ medical records, and the processing of healthcare information is also governed by certain confidentiality guidelines issued by the Malaysian Medical Council.

Cloud Service Regulation: In October 2021, the Malaysian Communications and Multimedia Commission announced the Cloud Service Regulation along with a Frequently Asked Questions list. The regulation requires cloud services to be licensed under the Applications Service Providers Class license ‘ASP (C) license.’ Notably, the regulation specifies that a company that does not have a local presence and does not provide its cloud service applications to end-users through a local data center may be required to be registered under the ASP (C) license and ‘therefore will not be given any regulatory protection to both the user and provider of the service.’ The regulation is due to take effect on 1 January 2022.²⁶¹

Regulations specific to healthcare data in the cloud

There is a lack of clarity on whether the healthcare sector in Malaysia is allowed to use the cloud for healthcare data, as the regulations are currently silent about this. While cloud service providers are currently aware of the Personal Data Protection Act (PDPA) as well as the standards for ISO, the mechanism to ensure protection against loss of data depends on each organization adopting the cloud.

- In February 2020, the Commissioner issued Public Consultation Paper No. 01/2020 on the Review of Personal Data Protection Act 2010 (Act 709) (the PDPA Consultation Paper), which sought views and comments from the public on a total of 22 issues, including the processing of personal data in the cloud and the reporting of data breach incidents. It remains to be seen how this would affect the usage of the cloud for healthcare data.²⁶²

6.6.3 Barriers & Challenges to Cloud Adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Digital divide:

There is a significant digital divide in Malaysia, with rural areas severely underserved in terms of internet and broadband connectivity. Rural areas such as Sabah lack the ICT infrastructure needed for internet connectivity which precludes cloud adoption.²⁶³



“The government needs to have a “digital-first mindset” for it to adapt to the changes in the technology across the globe. There needs to be a bridging of the digital divide across segments of the society in order to realize digitization in this time and age.”

— Fabian Bigar, CEO, Strategic Management Office

2. A large resources and skills gap:

The budget for migration from legacy systems and fresh migrations is difficult to obtain as financial resources in the healthcare sector have been mostly diverted to manage the COVID-19 pandemic, including allocations to pay for COVID-19 vaccines, testing facilities, and hospital services. Additionally, a lack of knowledge and training among medical professionals hinders the adoption and promotion of the cloud.

3. Data security and privacy concerns:

Concerns regarding the safety of data, especially patient data, must be addressed as the real possibility of data leakage is a primary barrier that prohibits the adoption of the cloud for health.



“The regulations must explicitly state what data can and cannot go on cloud and ensure that there is confidence in the security of records stored in the cloud.”

— Fabian Bigar, CEO, Strategic Management Office

“It’s a good initiative to adopt cloud in general. But I believe private or hybrid clouds are the way to go since it can provide more security measures and that we don’t want to experience any kind of data breach or leakage given that sensitive data we store in it.”

— Policymaker

4. Absence of a clear framework and guidelines for cloud adoption:

The largest barrier towards cloud adoption in Malaysia is the lack of regulation explicitly stating the standards for the utilization of cloud-based solutions. Establishing the required regulations will ease the way and build trust in setting up cloud systems, with the latest Cloud Service Regulation being a step in the right direction. Furthermore, the lack of standardization in cloud services in the country, as well as local and internal capacities, should be addressed and strengthened.



“In order for the public healthcare system to adopt cloud, we need to provide the framework for implementation first. The primary question we have to answer is if we have started to do this and if there will be a public-private consultation process.”

— Fabian Bigar, CEO, Strategic Management Office

“The biggest barrier towards cloud adoption in Malaysia is the lack of regulation explicitly stating the standards and on the utilization of cloud-based solutions.”

— Head of IT, Leading private healthcare hospital chain

6.6.4 Recommendations

1. Strong, visionary leadership and stakeholder engagement is needed to drive Malaysia’s digital health journey forward:

Malaysia began its digitalization journey earlier than its peers; however, without leadership bringing the public and private sector together to implement their forward-looking policies. With a medium-term goal of increased and uniform adoption of EMRs and ensuring interoperability, Malaysia will help bring efficiency and innovation into its health systems, translating into better health outcomes. [See Recommendation 1, Recommendation 4]

2. Address healthcare data privacy and security concerns:

Dialogue between healthcare organizations, the private sector, including CSPs, ICT leadership, and think tanks is needed to understand and address data privacy and security concerns. The government must establish security standards for the cloud and clarify how these apply to healthcare data. [See Recommendation 2, Recommendation 2.1, Recommendation 3, Recommendation 4]

3. Address capacity building in cloud services:

A neutral platform can help provide health-sector-specific knowledge, technical assistance, and provide support in capacity building for cloud skills, including curriculum development and training. With the cloud being a key enabler of the digitalization of healthcare, Malaysia should invest in a long-term strategy of building talent that combines both specializations of ICT and healthcare. [See Recommendation 2.2, Recommendation 3, Recommendation 4]



“I think cloud has been around long enough and has proven its security mechanisms; it’s only a matter of when the government would start adopting cloud for healthcare rather than how and why.”

— Policymaker



THAILAND



THAILAND: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 80/100²⁷²

Rank: **Progress on health-related SDGs (2015)** 74.19/188²⁷³

Rank: **Healthcare Access & Quality Index (2015)** 67.9/100²⁷⁴

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 57/193²⁷⁵

Cloud Readiness Index 60.2/100²⁷⁶

UN ITU ICT Development Index 7/193²⁷⁷

CLOUD & DATA SECURITY

- ✗ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

THAILAND — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Thailand has a population of ~ 67 million. According to the 2019 Global Security Index Report, Thailand ranked 6th in the world in terms of countries with the strongest health security, scored second highest for its health system, third on disease prevention, and fifth on rapid response.²⁶⁴

Health Authority: The Ministry of Public Health (MOPH) is the national health authority responsible for formulating, implementing, monitoring, and evaluating health policy.

Health Financing: Thailand achieved Universal Health Coverage in 2002. The population in Thailand is covered through three main health financing schemes. The Social Health Insurance²⁶⁵ (SHI) covers private-sector employees; the Civil Servant Medical Benefit Scheme²⁶⁶ (CSMBS) covers civil servants, pensioners, and their dependents; and the remaining population is covered under the Universal Coverage Scheme (UCS). Sources of funds are from general tax, followed by direct OOP payment, social health insurance, and private insurance premiums.

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Aging population: The World Bank in 2016 forecasted that over 25% of the Thai population (17 million) will be 65 years of age or older by 2040.²⁶⁷

Unsustainable Healthcare System: Diminishing general tax revenue in Thailand due to a shrinking labor force is questioning the sustainability of the healthcare system.²⁶⁸

Inadequate Health Human Resource: There has been an outflow to the health workforce from the public sector to the private sector, particularly physicians, from the rural public facilities.²⁶⁹

Decentralized Healthcare System: Ministries, government agencies, public insurance schemes, and local governments use a variety of means to channel funds to health providers, leading to inefficiencies stemming from the differences in administration, payment, reporting, and monitoring.^{270 271}

6.7 Thailand

6.7.1 Digital Transformation of Healthcare in Thailand: Context and Maturity

In 1996, the first National IT policy called IT2000 was launched. IT2000 provided the framework and guideline for subsequent IT policies and initiatives. In 2002, IT2010 was endorsed for a comprehensive policy framework on Information and Communication Technology (ICT) development. IT 2010 identified five main areas for development, and e-Society focused on lowering the digital divide improving quality-of-life, e-Education e-Government, e-Commerce, and e-Industry.

The National ICT Master Plan was created, serving as a blueprint for sustainable growth in the ICT sector. The Master plan proposed seven principal strategies to be achieved by 2006 and called for the establishment of the Ministry of Information and Communication Technology (MICT).²⁷⁸

Since then, Thailand has seen remarkable developments in the ICT sector. The wireless market expanded tremendously by 2013, with mobile-cellular penetration reaching over 138% and broadband penetration reaching 52%. Thailand made strong progress in household ICT accessibility and development as well. In 2014, an expansive new policy framework, “Smart Thailand 2020,” was introduced. The main objective of this new plan was to boost accessibility, make ICTs a basic commodity for the entire country through ongoing improvements in infrastructure, and increase mobile broadband penetration. Thus far, Smart Thailand has resulted in the establishment of some 400,000 public Wi-Fi access points.

Cloud policy for the public sector:

Thailand has been using cloud computing for about 5 years, but it has not been widely accepted and used. It has penetrated the private sector and several industries²⁷⁹ such as petroleum and natural gas, specialized consulting, financial services, electronic and other electrical equipment, which have served as trailblazers in the use of this platform.

In May 2020, the government of Thailand announced that the Government Data Center and Cloud (GDCC) service will be used as a central cloud system to ensure the safety of government data and will also serve as a backup in the event of disasters.²⁸⁰

GDCC is the central cloud system to be used by government agencies, ensuring security and serving as a big data facility for state agencies. It facilitates data exchange between the government and public sectors through a central cloud. The GDCC will be operated by the National Digital Economy and Society Commission together with state-owned CAT Telecom. The government estimates it will save 5 billion baht from reduced spending on public cloud services. State agencies will no longer be allowed to budget for public cloud services from the fiscal year 2021.²⁸¹

The National Information and Communication Technology (NICT) identified six ICT-related laws and mandated that these laws be developed to ease ICT development in Thailand. These are: electronic transaction law, electronic signature law, national information infrastructure law, data protection law, computer crime law, and electronic funds transfer law.²⁸² Ministry of Information and Communications Technology (MICT) and Electronic Government Agency (EGA) are the key agencies responsible for the implementation of government cloud services.

Notable Digital Health initiatives

The MOPH launched a national eHealth strategy (2017-2026) for Thailand in 2015 that aims to leverage technology to improve health services, management, and communication.

Some of the digital transformation initiatives ongoing in Thailand as part of the eHealth Strategy (2017-2026) and carried out by the MOPH include:²⁸³

- Development of the National Refer data xChange (nRefer) system for information exchange between hospitals and to keep track of the treatments between transfusion hospitals and medical facilities.
- Development of a coordinated drug and pharmaceutical database, pharmacy management system, finance, drug information system, and the development of an electronic drug store system in collaboration with the Healthcare Supply Chain Excellence Centre (LogHealth) of Mahidol University.
- Development of information management support systems such as HROPS for human resources management, electronic financial services systems, complaint management system, electronic documentation system, and central data center system of The Ministry of Public Health.
- Development of a standard for exchanging information between public health systems as a guideline for the implementation of Personal Health Records (PHRs) and for data protection practices in Electronic Health Records systems by working jointly through a board of representatives from various organizations inside and outside the ministry.

The pandemic has further spurred the government to use digital technologies to manage the COVID pandemic:

Healthcare Applications: The government of Thailand launched various healthcare applications such as H4U (personal health profile app), Smart Health ID (patient administration cloud service), and the Primary Care Cluster App (telehealth and telemedicine) during 2018–2020. The Thai government is also using artificial intelligence (AI) and 5G technology to combat the current COVID-19 pandemic.

6.7.2 Cloud adoption in public healthcare: Notable Initiatives, Policies & Regulations

While most Thai hospitals have already implemented some degree of electronic medical record (EMR) and electronic health record (EHRs) capabilities, the most modern EMR and EHR solutions, as well as, most recently, cloud computing capabilities, have only been introduced in private hospitals in Bangkok, Phuket, and Chiang Mai.²⁸⁴ In the public sector, the use of EMR is still very limited given the lack of funds and inefficient infrastructure of the hospitals.²⁸⁵

Cloud computing solutions are gaining traction in the Thai market, but Thai hospitals, overall, still operate independently, and there is no vision for developing a single health cloud. Each hospital may have a cloud-based email and Customer Relationship Management (CRM) software that sits alongside a backend for patient data that is hosted onsite.²⁸⁶

Cloud for healthcare: Maturity and Notable Initiatives

The Ministry of Public Health established a data center in accordance with Uptime Group II and ISO 27001 standard within The Ministry of Public Health, Nonthaburi, provides MOPH private cloud in providing IaaS services and storage, hardware, servers, and network services to agencies that operate under the Ministry of Public Health.²⁸⁷

Less than 10% of public hospitals use the cloud in Thailand, and this is mostly in tertiary hospitals with support from government funding and resources. In large public and academic hospitals, they utilize the full versions of the HIS. In public hospitals with a lower bed capacity, a hybrid model of HIS technology is used where paper-based records are still dominant. Open-source software, HOSxP, developed by a Thai scientist, is the primary system used across all public hospitals in Thailand but, each of them implements their own specific customized version.²⁸⁸

The use of the cloud for health is mainly on a private cloud with a slow process of adoption across hospitals, as they mainly store patient data. However, there is limited use of the public cloud, mostly through Office 365. If public hospitals would adopt cloud, albeit private, they will have to seek government support while providing the data and complying with regulations.²⁸⁹

In the private sector, each hospital uses its own form of procured software which limits the interoperability of EMRs. Only those hospitals with the same software and within similar networks can exchange health data.²⁹⁰ Currently, most hospitals utilize on-premise systems.



“For me, EMR is a good start towards digital transformation in healthcare as it provides a central database to allow healthcare professionals to access patient information and build a workflow from admission to discharge. This is going to be a turning point for the next-generation HIS in Thailand. Cloud-based systems are explored and seen as a solution by public hospitals as these will offload the maintenance and operations of hosting from the existing IT personnel to someone else. In turn, these staff can perform additional and critical tasks in the hospital.”

— Healthcare Digital Transformation expert, Thailand

Success Stories

Songklanagarind Hospital, a public university teaching hospital and medical research hub supporting 14 provinces in the South of Thailand, has deployed Nutanix's private cloud to improve service performance. During the pandemic, the cloud has allowed medical staff to work remotely and has helped the hospital implement new systems rapidly and in a flexible manner. The hospital is looking at trialing a hybrid cloud system in the next 3-5 years. Songklanagarind Hospital will also be able to support national vaccine distribution.²⁹¹

Relevant Regulations

Regulations around healthcare data protection and privacy are still relatively recent and under development.

Regulations on personal data protection and privacy

In 2019, the Personal Data Protection Act ("PDPA") became law in Thailand. However, the Royal Decree on the Organisations and Businesses of which Personal Data Controllers are Exempted from the Applicability of the PDPA B.E. 2562 (2020) ("**Royal Decree**") was published in the Royal Gazette, which effectively extended the implementation of the key provisions of the PDPA for another year – until 1 June 2021.

- The PDPA acknowledges individual data subjects' right to control how their personal data is collected, stored, processed, and disseminated by data controllers. It provides lawful bases for the processing of personal data as well as prescribing the duties and responsibilities of data controllers and processors. The data protection obligations under the PDPA generally apply to all organizations that collect, use, or disclose personal data in Thailand.²⁹²

Data Privacy: Thailand has very recently passed a privacy law relating to personal data and, therefore, has no governing regulatory body. Victims whose privacy has been breached may still pursue legal action regarding this matter. However, there are no breach notification laws within Thailand, and thus, entities have no legal requirement to notify their customers and/or business partners when their personal data is exposed.²⁹³

Regulations on data security

Thailand's Cybersecurity Act came into force in May 2019. The Act will allow the government to track, monitor, and access digital data. As per the Digital Economy Promotion Agency ("DEPA"), the new legislation aims to combat cyber threats and equip law enforcement personnel with the ability to protect the country's digital infrastructure. Authorities will have the right to seize incriminating computers and systems, for which they should go through court warrants and comply with established procedures involved in securing one. The Act classifies cyber threats into three groups: non-critical threats, critical threats, and crisis-level threats.²⁹⁴

Cloud service providers (CSP) are not held by security laws or codes which pertain to general security requirements or audit requirements. Laws pertaining to the certification of technological products are also absent.²⁹⁵ The laws surrounding the misappropriation of information of cloud computing services offer limited protection for criminal activity.²⁹⁶

Regulations specific to healthcare data in the cloud

There are no specific guidelines for the cloud.

6.7.3 Barriers & Challenges to Cloud Adoption

Despite several positive developments, the government faces challenges in adopting a cloud-based system:

1. Data Security Regulations:

The Ministry of Public Health, Thailand, endorses a regulation for data security and privacy for healthcare data. However, there is a lack of implementation by the hospitals and continuous ignorance of said policies. The government policies need to be supported by a provision of budget for these hospitals to implement the guidelines appropriately.

2. Challenges with Resources:

One of the main barriers is the imminent budget cuts and budget reallocation for public hospitals once they start to adopt private cloud from the government. Although the hospital will gain efficiency in its health-IT operations, respondents cited that the idea of budget cuts prevents public hospitals' adoption of the cloud. If the hospitals decide to adopt cloud, they will have to go through and comply with guidelines for the new system, training of personnel, provision of enabling infrastructure, and increase in security protocols. Highly skilled, technical, and cloud skills would be required for the transition phase, which is already lacking in the country. Additionally, cloud adoption is further obstructed as state agencies will no longer be allowed to budget for public cloud services from the fiscal year 2021.²⁹⁷



“One of the main barriers by these public hospitals is the imminent budget cuts and reallocation they would experience once they adopt the private cloud from the government, in hindsight, it will lessen the burden from their end in terms of work efficiency, but the idea of budget cuts prevents them from transitioning towards this kind of digital technology.”

— Healthcare Digital Transformation expert, Thailand

3. Policies and Regulations:

Despite all efforts to promote the provision and adoption of cloud computing, the existing legal infrastructure remains challenging for Thailand. Service providers perceive the Computer Crime Act, B.E. 2550 (2007) and Amendment B.E. 2560 to be disruptive and inconsistent with current cloud computing practices.²⁹⁸ Data required to be stored by the providers within a cloud will be large and challenging to inspect. The Act specifies that any service provider who intentionally supports or consents to a crime involving dissemination or forwarding of forged or false computer data which can cause damage to a third party or the public, or to the country's security or data of a pornographic nature, shall be subject to the same penalty as that of a person committing the crime. This section of the law has strong negative effects on public cloud service provision.²⁹⁹

6.7.4 Recommendations

1. Review cloud policy and introduce policy tools to further cloud adoption:

In Thailand, the main problem is not necessarily the lack of regulation but its apparent lack of clarity and enforcement in the country. In most instances, the government provides guidelines to use technology in public hospitals, but compliance by doctors is very low due to their apprehensions about using digital technology. There is no policy encouraging the use of the cloud in public healthcare and little guidance as to its implementation. The government must look at adopting a Cloud First Policy for healthcare. [See Recommendation 1, Recommendation 2]

2. Government financial support:

Cloud adoption has improved many of the private digital initiatives in Thailand and has the potential to bring further efficiencies and innovation in the public health sector. The government must subsidize the costs of government hospitals adopting the cloud and supplement them with appropriate budget and training for its healthcare personnel for adoption, implementation, and scale. [See Recommendation 2, Recommendation 2.3]

3. Inter-departmental partnerships:

The government will have to prioritize and allocate budget for healthcare IT development through collaboration between MOPH and the IT department [See Recommendation 1]

4. Capacity building and monitoring:

Younger doctors tend to be more open to adopting digital technologies in healthcare. The government will need to emphasize education, training, and equipping the senior doctors with knowledge on how to embrace cloud-based solutions. There is a need to establish clearer roles and responsibilities for local governments and the Ministry of Public Health. Mechanisms for better central oversight and accountability need to be established. [See Recommendation 3, Recommendation 4]

5. Digital Health Leadership:

The government needs to recruit more health IT experts as part of the government for a better understanding of how to tackle healthcare challenges with digital solutions and technologies. [See Recommendation 2.1, Recommendation 4]



“I believe cloud is a good answer and solution for Thai’s healthcare system as we follow the footsteps of other developed nations in their digital transformation. Cloud systems will enable interoperability and data exchange that will be vital for the patient’s sake, especially during emergency treatment. With a cloud-based system, hospitals would only need to manage their internet connection, and at the same time, it will reduce manpower requirements and promote healthcare data exchange. Government lacks the vision which, in turn, makes the policy impossible to be crafted well.”

— Dr. Pattama Rimmakunsub, Medical Informatics Specialist, Thailand

6. Standardization:

Different hospital departments and centers have separate needs, follow different data standards, and use diverse solutions with little or no interoperability between systems. The policy needs to develop standards, encourage interoperability, and deal with the need for provision to customize the unique workflow of each individual hospital, department or clinic. [See Recommendation 2, Recommendation 2.1, Recommendation 2.2]

7. Pilot projects can help build trust:

Cloud adoption should ideally begin with a pilot project in a chosen hospital. It can be scaled as per its outcome to a bigger network of hospitals with the necessary guidelines and budget. [See Recommendation 2, Recommendation 2.3, Recommendation 2.4]



“The need to maintain continuous operations is another barrier to cloud adoption. Should hospitals decide to adopt cloud, they are worried about the transition phase it would entail, such as the creation of guidelines for the new system, training of personnel, provision of enabling infrastructure, and increase in security protocols that they need to put in place.”

— Healthcare Digital Transformation expert, Thailand



INDONESIA



INDONESIA: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 57/100³⁰¹

Rank: **Progress on health-related SDGs (2015)** 125/188³⁰²

Rank: **Healthcare Access & Quality Index (2015)** 44/100³⁰³

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 88/193³⁰⁴

Cloud Readiness Index 55/100³⁰⁵

UN ITU ICT Development Index 111/193³⁰⁶

CLOUD & DATA SECURITY

- ✗ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✗ Legislation on Personal Data Protection
- ✗ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

INDONESIA — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Indonesia is the largest archipelago in the world, with an estimated total of 17,504 islands. With a population of 271 million, the country is ranked 4th globally in terms of population, dominated by the working-age population.

Healthcare Authority: The Federal Ministry of Health (MoH) mostly regulates health service delivery and resources, while local governments, under the Ministry of Home Affairs (MHA), are the ones that deliver health services.

Health Financing: *Jaminan Kesehatan Nasional* (JKN) in the national health insurance scheme. It pools contributions from members and the government under a single health insurance implementing agency, *BPJS Kesehatan*. As of April 2021, it covers 82.3% of the population.³⁰⁰

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Lack of Supply-Side Financing. Investment in the healthcare workforce, facilities, and equipment is lagging, particularly in poorer and more distant regions.

Double Burden of Disease. Less developed and rural areas face communicable diseases, mostly vaccine-preventable diseases (VPDs), while in the urban population there is a steady increase in the prevalence of non-communicable diseases.

Lack of Health Human Resource and Incentives. Rapid growth of private healthcare facilities in big cities and inadequate incentives for service in underserved and remote areas have resulted in major disparities in human resources for health.

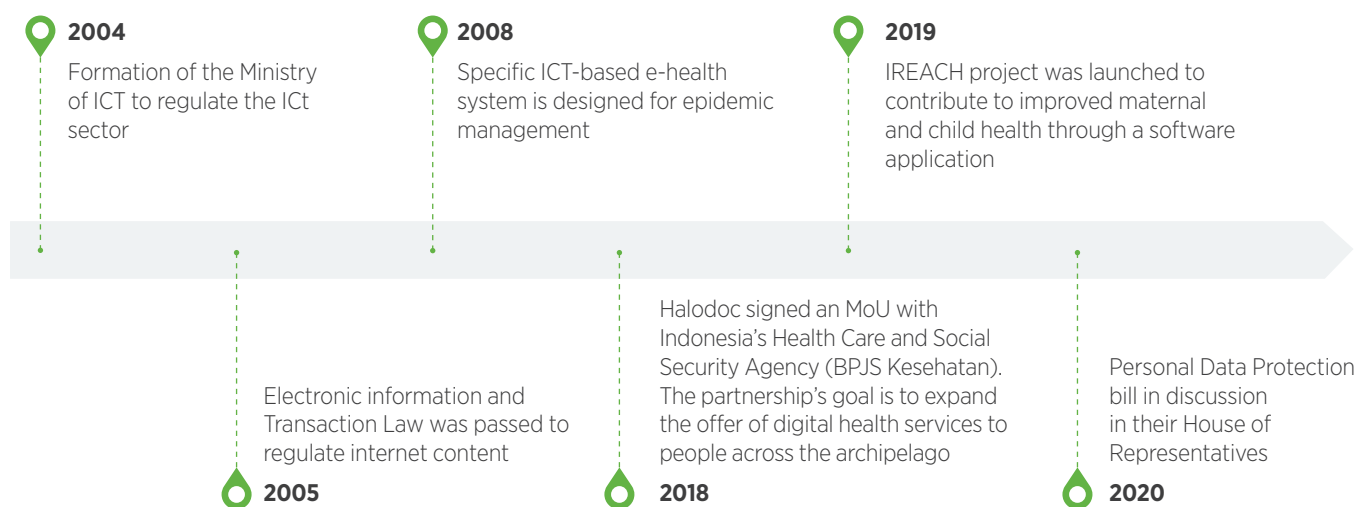
Fragmented Health Information System. In the absence of well-coordinated standard monitoring and surveillance systems, decentralization has resulted in fragmented data architecture since many regional agencies have initiated their own systems.

6.8 Indonesia

6.8.1 Digital Transformation of Healthcare in Indonesia: Context and Maturity

In the last 5–10 years, digital health has been gaining momentum as Indonesia's sizeable youth population increasingly looks to digital solutions to access goods and services. However, Indonesian organizations, in general, have been slow to embark on their digital transformation. Just 43% are currently undergoing this journey, although 34% expect to follow suit by the end of 2021.³⁰⁷

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

There are several eHealth implementation mechanisms employed in the public sector:

JKN Mobile:

Badan Penyelenggara Jaminan Sosial Kesehatan (BPJS-K), the provider of the National Health Insurance – Healthy Indonesia (JKN –KIS) program, has introduced a Mobile JKN application through which users can access information regarding JKN through the application. The application provides users general information on the user's personal data, maps of health facilities for the nearest available location, payment information as well as health screening options.³⁰⁸

P-Care BPJS:

In 2014, BPJS introduced P-Care BPJS, a web-based patient information system for primary care facilities that allows real-time and integrated patients services between all levels of institutions.³⁰⁹ This system was further leveraged as the main database to record the administration of the COVID-19 vaccination.³¹⁰

BPJS Digital Claim Verification (Verifikasi Digital Klaim/ Vedika):

To improve BPJS service and operations, BPJS launched BPJS Digital Claim Verification Software, which is used to claim both inpatient and outpatient services. The application is useful for hospital management to monitor its JKN costs.³¹¹

Application for Online Outpatient Registration:

The Ministry of Health launched a website-based queue management system accessible through <http://sirs.yankes.kemkes.go.id/>. A patient seeking outpatient treatment will be able to choose a hospital and physicians from among a total of 32 state-owned General Hospital Centers (RSUP) in Indonesia.³¹²

TeleECG and TeleRadiology:

TeleECG and TeleRadiology are the two telemedicine pilot projects initiated by the Ministry of Health in 2012, with the concept of teleimaging and teleradiologic, specifically in referring to the results of electrocardiography (ECG) and X-Ray.³¹³

Makassar's 24-hour-homecare/ telemedicine and teleradiology:

Makassar introduced a 24-hour homecare service and telemedicine services through its homecare service to bring health equity into surrounding areas. A transportation facility, Dottoro'ta, was arranged for the patients, equipped with medical equipment and patient monitoring tools.³¹⁴

Digital Acquired Immune Deficiency Syndrome (AIDS) Application

In 2013, Indonesia's Ministry of Health, together with the Indonesia AIDS Coalition (IAC), launched the Digital AIDS Application with the aim to support AIDS prevention programs.³¹⁵

6.8.2 Cloud adoption in public healthcare: Notable Initiatives, Policies & Regulations

In the public sector, the government is in talks to form a government cloud platform with at least two large data centers to be placed in the Agency for the Assessment and Application of Technology, the Registration of the Ministry of Home Affairs, and the Ministry of Finance, in addition to their existing data centers.³¹⁶

Cloud policy for the public sector

The government of Indonesia has not legislated a separate cloud-specific regulation yet, but relevant regulations surrounding the utilization and implementation of cloud-based solutions in Indonesia are the following:³¹⁷

1. ITE Law or Law No. 11 of 2008 concerning Information and Electronics Transactions (Law No. 11/2008).
2. PP PSTE or Government Regulation No. 82 of 2012 concerning the Implementation of Electronic Systems and Transactions (Regulation 82/ 2012) amended by Government Regulation No. 71 concerning Operation of Electronic System and Transaction (Regulation 71/2019).
3. Ministry of Communication and Informatics Regulation No. 20 of 2016 on Personal Data Protection on Electronic system. (Regulation 20/2016).
4. Ministry of Communication and Informatics Circular No. 3 of 2021 on Use of Third-Party Cloud by Government Agencies.

These lay out guidelines for Electronic System Operators (ESOs) who might work with public and private entities in storing data and implementing applications in the cloud. One of the relevant provisions is Article 17 of Regulation 82/2017, which mandates the placement of data centers and disaster recovery centers to be within the territory of Indonesia. However, Regulation 71/2019 amended this, which allowed ESOs to transfer or store data offshore. However, public scope ESOs, including state administrative agencies, are required to seek approval from the Minister of Communications and Informatics first.

The most recent guidance, Circular No. 3/2021, sets out 13 security criteria for third-party cloud providers that public agencies can use.

The guidance requires two availability zones at different data locations in Indonesia and also requires that encryption keys be stored within Indonesia. There are data privacy policies in place, but there is no specific data security regulation for the cloud.³¹⁸

Cloud for Healthcare: Maturity and Notable Initiatives

There are efforts to implement health solutions using cloud computing based on situations in Indonesia. Some of these are: electronic health/medical records, medical image archiving, and physician collaboration solutions.

The government of Indonesia recently published its digital transformation roadmap for 2021-2024, which also aims to improve health services through digital technologies. Cloud-based systems are already in place in Indonesia but are partially implemented across the country. Indonesia is adapting or buying technology from China and India.³¹⁹

The Ministry of Health currently has about 200-218 HIS, and while most of them are interconnected with each other, they are still considered to be independent. The government plans to ensure that these systems are integrated and interoperable. Moreover, these shall be compliant with international standards such as HL7's FHIR for interoperability.

Currently, most healthcare data are stored on-premises, but copies of these are made, which are stored in the cloud, especially for the data that is considered less sensitive. Healthcare centers have started to relocate their data centers to the cloud this year through their national telecommunications provider. Respondents have cited that, in general, the government still prefers private cloud over public cloud due to security concerns.

Success Stories

Indonesia's healthcare sector is in the very early stages of cloud adoption. The private sector has been more advanced in the usage of the cloud compared to the public sector:

One Solution System

In April 2021, PT Pertamedika IHC, one of the largest state-owned hospital networks, announced the launch of an integrated health service system called One Solution System (OSS) on its 73-hospital wide network. The OSS platform will act as a source for patient medical information ranging from allergies to medications to surgical procedures, as well as data from the recently launched Mobile Telemedicine application, IHC Telemed. This comprehensive data is expected to be useful in making faster and more accurate patient diagnoses. The cloud infrastructure will also help Pertamedika IHC scale its implementation nationwide.³²⁰

AI-based CT Scan Analysis

Last year, Alibaba Cloud Indonesia partnered with Jakarta's Omni Hospital and Eka Hospital to speed up the diagnosis of COVID-19 cases through its CT Scan image analysis technology, Alibaba Cloud Image Analytics. The cloud services provider said that personal data is not stored or accessed during its AI-based analysis process. Along with the two hospitals, Alibaba Cloud and its partner, Medinesia, also launched the thoraxcovid.id portal, which is intended to send CT Scan images of patients anonymously to be analyzed by the Alibaba Cloud algorithm. Alibaba claims that the technology allows testing through machines 60 times faster when compared to detection made by humans.³²¹

Relevant Regulations

Indonesia's cybersecurity regulations are currently underdeveloped.

Regulations on personal data protection and privacy

Currently, legislation to serve as the main document on personal data protection in Indonesia, the Personal Data Protection (PDP) Bill, is still being drafted. While this is underway, multiple relevant policies guide data privacy and protection, as listed below:³²²

1. Law No. 11 of 2008 on Electronic Information and Transaction as amended by Law No. 19 of 2016 (Law No. 11/2008).
2. Government Regulation No. 71 of 2019 on Administration of Electronic Transaction and System (Regulation 71/2019).
3. Ministry of Communication and Informatics Regulation No. 5 of 2020 on Private Electronic System Providers (Regulation 5/2020).
4. Ministry of Communication and Informatics Regulation No. 20 of 2016 on Personal Data Protection on Electronic system (Regulation 20/2016).

These regulations put emphasis on the importance of the informed approval of the data owner. They require that the purpose, extent, and process of data collection, including the data owner's rights over the data, must be conveyed to the data owner. The limitations of ESO's processing, storage, and retention of data depend on what was agreed by the data owner.

Regulations on personal data protection and privacy

Similar to data protection and privacy, there is no single legislation that guides data security. Moreover, data security regulations are included as clauses in data protection and privacy regulations. These regulations guide the electronic system providers (ESPs) from registration to sanctions.

Article 2 and 6 of Regulation 71/2019 requires ESPs to register with the Ministry of Communication and Informatics via the Online Single Submission system, while Article 25 of the Regulation 20/2016 dictates ESPs are responsible for the security of personal data they have acquired, collected, processed, analyzed, stored, displayed, announced, delivered, disseminated, and erased. Their responsibility includes notification of the data owner in case there has been a data breach, as guided by Article 24 of Regulation 71/2019, Article 28 Regulation 20/2016, and Article 14 of Regulation 71/2019.

Lastly, Article 30 of Law No. 11/2008 lays out possible penalties for unlawful access and tampering with electronic systems and records. The maximum penalty includes imprisonment of up to ten years and/or a fine of up to Rp5 billion (US \$349,000).³²³

Regulations specific to healthcare data in the cloud

While the abovementioned regulations generally guide data privacy, security, and protection, there are sector-specific laws in Indonesia.

Government Regulation 46 of 2014 on Health Information System: Under this regulation, any organizations that serve as the ESP for eHealth in Indonesia shall:

- (i) provide a standard procedure of protection that guarantees security or confidentiality of patient's data (in the form of electronic information or documents).
- (ii) applying risk management upon any damage or loss arising out of electronic system operation;
- (iii) provide and carry out procedure and facility to protect the electronic system from any interference and any material or immaterial loss;
- (iv) provide security standard covering procedure and system to prevent and overcome any threat or interference attempt.

In providing its electronic system for telehealth purposes in Indonesia, the ESP is required to obtain a corporate general license, and if there is foreign capital participation, an investment license from the Indonesian Investment Coordination Board (BKPM) is also required.

Medical Records: The Ministry of Health Regulation No. 269 of 2008 regulates what information can be collected in a medical record as well as a health unit's obligations regarding storing, deletion, and confidentiality of a medical record.³²⁴

Law No. 36 of 2009 on health, on the other hand, regulates handling personal data in the health sector. It includes the importance of informed consent, especially when involved in research.³²⁵ Regulations specific to healthcare data in the cloud, however, do not exist so far.

6.8.3 Barriers & Challenges to Cloud Adoption

The following barriers were identified based on secondary research and interviews with key decision-makers and digital health experts.

1. Security issues:

Security issues, such as data confidentiality and data recovery, remain the first consideration of healthcare organizations seeking to adopt cloud services. Indonesian healthcare organizations do not yet have the confidence to store healthcare data off-premises.

2. Low speed of internet connection in rural areas:

This challenge arises due to the inadequacy of ICT infrastructure in Indonesia, specifically in the eastern parts of Indonesia and in rural areas. The country's geography is a challenge for data communication channel providers or internet providers seeking to build base transceiver station (BTS) towers or to deploy fiber optic cables in those areas. However, this does not apply to the urban areas, specifically in Jakarta, where the internet connection speed is no longer a problem as it has sufficient ICT infrastructure.

3. High costs of bandwidth and supporting hardware:

To be able to access cloud resources at high speed, it takes a large amount of bandwidth capacity. In Indonesia, internet costs are still relatively high. For cloud service providers that do not have their own data communication channel infrastructure, this requires greater financial investments so as to obtain enough bandwidth capacity.

4. Data migration risks:

Respondents cited that data migration is a key concern for healthcare management. The fear is that the resultant lag in output and efficiency as the organization's IT staff and clinicians familiarize themselves with newer technology will lower the organization's productivity.



"The most difficult challenge to overcome is to obtain the willingness of the staff and management of hospitals to adopt cloud technologies. Even if it is provided for them, they will not utilize it until they are not ready and equipped with the necessary skills to operate them."

— Digital Transformation Consultant, India

5. Knowledge gaps and limited awareness of the cloud model:

The cloud business model is relatively new to Indonesia. While there has been an increase in the number of cloud service providers, its progression has been quite slow. The understanding of cloud computing, its use, benefits, and application in healthcare is quite limited, which further impacts cloud adoption.

6. Data integration:

There is an existing issue in terms of data integration in Indonesia. A key factor that leads to this is that applications are not designed to be integrated. Further, a policy of decentralization allows districts to implement policies and systems at their discretion, which inhibits the unification of HIS across the country. There is ineffective coordination during systems development, and data standards are not followed.



"We need to redefine our national health priorities as we consider data to be vital these days. In this case, we see that cloud-based solutions for healthcare may be the solution. Personally, I think there is a strong need to have this cloud system to support data integration for healthcare as the current system is complicated to navigate. Recently, the healthcare industry has started perceiving cloud computing as a solution to system-wide health challenges, which is why stakeholders are putting huge efforts into addressing all technical and non-technical issues. As you know, the pandemic really pushed the government to move faster to adopt a lot of innovations in digital health like e-pharmacy."

— Prof. Surahyo Sumarsono, Senior Consultant (IT Management Consulting Company)

6.8.4 Recommendations

1. Invest in building infrastructure:

The Indonesian government must work with development partners that can assist with the technical expertise required to build the required infrastructure. This will be crucial in supporting the digital health transformation of Indonesia's healthcare systems. [See Recommendation 3 in Section 4]



“Specifically, the biggest barriers in terms of EMR adoption is the lack of solid, reliable, and robust infrastructure supported by a national strategy.”

— Prof. Surahyo Sumarsono, Senior Consultant (IT Management Consulting Company)

2. Establishing policies and regulations for the cloud through a national healthcare strategy:

The government of Indonesia needs to focus on establishing a national health information system that can be supported by a cloud-based system. This will allow the integration of health data across all facilities. There is a need for guidelines on how to train healthcare IT staff, and capacity building is also needed in developing and enforcing regulations across all levels of healthcare. Currently, there are few legislative requirements governing IT deployment in the local sector; and Indonesia's healthcare operators are keen to adopt industry best practices. It should cover diverse aspects such as the protection of patient data, health apps and diagnostics (including AI-based), and ethical health insurance to increase the quality and access of healthcare in Indonesia. [See Recommendation 1, Recommendation 2, Recommendation 2.2, Recommendation 4]



“The government is slowly adopting cloud for healthcare in Indonesia, but people still believe their data are not safe and secure in that digital system. I believe that it will take time to trust the cloud model, but it will surely go in that direction. For more organizations to adopt cloud, the government has to step in and make the regulation easy to follow and very straightforward for users. Digital transformation in healthcare should be driven internally by the government; they should initiate such an initiative and not just wait for things to happen. I hope the government moves towards technology not only with cloud but also more advanced technology such as remote monitoring. This will improve the health of individuals; this will make them more conscious, more aware of what is a healthy life.”

— Dr. Agus Mutamakin, Chief Information Officer, Dr. Cipto Mangunkusumo Hospital in Jakarta

“There is no specific healthcare data security regulation for electronic data in place. The government must put this in place. More regulations should be developed, especially on how data can be protected and the limitations of its implementation. The government must also educate the public about the regulations surrounding cloud and how this type of technology can benefit them.”

— Dr. Agus Mutamakin, Chief Information Officer, Dr. Cipto Mangunkusumo Hospital in Jakarta

3. Build a sustainable IT workforce equipped with cloud skills:

One of the challenges providers face today is a lack of technical knowledge to understand and develop new applications, especially for the transition from paper-based EMR to electronic records, and understanding the usability of the cloud. There is an urgent need to develop a sustainable IT workforce through policies and short-term and long-term upskilling programs developed through public and private partnerships. [See Recommendation 2.2, Recommendation 3]

An aerial photograph of the Notre-Dame Cathedral in Ho Chi Minh City, Vietnam. The cathedral, with its red brick walls and multiple domes, is the central focus. In the background, a dense urban skyline is visible, featuring several modern skyscrapers, including the Bitexco Financial Tower. The sky is filled with soft, white clouds. The word "VIETNAM" is overlaid in white, bold, sans-serif capital letters on the left side of the image, with a short horizontal line underneath it.

VIETNAM



VIETNAM: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 75/100³²⁹

Rank: **Progress on health-related SDGs (2015)** 49/188³³⁰

Rank: **Healthcare Access & Quality Index (2015)** 60/100³³¹

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 86/193³³²

Cloud Readiness Index 46.2/100³³³

UN ITU ICT Development Index 107/193³³⁴

CLOUD & DATA SECURITY

- ✗ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✗ Legislation on Personal Data Protection
- ✗ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

VIETNAM — HEALTHCARE SYSTEMS MATURITY & CONTEXT

Vietnam lies on the east edge of the Indochinese peninsula with a population of 96 million, falling within the top 20 most populous countries in the world.

Healthcare Authority: Vietnam's healthcare system is a hybrid model between its public and private sectors, in which the public sector plays a more substantial role through the Ministry of Health, Department of Health, District Health Bureaus, and Commune Health Centers.

Health Financing: In 2014, national health insurance was mandated for all. As of 2019, universal health insurance coverage includes 87.7% of Vietnam's population.

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Double burden of disease. Vietnam has been undergoing a double burden of non-communicable diseases and infectious diseases.³²⁶

Lack of infrastructure and shortage of healthcare staff. Hospitals, which are already few in number, are overexploited due to the lack of services available at primary healthcare units.³²⁷

Demographic changes. The increasing share of older persons living in rural areas is doubly challenging for Vietnam's government to not only develop healthcare strategies for the older population but to also build the infrastructure at the *commune* level.

Cost challenge. Vietnam's total healthcare spending is estimated to unprecedentedly increase from around USD 420 billion to USD 740 billion by 2025. In 2014, Vietnam's public healthcare expenditure as a percentage of GDP was the highest among ASEAN countries, around 3.8%.³²⁸

6.9 Vietnam

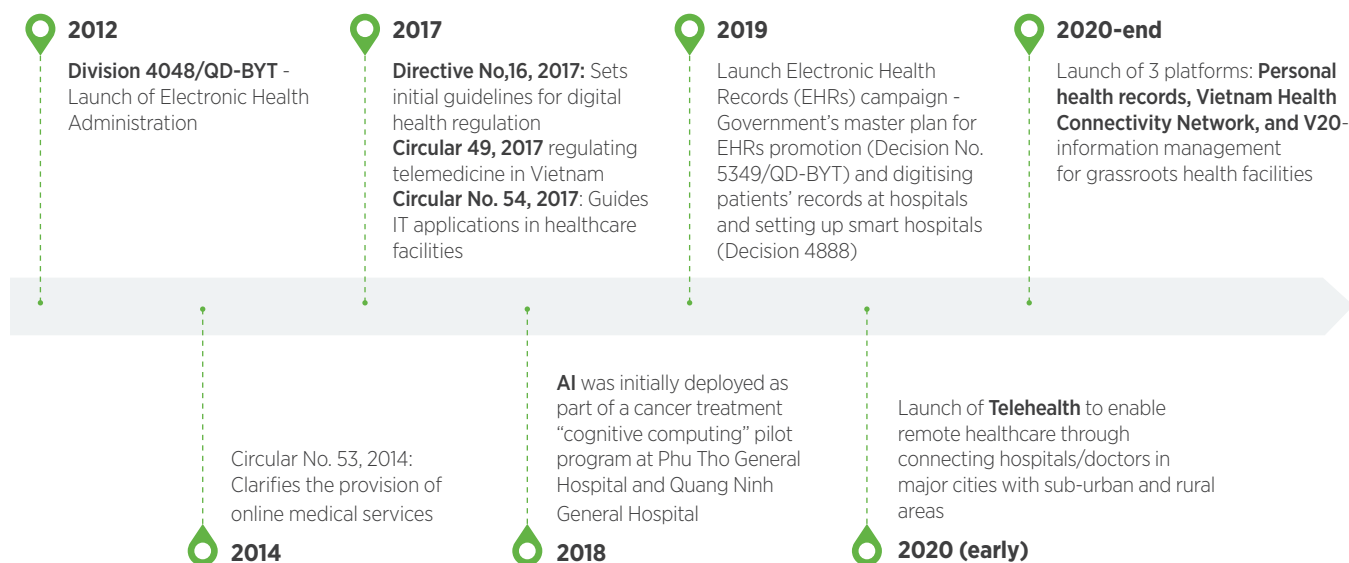
6.9.1 Digital Transformation of Healthcare in Vietnam: Context and Maturity

In 2020, the government of Vietnam approved the National Digital Transformation Roadmap 2025, with a Vision towards 2030 program aiming to increase the coverage of the public sector – all national databases, including those for population, land, business registration, finance, and insurance, are online and connected, with shared data on a government-reporting information system.³³⁵

The program targets to have 100% public services online at level 4 and the establishment of a Digital Government. By 2030, Vietnam aims to join the top 50 countries in e-government development.

In 2021, Vietnam was able to implement a 5G network on a larger scale and also launched a digital National ID. The rising demand for healthcare services, overcapacity, and financial autonomy policies faced by the public health system in Vietnam have pressured them to shift towards digitalization. The government is the key driver in digitalizing the healthcare sector in Vietnam by driving a national agenda and encouraging the adoption of digital health solutions in all hospitals across the country.

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

The COVID-19 pandemic has pushed the government to speed up digitalization in healthcare, leading with the launch of the following initiatives:

The Telehealth platform:

The platform was launched in April 2020, aiming to connect 100% of district-level health facilities allowing more people access to healthcare services.³³⁶ As of August 2021, the platform now connects 30 central hospitals with all 1,400 district-level hospitals, including those located in mountainous and island areas.³³⁷

6.9.2 Cloud Adoption in Public Healthcare: Notable Initiatives, Policies & Regulations

Due to the ICT infrastructure that the government has built and the support from the legal framework built into the National Digital Transformation Roadmap, using the cloud has become more popular.

Cloud policies and regulations for the public sector

Though the Vietnam government has issued many acts and laws to support digitalization in healthcare, they have not clearly defined their policy on cloud computing. In 2016, the Law on Cyber Information Security included some decrees for cloud service providers such as:

- Decree 108/2016/ND-CP:³³⁸ Cyber information security services and products.
- Decree 58/2016/ND-CP:³³⁹ Trading of civil encryption products and services and importation, the exportation of civil encryption products.
- Decree No. 85/2016/ND-CP:³⁴⁰ Security level of Information System.

On April 3rd, 2020, Vietnam's Ministry of Information and Communication (MIC) issued an Official Letter No. 1145/BTTTT-CATTT to provide guidelines on technical criteria and specifications for cloud computing solutions for e-government deployment. State agencies and organizations are required to rely on these in assessing and selecting solutions for leasing cloud computing services for the development of e-government.³⁴¹

The private sector entities, however, are not required to but encouraged to also refer to these guidelines when setting up and deploying their services on the cloud. This meant the market of providing cloud computing for the private sector in Vietnam is still open in regulation.

Cloud for healthcare: Maturity and Notable Initiatives

Though the MOH released Decision No.4888/QĐ-BYT to promote the application of IT at health check-ups and treatment facilities to boost administrative reform and reduce hospital overload, the use of EMRs for getting rid of paper medical records, applying for electronic treatment fee payments, and creating smart hospitals, it still depends on the hospital's discretion whether they want to adopt cloud-based solutions. Cloud service providers and hospitals can negotiate together in terms of what data can be stored on the cloud and how extensive its utilization will be.³⁴²

Medical History Management System and Health Monitoring Application:

The two projects were built on cloud and IoT platforms by FPT Software (FPT Smart Cloud) as commissioned by the Ministry of Health. Both projects have developed useful services and devices that monitor patients' health, allowing for more efficiency in the healthcare system.

Hospital Management Systems: Digital hospital management solutions have also been well-received by hospitals as they have enabled improved operations management and data storage. More than 92% of public hospitals have outsourced IT development to local IT companies such as FPT, Link Toan Cau, Dang Quang, and OneNet to develop digital solutions for their facilities.³⁴³ Most cloud setups are deployed on a hybrid model – since they cannot move everything to the cloud, they have opted to maintain two systems where one is managed by them fully and the other completely devolved to the Cloud Service Provider. Many hospitals are using cloud-based hospital information systems.

Examples of Digital Health providers and their hospital partners:

- FPT with FPT.eHospital 2.0³⁴⁴ - Partners: 300 hospitals, including Bach Mai hospital and Cho Ray Hospital (central level) and six healthcare institutions nationwide.
- VNPT – Partners:³⁴⁵ 168 hospitals, including Bach Mai hospital and Huu Nghi Viet Duc hospital.

PACS-RIS (Picture Archiving and Communication System-Radiology Information System):

This is one of the key implementations of cloud computing in healthcare. PACS cloud has strengthened the connection between hospitals and imaging centers for the storage of imaging and diagnoses.³⁴⁶ So far, 23 hospitals in Vietnam have adopted PACS cloud in place of their legacy platform.³⁴⁷

Success Stories

Vietnam Ministry of Health Telemedicine Centre

The Vietnam Telemedicine Centre for COVID-19 Outbreak Control was launched in Mar 2020. The center is tasked with managing and operating resources and professional activities to support health clinics in receiving, quarantining, diagnosing, and treating COVID-19 patients directly or online. The telemedicine center is able to connect with 23 key disease prevention places and over 1,400 hospitals across Vietnam.

The center has contributed greatly to the very low COVID mortality rate in Vietnam. It uses various smart medical solutions, including teleconferencing, electronic medical records, and the cloud-based Picture Archiving and Communication System (Cloud PACS).

Special High-Tech Industries Development Program - PACS-CLOUD

Special high-tech industries Development Program is a sub-division of the Vietnam Ministry of Industry and Trade. In December 2020, it successfully deployed the BKPACS-CLOUD to develop equipment to replace imported products from abroad, including the development of the PACS-Cloud (Picture Archiving and Communication System).

PACS-Cloud software includes cloud management software, web data mining software for computers, mobile data mining software, and data mining software via workstations. Five hospitals/medical facilities that have connected to the PAC Cloud are Hoa Hao Medic Medical Center, Hoa Hao-Medic Can Tho General Hospital, Ca Mau Medic Hospital, Binh An-Medic Kien Giang Hospital, and Shingmark University Hospital of Medicine and Pharmacy. The solution is capable of scaling up to 20 hospitals.

Relevant Regulations

Regulations on personal data protection and privacy

In January 2020, Vietnam released a draft of the Personal Data Protection Decree.³⁴⁸ The decree has been issued to collect public opinion and is expected to come into effect at the end of 2021. Some areas covered by the decree are the specific rights of data subjects, cross-border transfer of data, and the processing of sensitive personal data. Noncompliance may subject stakeholders to a temporary suspension of operation and/or revocation of permission for cross-border data transfer in addition to monetary fines.

Regulations on data security

In June 2019, the Law on Cyber Information Security was mandated. Some of its relevant clauses include:

- **Data localization** – Requiring service providers to store Vietnamese data within the territory of Vietnam.
- **Definition of illegal content** – This includes discriminatory acts such as gender, religion and racial discrimination, human trafficking and the trafficking of illegal goods, and terrorism or acts that threaten national security, including the violation of state secrets.
- **Auditing of the Ministry of Information and Communications and the cybersecurity agency under the Ministry of Public Security** – Conducting an audit of service providers' information systems, including software systems, hardware and devices, and data that are transmitted, processed, and stored.

However, there are no data security regulations specifically for healthcare data in Vietnam.

Regulations specific to healthcare data in the cloud

There are no cloud-specific regulations yet for healthcare data in Vietnam.

6.9.3 Barriers & Challenges to Cloud Adoption

Based on secondary research and interviews with key decision-makers, these are some barriers Vietnam faces when it comes to accelerating cloud adoption in the healthcare sector.

1. Security and privacy concerns:

Most hospital management and IT personnel are used to physically seeing and managing their IT infrastructure, which contains sensitive healthcare data. With the move to the cloud, albeit hybrid, there is a sense of mistrust or fear that the system may be breached and data might get leaked. As mentioned above, the Personal Data Protection Decree will only come into effect by the end of 2021, and currently, there are no regulations to protect patient data specifically.

2. Healthcare management is not ready for change:

All healthcare professionals need to be trained to use digital systems. This is one of the largest barriers in this aspect, where doctors and nurses are more focused on patient care than learning new systems. Without their cooperation, it is difficult to implement new technologies. These barriers are even more challenging in rural or remote regions.



“Cloud is an emerging technology in the last 2-3 years in Vietnam where transitioning from a visible IT infrastructure to something abstract is new to hospital management. Therefore, I think it will take a long time for cloud to be embraced and trusted completely.”

— Tam Phan Hong, Director of Cloud Infrastructure (FPT Smart Cloud), Vietnam

3. Lack of clear and strong regulations:

The use of cloud-based solutions is not yet clearly defined in any government policy. Any adoption that has taken place has been at the discretion of hospitals. In the private sector, too, there are no official guidelines covering cloud computing. This creates a challenge for further adoption.

Notably, according to Law on Cyber Security 2019, any party collecting, exploiting (using), analyzing, or processing personal data or data generated by users in Vietnam must store such data in Vietnam for a period stipulated by the government. This ambiguity on unclear approved data storage will also be a great consideration for both domestic and foreign players when adopting cloud computing.

4. Financial Constraints:

Few hospitals can accommodate the costs for migration and maintenance into their budgets. Especially from 2018, public hospitals, mostly at the provincial and central levels, have been operating autonomously – they are no longer dependent on the direct budget subsidy for their operating costs. Besides, the complex healthcare system in Vietnam with the funding split between MOH and VSS also indirectly puts financial pressure on public hospitals.

5. Underdeveloped infrastructure, especially in rural areas:

A great number of older patients and people living in rural areas have low digital literacy and limited access to technology. The limitation in synchronizing digital technology across many hospitals, especially Group 2 and Group 3 hospitals, is among the key challenges for the implementation of telemedicine in Vietnam.

6.9.4 Recommendations

Vietnam has been making good progress in using cloud-based solutions; however, with the right policies and regulations in place, there can be wider and safer adoption of the cloud in healthcare.

1. Cloud First policy for healthcare:

The ministry of health must look at establishing a Cloud First policy for healthcare. This will help ensure that the sector benefits from cloud scalability, data integration capabilities, and innovation readiness while using the more cost-effective pay-as-you-go model. [\[See Recommendation 1\]](#)

2. Data protection and security regulations:

With further support from the government in terms of a clear mandate, data protection, and security regulations, hospitals will have greater confidence in the cloud that will give an impetus to cloud adoption. [\[See Recommendation 2\]](#)

3. More awareness and education needed:

There is still limited awareness of the benefits of cloud – training and education are greatly needed to help hospital management make an informed decision on deploying cloud-based solutions. Learning about how end-users can benefit will also help smooth a transition to the cloud. [\[See Recommendation 3, Recommendation 4\]](#)



PHILIPPINES



PHILIPPINES: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 61/100³⁵²

Rank: **Progress on health-related SDGs (2015)** 115/188³⁵³

Rank: **Healthcare Access & Quality Index (2015)** 51/100³⁵⁴

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 100/193³⁵⁵

Cloud Readiness Index 55.3/100³⁵⁶

UN ITU ICT Development Index 134/193³⁵⁷

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✓ Data Protection & Privacy Legislation for Healthcare Data
- ✓ Cloud: Data Security/Privacy Legislation for Healthcare Data

PHILIPPINES — HEALTHCARE SYSTEMS MATURITY & CONTEXT

The Philippines is an archipelago consisting of about 7,640 islands with a population of 109 million.³⁴⁹

Healthcare Authority: The country's public health system is overseen by the Department of Health, but it follows a decentralized system where health services delivery is devolved to the local government units.

Health Financing: The National Health Insurance Program (NHIP), managed by the Philippine Health Insurance Corporation (PhilHealth), finances the Philippines' public health system. PhilHealth has about 94 million registered members, i.e., about 87% of the population. However, the Universal Healthcare Act dictates that all citizens are automatically included in the program.³⁵⁰

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Fragmented Health System. Due to the autonomous local health offices and thousands of private health providers, fragmentation exists in the continuum of care and financing, resulting in inefficiencies and health inequities in healthcare access.

Disparities in Health Resources Distribution. The Philippines faces a shortage in medical personnel and facilities. It has a doctor to patient ratio of 0.6:1,000³⁵¹ with healthcare services being concentrated in urban areas like Metro Manila.

6.10 Philippines

6.10.1 Digital Transformation of Healthcare in Philippines: Context and Maturity

The Philippines is seeing a slow but steady transformation of the public healthcare sector.

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

Conceptualized in 2013, the eHealth Strategic Framework 2014-2020 aimed to support the delivery of health services and management of health systems through digitalization. The following are some notable digital health innovations under the program and other notable initiatives in digital health in the Philippines:

Electronic Medical Records (EMR):

The integrated Clinic Information System (iClinicSys) is used at the primary care level. From 2013-2015, the number of users of digital health tools increased by an average annual rate of 34%, with 376 users registered by the end of 2015. This digital health tool enabled the patients to interact with their physicians via online consultation, and on the doctors' end, it provides an e-prescription module that prepares prescriptions for patients.³⁵⁸ Another EMR system meant for public health units offers interoperability across provinces and report generation to the Local Government Unit (LGU), Department of Health (DOH) and PhilHealth, through the eHealth TABLET for Informed Decision-Making of LGUs (eHATID LGU) project funded by the Department of Science and Technology - Philippine Council for Health Research and Development (DOST-PCHRD).³⁵⁹

iHOMIS:

The Integrated Hospital Operations and Management Information (iHOMIS) system is one of the tools created for the implementation of the integrated hospital operations and management strategy of the DOH.

During the year 2016, the iHOMIS was used in 91 DOH and LGU Hospitals. It functions as an electronic medical record, hospital information system, and health information system.³⁶⁰

eFHSIS:

The Electronic Field Health Service Information System (eFHSIS) provides the fundamental service data needed to monitor the activities and projects of several public health programs.³⁶¹

Telemedicine:

While there are no telehealth laws to regulate digital health, due to the surge of telemedicine engagement in 2020, the Department of Health issued the circular *Guidelines on the Use of Telehealth in COVID-19 Response*. Private telemedicine platforms like Medgate and Konsulta MD saw an increase of 170% to 450% in teleconsultations during the COVID-19 pandemic compared to before the outbreak. Additionally, other private hospitals are also offering their own telemedicine platforms (through messaging applications like Viber and WhatsApp) for teleconsultation services.³⁶²

6.10.2 Cloud Adoption in Public Healthcare: Notable Initiatives, Policies & Regulations

Despite adopting a Cloud First Policy ahead of its peers, the Philippines has made limited progress towards the adoption of the cloud for public healthcare – however, the pandemic has spurred the adoption of the cloud.

Cloud policy for the public sector:

Government processes are still mainly pen-and-paper, but efforts have been made to digitize governance since 2004. In 2004, the establishment of the Commission on Information and Communications Technology (CICT) under the then Department of Transportation and Communications (DOTC) was mandated to strategize the development of information and communications technology in the Philippines.³⁶³ The CICT, along with other organizations, was restructured into the Department of Information and Communications Technology (DICT).

The latest iteration, the E-Government Masterplan (EGMP) 2022, aspires for “One Digitized Government,” echoing the priorities of the previous policies to enhance interoperability, provide information and communications technology services for the public, and enable growth in the private sector.³⁶⁴

Cloud First Policy. In 2017, DICT released Department Circular no. 2017-002 prescribing a Cloud First Policy. As the title suggests, the mandate advises all government agencies to adopt cloud computing in their ICT deployment, whether in internal administrative use or online government services. The mandate also serves as guidance for cloud service providers and government agencies planning to enter into a contract with cloud service providers’ policies on data classification, sovereignty, and migration, among others.³⁶⁵ In 2020, DICT amended the Cloud First Policy to meet demands under the “New Normal” in light of the increasing use of cloud servers in processing COVID-19 related data in 2020.³⁶⁶

Cloud for healthcare: Maturity and Notable Initiatives

The Universal Healthcare Act includes regulations on the maintenance of a health information system consisting of enterprise resource planning, human resource information, electronic health records, and an electronic prescription log, which shall be electronically uploaded on a regular basis through interoperable systems. Even before the Universal Healthcare Act, there have been efforts to mandate an interoperable health database.

The Department of Health – Department of Science and Technology – Philippine Health Insurance Corporation (DOH - DOST- PHIC) Joint Administrative Order No. 0001-16 implements the Philippine Health Information Exchange (PHIE), which is a platform for secure electronic access and efficient exchange of health data and/or information among health facilities, healthcare providers, health information organizations, and government agencies.

The PHIE was created to facilitate ease of access to healthcare by integrating and harmonizing health data collected from various electronic medical record systems and private and public hospital information systems. The aim is to allow healthcare providers to share data and information to improve healthcare efficiency and reliability and generate data for policy decision-making.

With the aim to improve disease surveillance, Republic Act 11332, known as the Law on Reporting of Communicable Diseases, was enacted in 2019. It required all health units and healthcare providers, whether public or private, to report identified notifiable diseases and diseases of public health concern to the Department of Health. In light of the COVID-19 pandemic, the implementing rules and regulations of RA 11332 were updated to include COVID-19 incidence protocols.³⁶⁷ Related to this, the Republic Act 11525 or the COVID-19 Vaccination Program Law was legislated in 2020 related to the reporting of COVID-19 vaccine roll-out, where a master list of names and profiles of recipients are to be submitted to the Department of Health.³⁶⁸ The government currently employs cloud-based solutions as part of its COVID-19 related response and data gathering efforts. Respondents cited that without the health information system being deployed in the cloud, the government would not be able to issue daily updates on the prevalence of the disease.

Success Stories

In 2018, a private hospital, **Chinese General Hospital and Medical Centre**, led the adoption of cloud technology among tertiary healthcare units. In partnership with Exist Software Labs, MERXTM—a next-generation hospital information system—will be applied to the hospital system. The adoption of the system envisions a “near paperless” setup integrating operational and clinical systems, including electronic medical records.³⁶⁹

Relevant Regulations

Personal data protection and privacy laws are well-developed in the Philippines.

Regulations on personal data protection and privacy

Data privacy regulations were set in 2012 through Republic Act 10173, or the Data Privacy Act of 2012.

The Data Privacy Act (DPA) protects data subjects from any form of unauthorized processing of personal information and sensitive personal information. The DPA gives the autonomy over the data collected to the data subject and emphasizes data collectors' role in obtaining informed consent and accountability to data subjects.

Healthcare Data. The DPA is an important safeguard for the digitization of healthcare data which requires data subjects, or end-users, to provide their sensitive information such as personal and health details to health providers. To uphold this regulation, the National Privacy Commission was formed under the DICT.³⁷⁰

While the DPA is not all-encompassing, NPC has been active in drafting policies to better guide government offices in data privacy and security. One of which are guidelines in data sharing from one country to another, which puts responsibility upon Personal Information Controllers (PICs) to ensure data transfer meets DPA guidelines.³⁷¹

Regulations on data security

Regulations on data security are included under the Data Privacy Act of 2012. In general, security measures for personal data include protection against accidental or unlawful destruction, alteration, and disclosure, as well as against any other unlawful processing. To implement this, section 26 mandates the appointment of accountable personnel within a data processing organization: compliance officers or data protection officers.

Incompliance to the clauses under the Data Privacy Act of 2012 includes a range of penalties from imprisonment from one to six years and a fine of P500,000 (USD 9797) up to P4 million (USD 78 thousand).³⁷²

On the other hand, Republic Act No. 10175, Cybercrime Act of 2012, lays out the definition for activities that may be considered cybercrime and their corresponding penalties, including but not limited to illegal access, interception, interference, and content-related offenses such as cybersex and child pornography.³⁷³

Regulations specific to healthcare data in the cloud

In 2016, data privacy was aligned to the Philippine Health Information Exchange (PHIE) through the DOH – DOST – PhilHealth Joint Administrative Order No. 2016-0002, known as the Health Privacy Code or the Privacy Guidelines for the Implementation of the Philippine Health Information Exchange. It contains detailed and sector-related procedures and guidelines to ensure the protection of data privacy in PHIE, including the use of cloud services.³⁷⁴

Under the Health Privacy Code, the cloud server environment is one of the servers identified that a health facility can utilize, along with an on-premises server or a combination of both. The Health Privacy Code sets standards for the Participating Health Care Provider (PHCP) and the cloud service provider. Some of the provisions include a requirement to encrypt data stored, to have the PHCP retain ownership of the data, and to have a risk management program that is adaptable to the evolving ICT environment.³⁷⁵ The guidelines require that the cloud server environment complies with the physical security ISO 27001 standards.

6.10.3 Barriers & Challenges to Cloud Adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Poor infrastructure:

One of the greatest barriers to implementing cloud services, and even digitizing health services, is the poor internet connection. As of 2020, only 43% of the population has access to the internet, and the average download speed remains at 31.44 Mbps, significantly lower than the global average of 96.43 Mbps.^{376 377} One of the factors behind this is the current market structure, where only two players provide internet connections in the country. A third player was awarded by Congress with a franchise early this year to increase competition in this industry and provide more options to citizens.³⁷⁸



“Government cloud services need to undergo major improvements and have to comply with international standards.”

— eHealth specialist, Philippines

2. Lack of cloud expertise:

Aside from gaps in infrastructure, there is a shortage of capable IT and cloud expertise. A strong workforce needs to be developed – with not only cloud experts but also an appropriate cadre of human resources, including privacy and cybersecurity experts. There is a significant gap that needs to be bridged before the full potential of cloud and enabled-digital health solutions are realized.

3. Low prioritization:

Investments in improving infrastructure and human resources are lacking as the government sees the extension of health services and building new health facilities as a higher priority. The budget appropriated for healthcare IT and cloud adoption was also said to be insufficient. IT is not seen as a high-priority resource which is partly because most healthcare management personnel are not yet well-versed with the benefits of cloud adoption. Respondents felt that little progress could be made without a mandate or incentives to adopt the cloud.



“Incentives are needed as a motivator for hospitals to adopt the cloud.”

— Dr. Raymond Sarmiento, Director, National Telehealth Center, University of the Philippines, Manila, Philippines

4. Data security concerns:

Additionally, data security measures in some cloud services are considered lacking. This can be attributed to gaps in laws and regulations in setting quality standards. On the other hand, regulations on data sovereignty limits the utilization of global cloud service providers to those who have data centers in the country. The National Privacy Commission has clear policies on not migrating the data outside of the Philippines.

6.10.4 Recommendations

1. Education and awareness programs are needed:

Information dissemination on the benefits of cloud adoption may help advocate for investment towards it. At the same time, the government needs to invest in the requisite skills training for healthcare staff and IT personnel to build capacity in the system. [\[See Recommendation 4\]](#)

2. Adequate infrastructure must be in place for cloud adoption to grow:

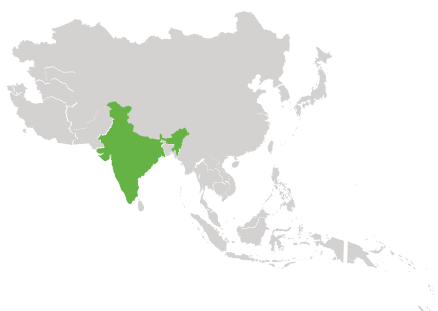
A requisite budget and investment plan are needed to fund the foundational ICT infrastructure to enable digital health systems to work efficiently and for greater adoption of the cloud. The budget should also cover reskilling and educational programs as mentioned above. [\[See Recommendation 2, Recommendation 4\]](#)



INDIA



INDIA: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 55/100³⁸⁸

Rank: **Progress on health-related SDGs (2015)** 100/188³⁸⁹

Rank: **Healthcare Access & Quality Index (2015)** 41.2/100³⁹⁰

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 100/193³⁹¹

Cloud Readiness Index 56.7/100³⁹²

UN ITU ICT Development Index 134/193³⁹³

CLOUD & DATA SECURITY

- ✓ Cloud First Policy
- ✓ Cloud for Public Healthcare Mandate/Policy
- ✗ Legislation on Personal Data Protection
- ✗ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

INDIA — HEALTHCARE SYSTEMS MATURITY & CONTEXT

India has a mixed health system with public and private sectors providing health services. There are 25,000 public hospitals and 43,000 private hospitals in India.³⁷⁹ The healthcare insurance sector is still small, albeit growing at a fast pace.³⁸⁰

National Health Authority: The National Health Authority (NHA) is responsible for the implementation of India's public health insurance scheme — Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (PMJAY), while also designing and building the IT infrastructure and strategies for the implementation of the “National Digital Health Mission. In September 2021, the scheme was renamed the Ayushman Bharat Digital Mission (ABDM).³⁸¹

Health Financing: In 2018, the PMJAY was launched to provide coverage for secondary and tertiary care for citizens below the poverty line. Primary healthcare is funded and implemented via the National Health Mission.³⁸²

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

Lack of infrastructure: The construction of medical, training, and IT infrastructure remains low compared to what is needed.³⁸³

New diseases on the rise: Non-communicable diseases and injuries account for roughly 60% of India's disease burden.³⁸⁴ Addressing COVID-19 and the existing infectious disease burden is an added challenge.

Financial burden: Out-of-pocket spending is high at 59% of the total health expenditure, creating a financial burden on households.

Shortage of trained medical personnel: There is a serious shortage of trained healthcare staff. Additionally, there is a marked urban-rural and interstate variation in the health workforce distribution.³⁸⁵

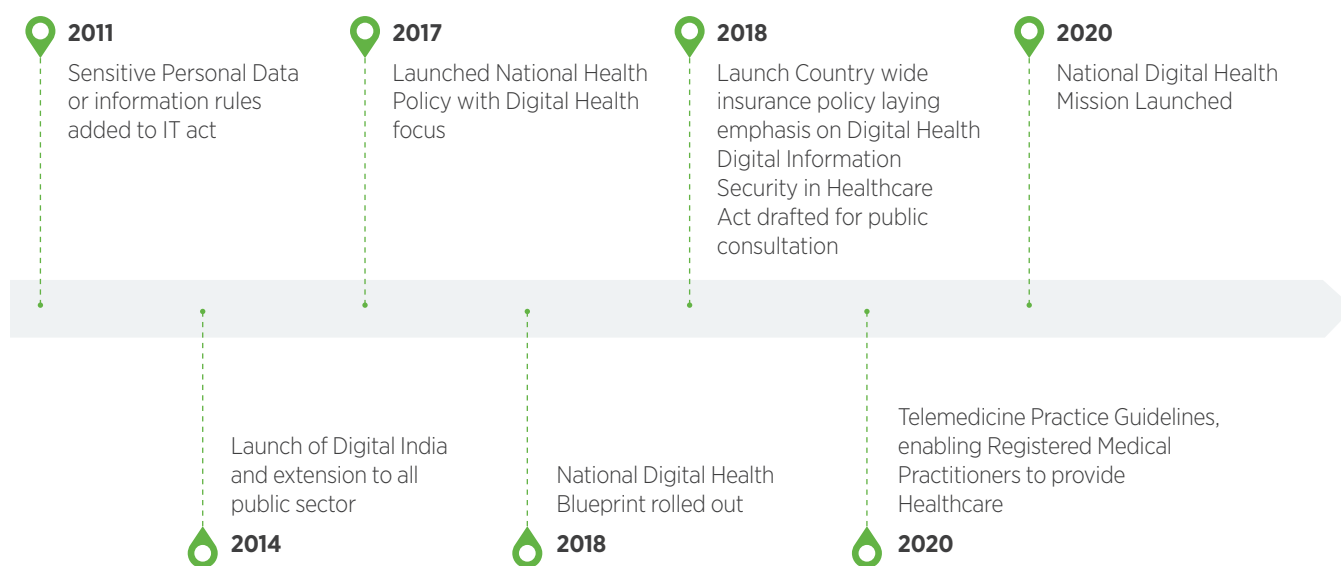
Fragmented Healthcare System: The referral mechanism and the patient journey are not seamless. There are multiple information systems which are not interoperable.³⁸⁷

6.11 India

6.11.1 Digital Transformation of Healthcare in India: Context and Maturity

India is presently the world's second-fastest digitizing economy among 17 mature and developing digital economies with a large internet market of 560 million connected consumers.^{394 395} The Government of India (GoI) launched the "Digital India" campaign in 2015 with the mission of making India a knowledge economy with on-demand access to information, governance, and services.³⁹⁶

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

In 2017, the National Health Policy (NHP) was launched with the aim of digitizing healthcare in India.³⁹⁷

In 2018, in line with NHP 2017, the Ministry of Health and Family Welfare released the National Digital Health Blueprint (NDHB), a vision document that provided measures for digitizing the health system, including the launch of the institutional establishment responsible for implementing this vision. Thereafter, the National Digital Health Mission (NDHM) was launched in 2020 to provide a backbone for the integration of digital health infrastructure in the country. The NDHM was renamed the ABDM in September 2021.

The following are some notable digital health innovations in India:

Reproductive and Child Health Care portal, 1997

The RCH, also known as the Reproductive and Child Health Care portal, was developed by the Ministry of Health and Family Welfare, Government of India, to facilitate early identification and monitoring of individual beneficiaries during the reproductive lifecycle of women, and to promote, control, and facilitate the delivery as well as reporting of reproductive, maternal, newborn, and child health schemes and programs.³⁹⁸

National Health Portal, 2014

The National Health Portal aims to provide citizens, students, healthcare professionals, and researchers with a single point of access to authenticated health information. Users can get detailed information about diseases, health services, healthy living tips, health programs, insurance schemes, health apps, and widgets. Furthermore, users can also access information on helplines, blood banks, and other resources.³⁹⁹

Integrated Health Information Platform (IHIP), 2021

This is an initiative to provide a single operating picture for disease outbreaks and related resources with geospatial information, which is integrated with all the applicable eGovernment and Information Technology (IT) standards. Key features include real-time data reporting, advanced data modeling and analytical tools, role and hierarchy-based alert mechanisms, geo-tagging of health facilities, and data integration with other health programs.⁴⁰⁰ The IHIP is the next-generation version of the Integrated Disease Surveillance Program (IDSP) portal launched in 2004.

6.11.2 Cloud Adoption in Public Healthcare: Policies, Notable Initiatives & Regulations

India has issued a slew of cloud initiatives over the past few years.

Cloud policy for the public sector:

In 2013, the Ministry of Electronics and Information Technology (MeitY) published the cloud policy document, GI Cloud (MeghRaj) Strategic Direction Paper, which provided a direction to establish and implement the cloud and an adoption approach for government entities.

- As a part of the MeghRaj initiative, MeitY launched the Cloud First Policy, by which all government departments are required to evaluate and adopt cloud computing for their current and new applications. MeitY has empaneled cloud service offerings of private Cloud Service Providers (CSPs), which government departments can avail and engage with.⁴⁰¹

Cloud for Healthcare: Maturity and Notable Initiatives

The NDHB mandates that digital health applications, patient data, and other sensitive information should eventually be on a Government Community Cloud or Virtual Private Cloud, which has strong security and privacy features.⁴⁰² In October 2021, the National Health Authority released a Request for Proposal to MeitY-empaneled CSPs and Managed Cloud Service Providers (authorized partners of the MeitY Empaneled CSPs) to select a provider for cloud services including compute, storage, network services, and IT Security on the 'Government Community Cloud' (GCC) or Virtual Private Cloud (VPC)' deployment model.⁴⁰³

Digitally enabled initiatives such as the PMJAY and ABDM are slated to generate large volumes of healthcare data, for which cloud adoption is needed and recommended. The Government of India has recommended a Cloud First approach to state government health departments.⁴⁰⁴ Different states are at different stages in terms of implementation.



“Cloud adoption in healthcare varies among states. Some states like Maharashtra, Karnataka, Uttar Pradesh, Madhya Pradesh, Rajasthan have adopted IT faster.”

— **Policymaker, Health Technology in Public Healthcare, India**

Notable Cloud-based Initiatives:

The following cloud-based healthcare initiatives have been implemented in the country:

e-Sanjeevani: The Government of India launched the cloud-based National Telemedicine Service or eSanjeevani in April 2020 to continue doctor consultations as clinics and health establishments were shutting down due to the pandemic and national lockdown. eSanjeevani has two components – one that facilitates patients in consulting doctors and another component that facilitates doctor-to-doctor consultations in the government's Ayushman Bharat Health and Wellness Centers. The eSanjeevani portal had been implemented by 23 states and had facilitated over 12 million consultations by September 2021.⁴⁰⁵

e-Hospital: The e-Hospital application is being provided as-is to government hospitals across the country via the SaaS (Software as a Service) model. Patient Registration (OPD & Casualty), IPD (Admission, Discharge & Transfer), Billing, Lab Information System, Radiology Information System, Clinic, Dietary, Laundry, Store & Pharmacy, and OT Management are the modules of the e-Hospital application that are currently available on the cloud. So far, 637 hospitals have onboarded the e-hospital application.⁴⁰⁶

Aarogya Setu for contact tracing: Aarogya Setu, launched in April 2020 by the National Informatics Centre, uses cloud computing. The contact tracking app informs citizens of their potential risk of COVID-19 infection.⁴⁰⁷

Online Registration System (ORS): ORS is an online patient portal that allows citizens to book hospital appointments online. ORS is a system that connects hospitals across the country to allow patients to book online appointments and receive patient-centric services such as viewing lab reports, checking blood availability status, and making online payments.⁴⁰⁸

e-Sushrut: C-DAC's Hospital Management Information System, e-sushrut, is a major step towards adopting technology to enhance healthcare delivery. For better hospital administration and patient care, HMIS includes an integrated computerized clinical information system. It also helps the patients with an accurate, electronically stored medical record. Such records can be stored in a data warehouse for statistical and research purposes. The real-time HMIS streamlines patient treatment flow while also empowering employees to perform at their best in an optimized and efficient manner. It is based on a unique combination of a patient-centric and a medical-staff-centric paradigm, which benefits healthcare recipients and providers.⁴⁰⁹

Central Government Health Scheme (CGHS):

Subscribers to the CGHS can access an online portal to check their medical history, reimbursement claims, and medicines, among other things. This portal can be accessed using the beneficiary ID and password.⁴¹⁰

Integrated Disease Surveillance Program (IDSP): This website is for online reporting under the Integrated Disease Surveillance Program (IDSP), one of the most significant national health programs under the National Health Mission for all states and territories. The program's main goal is to maintain a decentralized laboratory-based IT-enabled surveillance system for epidemic-prone diseases to track trends, detect, and respond to outbreaks in their early stages with the help of a trained Rapid Response Team (RRT).⁴¹¹

Mera Aspataal: Mera Aspataal (My Hospital) is the Ministry of Health program to record patient feedback for hospital healthcare services through multiple channels such as Short Message Service (SMS), Outbound Dialling (OBD), mobile application, and their web portal.⁴¹²

Success Stories

eVIN (Electronic Vaccine Intelligence Network):⁴¹³

This is the Indian government's technology system that uses a smartphone application to digitize vaccine stocks and monitor cold chain temperature. eVIN supports the government's Universal Immunization Program by providing real-time data on vaccine stocks, flows, and storage temperatures across all cold chain points in the country.

Success Stories

eVIN technology uses a smartphone, web-based application, temperature loggers, and a cloud-based server to digitize vaccine stock inventory and storage temperature from vaccine stores and cold chain points located in all public health facilities. All cold chain handlers are given smartphones with the eVIN app, which allows for the digitization of vaccine inventories such as:

- View real-time stock & temp
- Vaccine requirement
- Emergency management
- Consumption patterns
- Route planning
- Stock reallocation

As of August 2020,

- eVIN is functional in 32 states and Union Territories
- 99% of health centers reported increased vaccine availability
- Time taken to replenish vaccine stock reduced by half
- Vaccine stock-outs have decreased by 80%

Relevant Regulations

Data security and privacy laws for personal information and healthcare data are in the nascent stages in India.

Regulations on personal data protection and privacy

Policies governing IT are in place, although the data protection and security policy is still in a draft stage. The draft Personal Data Protection Bill, 2019 (PDP Bill) has been submitted to Parliament for approval. The PDP Bill mandates prior consent for the use of individual data, limits the purposes for which data can be processed by companies, and lays out restrictions to ensure that only data required for providing a service to the concerned user is collected.^{414 415} The Bill will also likely cover non-personal data, based on a recent proposal made that anonymized non-personal data coming from sensitive personal data may still have to be considered sensitive.⁴¹⁶ The Winter session of the Parliament happening in November – December 2021 will deliberate this Bill.⁴¹⁷ *The Indian Medical Council (Professional Conduct, Etiquette and Ethics) Regulations, 2002* governs patient confidentiality.

The NHA Data Privacy Policy Version 2.0, 2020:

The NHA, the authority responsible for the implementation of the Ayushman Bharat Digital Mission (ABDM) and the national health insurance program PMJAY, has released a policy to ensure the privacy and safety of personal health information collected and handled through PMJAY – the NHA Data Privacy Policy.

The policy specifies the principles that will be followed in handling the personal and health data of the beneficiaries of PMJAY. The policy provides nine principles that will govern the use, collection, and transmission of personal and sensitive information, and defines the roles of government agencies in handling such information of the PMJAY program.⁴¹⁸



“The Patient Data Protection Bill has been put up at the parliament level for approval, and it is in progress. Meanwhile, the ABDM has already published the patient data management policy, which is in line with the patient data protection bill.”

— **Manisha Mantri, Joint Director, Centre for Development of Advanced Computing (CDAC), India**

ABDM draws the distinction between Health Information Providers (HIP) and Health Information Users (HIU) in their guidance document, Guidelines for Health Information Providers, Health Repository Providers, Health Information Users and Health Lockers, released in August 2020. HIP refers to any health provider who created health information in the context of providing healthcare: e.g., hospitals, diagnostic centers, and government health initiatives. The HIU is any entity that wishes to access health records, e.g., hospitals, doctors, and mobile apps that display Personal Health Records. The 2020 Guidelines lay out the responsibilities and standards expected of HIPs and HIUs.⁴¹⁹

Regulations on data security

The Information Technology Act 2000 (“IT Act”) is the main legislation governing cyberspace. The Act provides legal recognition and protection for electronic data and transactions while also defining security practices to be followed by corporates and intermediaries, along with recognizing the role of the Indian Computer Emergency Response Team (“CERT-In”). CERT-In is responsible for the collection, analysis, and dissemination of information on cyber incidents and taking emergency measures to contain such incidents.⁴²⁰

- There is no comprehensive legislation for the governance of data in the country, but different sectors have their own legal advisories and directions that should be complied with.⁴²¹
- If a body corporate is negligent in implementing and maintaining reasonable security practices while storing or handling personal or sensitive data, thereby causing wrongful loss or wrongful gain to any person, it is liable to pay damages by way of compensation to the person affected.⁴²²

These provisions are further cemented through the empanelment conditions for CSPs for government data.

Regulations specific to healthcare data in the cloud

Cloud-specific policies and guidelines – Cloud-specific policies are in the nascent stages. At the same time, NDHB prescribes that all health data applications and sensitive data need to be on a Government Community Cloud or Virtual Private Cloud, to be known as the Health-Cloud (H-cloud). The cloud service providers empaneled by the Ministry of Electronics and Information Technology will be providing these services to the Indian states.⁴²³ As health is a state subject by the Constitution, each state is free to take their call on managing their health data, within the overall ambit of the guidelines issued at the national level.

6.11.3 Barriers & Challenges to Cloud Adoption

1. Inadequate supporting infrastructure:

Since cloud computing allows data to be accessed over a network, robust security architecture is essential before enterprises even consider migrating to the cloud. The lack of internet infrastructure is a severe bottleneck for rural markets in India, especially in Group 2 and Group 3 cities.⁴²⁴



“Many places in India still have limited internet connectivity, and hence most current applications are designed to have a local memory storage, which can be synced when the health worker reaches a location with good connectivity.”

— National Digital Health expert, India

2. Low clarity on cloud regulations:

The study respondents shared that government and private stakeholders do not have a complete understanding of cloud regulations.



“Operational details are yet to be worked out in cloud adoption. For example, there is no clarity whether private entities engaged in a partnership with government through PPP models have to use the government’s cloud for the health data generated as a part of the partnership.”

— National Digital Health expert, India

3. Cloud adoption is not a compulsory mandate for states:

Health is a state subject in India, and the decision to implement health initiatives remains with the state. For instance, the national health insurance program, PMJAY, has seen staggering adoption by states since 2018, with 32 states and union territories implementing the program in 2021.⁴²⁵ Similarly, the mandate for cloud adoption is a recommendation from the national level to states, while the states can independently choose whether to adopt cloud in healthcare initiatives.

4. Healthcare management and staff are resistant to change:

The adoption of a cloud solution necessitates significant changes in the processes used by healthcare providers. Legacy systems and methods have been used in healthcare facilities, many of which are outdated and inefficient. Therefore, modernization of the infrastructure is required. However, healthcare providers are hesitant to modernize their IT infrastructure due to a lack of funds and a reluctance to invest in new technology. Furthermore, healthcare stakeholders have historically been resistant to change.⁴²⁶



“[Government-provided platforms] have software that support EMR applications. The issue is that clinicians are not using this system for generation of electronic medical records, but rather only for lab reports, patient demographics, and visit episodes.”

— National Health-IT Expert, India

5. Limited understanding of cloud:

The interviewees expressed that cloud computing as a concept is not very well understood by all government and private sector decision-making authorities. Due to this lack of complete understanding, cloud adoption is sometimes not planned or executed most effectively.



“Overselling to the decision-makers in public and private organizations who have limited understanding of cloud is eclipsing the reality of the purpose of cloud, its design considerations, and therefore the return on investment.”

— Arvind Sivaramakrishnan, CIO Apollo Hospitals group

6. Safety and Privacy Concerns:

Due to the sensitive nature of health data, moving from a government organization to a private party/location is not perceived as safe.

7. No demand from hospitals with strong on-prem options:

Private hospitals with a fixed capacity of patients who can be treated physically in the facility with existing solid IT infrastructure and cloud is not seen as essential.



“For a private hospital with a steady patient load and a fixed capacity, cloud adoption is not critical. Cloud is better suited for cases where sudden spikes are expected; for example, for an e-commerce website, on a billion-day sale, the volumes can spike from a thousand to a hundred thousand in the same given time interval.”

— Deeksha Senguttuvan, Head --Digital transformation, Cauvery Hospital, Tamil Nadu

6.11.4 Recommendations

1. Incentives from central government for cloud adoption:

The implementation of the ABDM should be actively encouraged and incentivized by the top level of government, similar to other well-performing health programs such as the National Health Mission. Such measures can catalyze digital health and cloud adoption rapidly in the country.

ABDM should distribute the interoperability building blocks as an open-source digital public good in the form of SaaS agent frameworks with pluggable API integration. The release of the SaaS components will help small and medium hospitals and clinics to connect within the National Digital Health Ecosystem-based Interoperability framework over the hybrid cloud. [See Recommendation 2, Recommendation 2.2, Recommendation 2.3]

2. Creation of institutional mechanisms that build trust in the cloud:

The lack of confidence in the cloud for sensitive information such as health data can be countered by government initiatives that certify the quality and security of available cloud adoptions, specifically for usage in health settings. The Meghraj initiative to empanel cloud service providers is a welcome move, but health-specific certifications or accreditations can catalyze cloud adoption in health. [See Recommendation 2.1, Recommendation 2.4]



“A certification and auditing agency should be empaneled to supervise cloud adoption. A healthcare cloud audit agency like the National Accreditation Board for Hospitals and Healthcare Providers, which accredits quality assurance in hospitals, would help bring trust in the cloud by showing that XX is cloud certified and regularly audited.”

— Manisha Mantri, Joint Director, Centre for Development of Advanced Computing (CDAC), India

3. Investment in strengthening internet connectivity in remote areas:

Rural India is rife with large bottlenecks in terms of internet infrastructure. Government agencies must ensure that the last mile connectivity infrastructure is robust enough to handle data-intensive operations over the cloud to avoid performance problems in these regions while using cloud solutions. [See Recommendation 3]

4. Effective change management:

Implementing cloud computing across various government departments and agencies at the federal and state levels would require intensive change management initiatives. The capacity-building exercise should include orientation programs to address these issues. India and similar countries can draw lessons from the nations ahead in the journey of digital transformation of healthcare. [See Recommendation 2.2: Recommendation 3, Recommendation 4]

5. Policies for cybersecurity in the health sector:

In India, policymakers should proactively develop robust policies to improve the cybersecurity architecture of the cloud that ensures data privacy and security in the healthcare sector. [See Recommendation 2, Recommendation 2.1, Recommendation 2.4]



BANGLADESH



BANGLADESH: KEY DATA AT A GLANCE



HEALTH SERVICE & QUALITY SCORES

Score: **UHC Service Coverage Index (2017)** 48/100⁴³¹

Rank: **Progress on health-related SDGs (2015)** 109/188⁴³²

Rank: **Healthcare Access & Quality Index (2015)** 47.6/100⁴³³

ICT & E-GOVERNANCE MATURITY

UN E-Government Readiness Index (2020) 119/193⁴³⁴

Cloud Readiness Index —

UN ITU ICT Development Index 147/193⁴³⁵

CLOUD & DATA SECURITY

- ✗ Cloud First Policy
- ✗ Cloud for Public Healthcare Mandate/Policy
- ✓ Legislation on Personal Data Protection
- ✗ Data Protection & Privacy Legislation for Healthcare Data
- ✗ Cloud: Data Security/Privacy Legislation for Healthcare Data

BANGLADESH — HEALTHCARE SYSTEMS MATURITY & CONTEXT

With nearly five thousand public and privately run healthcare facilities in Bangladesh, the country offers a hybrid healthcare system.

Healthcare Authority: The Ministry of Health and Family Welfare is charged with health policy in Bangladesh through its two divisions: Health Services and Medical Education and Family Welfare.⁴²⁷

Health Financing: Public funds for health are the main prepayment mechanism for risk-pooling and constitute 26% of total health expenditure. The other major funding source is international development partners. Close to two-thirds of healthcare expenditures come from out-of-pocket (OOP) payments.⁴²⁸

HEALTHCARE CHALLENGES THAT CAN BE ADDRESSED BY CLOUD:

High Out-Of-Pocket payments: On average, Bangladeshi citizens pay 65% of total healthcare costs, keeping families with lower incomes from accessing healthcare and often leading to debt and poverty.⁴²⁹

Inadequate infrastructure and personnel: Bangladesh has inadequate technological infrastructure to obsolete healthcare facilities. According to the World Health Organization (WHO), Bangladesh suffers from both a shortage of and geographic maldistribution of health workers.⁴³⁰

Numerous disparate systems: Most hospitals in the country still rely on paper-based records for day-to-day operations and patient tracking in the absence of a unified health system. Although the government has started working towards establishing a unified healthcare system, the country still has miles to cover in achieving this vision.

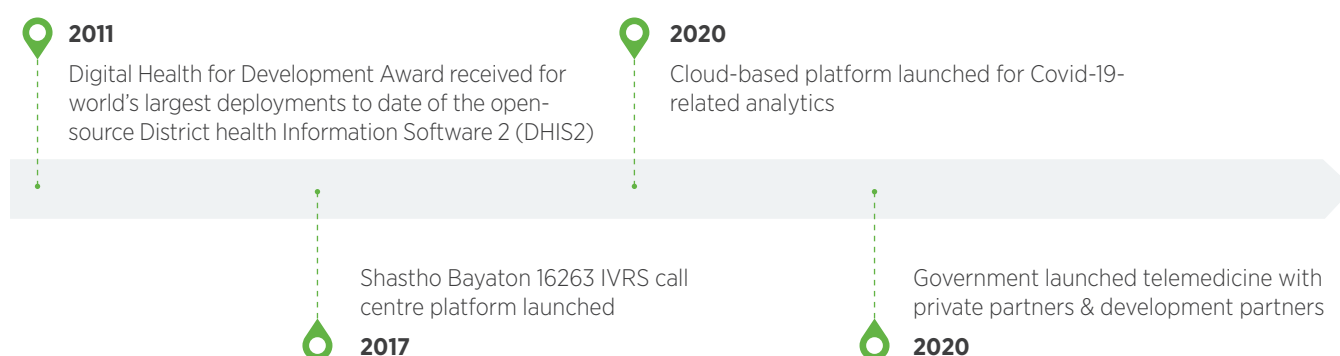
6.12 Bangladesh

6.12.1 Digital Transformation of Healthcare in Bangladesh: Context and Maturity

Bangladesh announced its Digital Bangladesh Vision 2021 in 2008; however, the translation of this vision in its healthcare sector has seen limited success. Bangladesh's healthcare industry is still plagued by excessive out-of-pocket payments, poor healthcare services, and inadequate infrastructure. Still, it continues to update its digital healthcare policy in line with current realities.

For instance, in 2020, Bangladesh launched its telemedicine scheme in partnership with the private sector and other development partners. The country now possibly recognizes the importance of leveraging technology in its attempt to overcome the key challenges in its healthcare sector.

Key milestones in the transformation of the healthcare sector



Notable Digital Health Initiatives

Bangladesh has relied on open-source systems to roll out key digital health initiatives, lowering the cost barriers for health facilities to invest in these systems. The country has seen an uptake in digital health initiatives since the onset of the COVID-19 pandemic.

District Health Information Software 2 (DHIS2):

In 2011, Bangladesh received the Digital Health for Development Award for the world's largest deployment-to-date of the open-source District Health Information Software 2 (DHIS2). The web-based software allows for the collection, validation, analysis, and presentation of aggregated statistical data tailored to integrated health information management activities. DHIS2 spurred initiatives to standardize data and ensure interoperability in eHealth software and database development. The deployment has also enabled a real-time SDG health indicator tracker on the DGHS (Directorate General of Health Services) website.⁴³⁶

IVRS Call Centre Platform:

In 2017, the Shastho Bayaton 16263 IVRS Call Centre platform was launched in Bangladesh and has helped in expanding access to healthcare across the country.⁴³⁷

Shared Health Record:

The MIS unit at the DGHS has also embarked on a Shared Health Record (SHR) project to create an archive of patients' electronic health records. The SHR has been piloted in a few hospitals and is being rolled out nationwide. SHR is integrated with an open-source medical records and hospital automation system, OpenMRS+, that allows healthcare organizations in the country to take a free copy of the software and join the national health facility automation system network.⁴³⁸

Human Resource Information System (HRIS):

Launched in 2012 in line with Bangladesh's Health Workforce Strategy 2015, the HRIS electronically captures and maintains human resource information for the health sector, helping to track employee attendance with plans to link the system with career planning and incentive systems.⁴³⁹

Advancing Digital Health Strategy:

In August 2019, Bangladesh initiated the development of a national digital health strategy in pursuing resolution 71.7 of the World Health Assembly (WHA). To advance this strategy, the Management Information System (MIS), under the Directorate General of Health Services (DGHS), conducted a one-day stakeholder consultative workshop to finalize the draft strategy developed by the Technical Working Group with key public and private stakeholders.⁴⁴⁰

Digital Health initiatives launched during COVID-19:

The following initiatives were launched during COVID-19 by the Bangladesh government:⁴⁴¹

- **National Corona Portal-Corona Info:** This national website provides updates on COVID-19 statistics, including confirmed cases, testing, recovery and deaths, as well as information on WHO guidelines, safety and prevention tips, and other public awareness data.⁴⁴²
- **Information chatbots:** Bengali and English-speaking chatbots on Facebook messenger and the national coronavirus portal have helped provide information on COVID-19 from online COVID-19 resource pages. They also offer mental health and doctor consultation advice.
- **Mobile Apps:** The government launched a number of apps for COVID-19 management to provide information on COVID-19. The Corona Tracer BD app was launched for Bluetooth-based contact tracing, while Surokkha was launched for vaccination registrations. The government also partnered with private sector players – ride-sharing platform Pathao and digital health solution Maya to provide instant health services via the Pathao health app.⁴⁴³

6.12.2 Cloud Adoption in Public Healthcare: Notable Initiatives, Policies & Regulations

In recent times, the government of Bangladesh has made positive moves to improve the national technology infrastructure. Government agencies now invest more than they ever had into ICT.⁴⁴⁴ Fortunately, this show of confidence and reliance on technology is starting to pay off. For instance, in 2012, the United Nations ranked Bangladesh 150th in its E-government Development Index. This ranking was greatly improved upon in 2018, when the country ranked 115th.⁴⁴⁵

Bangladesh has also made strong progress on its SDG health goals, yet there is a long way to go in its healthcare digital transformation journey. With most healthcare facilities in the country still relying on paper-based record management and systems, the first step in this digital transformation process would be to move towards digitizing medical records and expanding the use of electronic medical records (EMRs).

Cloud policy for the public sector:

Since 2002 when the first ICT strategy was launched across Bangladesh, the country's IT landscape has greatly improved. For instance, since then, the Bangladesh Computer Council (BCC) has developed cloud services for government agencies. BCC runs and manages the National Data Centre of Bangladesh that was established in 2010 and provides IaaS, PaaS, and SaaS services.⁴⁴⁶ There is no clear cloud policy for the government.

Cloud for healthcare: Maturity and Notable Initiatives

Despite limitations, cloud adoption has seen some successes in the health sector in Bangladesh.

COVID-19 Analytics Platform: In response to the ravaging COVID-19 pandemic, a cloud-based analytics platform was launched in 2020 nationwide. This tool has been instrumental in Bangladesh's fight against the coronavirus pandemic.⁴⁴⁷

Telemedicine launch: By adopting cloud solutions, the government successfully launched a telemedicine platform to reduce the hardship caused by the limited presence of trained doctors in rural areas. This was developed alongside private and development partners.⁴⁴⁸

mDoc: With 70% of the population in Bangladesh living in rural areas, the country faces an acute shortage of qualified doctors and healthcare workers. This has led many rural dwellers to rely on “village doctors” for treatment. When it launched in 2016, mDoc aimed to bridge the gap between urban doctors and rural health professionals. By leveraging its cloud-based platform, mDoc trains and empowers local pharmacists to work with urban doctors. This consequently improves access to healthcare and medicine for the rural dwellers, further reducing occurrences of incorrect prescriptions. The platform allows urban doctors to prescribe medicines and for pharmacists to print these in real-time.⁴⁴⁹

Relevant Regulations

Data governance is relatively underdeveloped in Bangladesh, with the UNCTAD identifying Bangladesh as one of the 25 countries without laws on data privacy and protection.⁴⁵⁰

Regulations on personal data protection, privacy, and security

Personal Data Protection and Security Regulations

The basic framework of personal data protection and privacy is laid out in the Information Communication Technology Act 2006 and the Digital Security Act, 2018. The ICT Act imposes responsibility on users who are possessing, dealing with, or handling any sensitive personal data or information and requires the implementation and maintenance of reasonable security practices to avoid the wrongful loss or wrongful gain by the data owner.⁴⁵¹

The Digital Security Act serves to ensure national data security in relation to matters such as data crime identification, prevention, suppression, and trial, whereby any data or information published or propagated in digital media which threatens data security can be blocked or removed.⁴⁵²

Cloud-specific guidelines: The Government of Bangladesh Information Security Manual (GoBISM) –2016, made by the Bangladesh Computer Council under the ICT Ministry, has provided some guidelines and recommendations in terms of security for government agencies aiming to adopt cloud computing.⁴⁵³

In the Information Security manual, the objective of the guidelines (which include tiered mandatory and recommended measures) for cloud computing is to identify and manage cloud system risks and protect official information and agency information on the system in accordance with the current legislation, the GoBISM, and the GOB Classification System and with other government security requirements and guidance.⁴⁵⁴

Regulations specific to healthcare data in the cloud

The current cloud adoption landscape in Bangladesh is not straightforward. There are several laws and policies that make this complicated, either individually or when joined together. For instance, while there is no cloud-specific regulation for healthcare data, it is known that the ICT Act forbids the disclosure of confidential or private information in electronic records, registers, documents, etc., without consent. The BCC has disclosed that the Data Privacy and Protection Act is currently being drafted.⁴⁵⁵

Without rules and legislation around the handling of personal data, health records, and the appropriate security classifications, public healthcare organizations will not have the legal standards and guidance needed to adopt the cloud.

6.12.3 Barriers & Challenges to Cloud Adoption

The following barriers and constraints were identified based on existing secondary research and interviews:

1. Lack of supporting legislation

The lack of clarity or legislation guiding the use of cloud services is a major barrier in moving healthcare cloud adoption forward. Also, some laws and policies, when acting together, can create a restrictive legal environment for data access, such as the Official Secrets Act of 1923, Digital Security Act of 2018, and Social Media Usage policies.

2. Budgetary constraints:

There is poor funding for healthcare across Bangladesh which inevitably impacts the budgetary arrangements for investments in ICT and cloud for healthcare.



“There is poor understanding of cloud amongst policymakers. Cloud Service Providers need to make decision-makers more aware of the benefits. They should also think about how they can lower the costs for the government as cost is a big issue.”

— **Fatema Uddin, Deputy Team Leader, HISP Bangladesh**

3. Data security and privacy concerns:

While there is regulation around data classification and security, there is little clarity and understanding among users, including healthcare-IT personnel. The sensitivity of healthcare data is also something that is not widely understood. Additionally, Bangladesh has a data localization law because of which sensitive data may not be stored outside Bangladesh. Respondents also reported that the fear of international sanctions or political instability disrupting cloud services was a reason why relying on foreign cloud service providers was a concern.



“There is a policy around data classification, but it isn’t all 100% clear. We have trained people to be careful with sharing healthcare data, some people are aware that this data is sensitive, but most have poor knowledge about it.”

— **Fatema Uddin, Deputy Team Leader, HISP Bangladesh**

4. Inadequate supporting infrastructure:

Bangladesh’s weak electrical grid has meant frequent power cuts.⁴⁵⁶ The country ranked 98th out of 181 countries in terms of broadband internet speed and ranked further down in mobile internet speed, ranking 135th out of 137 countries.⁴⁵⁷ Internet penetration in Bangladesh stood at 28.8% in January 2021.⁴⁵⁸ Government agencies must ensure that the last mile connectivity infrastructure is robust enough to handle data-intensive operations over the cloud to avoid performance problems in these regions while using cloud solutions.

6.12.4 Recommendations

1. A comprehensive cloud policy and strategy is required:

The use of the cloud in Bangladesh is currently limited to research and disease tracking. The Bangladesh government must look at investment options that allow for building the required ICT infrastructure in the country. Additionally, if healthcare data is to be migrated to the cloud, there must be a supportive framework and environment in place. For instance, the handling and (non) disclosure rules for personal biodata, individual health records, and other PII in addition to the proper classification of security information (including cyber-related security) is needed to ensure agencies have the legal standards and guidance they need as they shift more and more to a digitally enabled government. The government also needs to put frameworks in place to avoid a negative fallout to its cloud-based services in the event of international sanctions.⁴⁵⁹ [See Recommendations 1-4 in Section 4]

7. Appendix II: More about cloud services

7.1.1 Types of Cloud Services




There are three main types of cloud services:

Infrastructure as a Service (IaaS): IaaS contains the basic building blocks for cloud IT and usually provides access to networks, computing resources, and data storage on-demand.

Platform as a Service (PaaS): PaaS provides programming languages, libraries, services, and development tools on which applications are built. PaaS reduces functions such as procurement and management of hardware and operating systems and software maintenance.

Software as a Service (SaaS): SaaS provides the user a complete product such as an application, which can be run directly without the need to manage the underlying infrastructure. Examples include client relationship management systems and communication media such as web-based email.

Types of cloud services⁴⁶⁰

		
<ul style="list-style-type: none"> • Contains the basic building blocks for cloud IT • Typically provides access to networking features, computers (virtual or on dedicated hardware), and data storage space 	<ul style="list-style-type: none"> • Removes the need for organizations to manage the underlying infrastructure and allow you to focus on the deployment and management of your applications • Less heavy lifting in resource, capacity planning, and maintenance 	<ul style="list-style-type: none"> • Provides a completed product that is run and managed by the service provider • No maintenance of underlying infrastructure or the service

7.1.2 Cloud Deployment Models

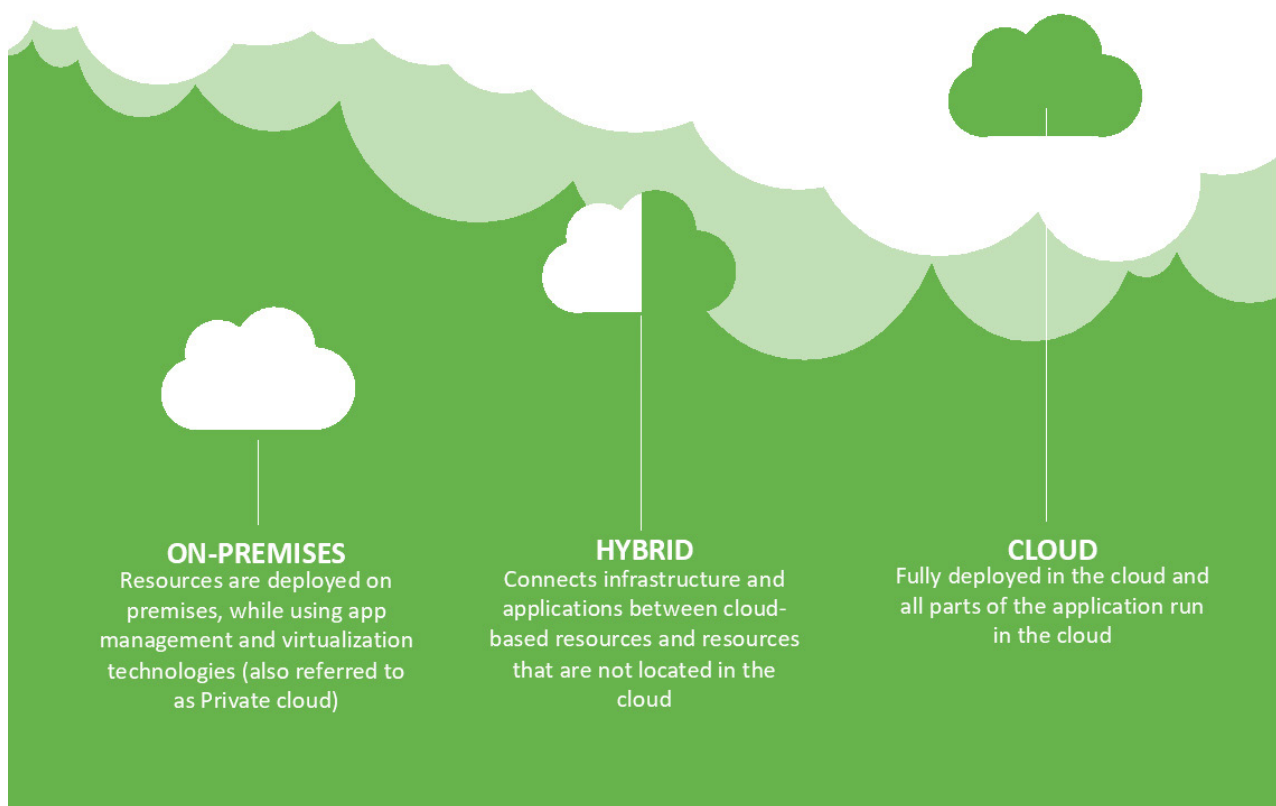
An application can be deployed on the cloud through different hosting models depending on where the hosting infrastructure is and who has control over changes and modifications.

Cloud services can be deployed fully in the cloud, fully on-premises, or as a combination of both.

Cloud: Type of deployment in which the application is fully deployed in the cloud and all parts of the application run in the cloud. Applications that are stored and deployed in the cloud have either been created in the cloud or have been migrated from existing infrastructure. These can either be built on low-level infrastructure pieces or use higher-level services that provide abstraction from the core infrastructure's management, architecting, and scaling requirements.

Hybrid: Hybrid deployment connects infrastructure and applications between cloud-based resources and existing resources not located in the cloud. The most common method of hybrid deployment is between the cloud and existing on-premises infrastructure; this model is used to broaden an organization's infrastructure into the cloud while connecting cloud resources to the internal system.

On-premises: In this model, resources are deployed on-premises along with the use of virtualization and resource management tools. This model is also commonly referred to as "private cloud." In most cases, this deployment model is similar to legacy IT infrastructure but uses application management and virtualization technologies to try and increase resource utilization.



Cloud deployment models

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