DIGITAL-IN-HEALTH PROGRAM

Ayushman Bharat Digital Mission's **Integrated Digital Health Ecosystem** is the Foundation of **Universal Citizen-centered Health Care** in India

KEY

HEALTH SYSTEM CHALLENGE ▶	Fragmented health and data systems occur at multiple levels, and a lack of access to timely information results in reduced quality of medical care.	
SOLUTION ▶	Use of standards based, flexible applications, software solutions, and technologies that work synergistically within the digital ecosystem. These technologies are a combination of interoperable open-source and proprietary applications that enable access to data and information in a timely manner to meet the unique needs of users.	
TOOL ▶	An integrated enterprise architecture through a unified digital health interface enables health information exchange across multiple digital health interventions.	
TIMELINE ▶	2018 till date.	
RESOURCES USED ▶	Implementation cost is approximately $4.5 million over 3 years.	

Introduction

The COVID-19 pandemic ushered in the need for accelerated digitization of health care across the globe. The Government of India amply demonstrated their digital prowess in their response to the pandemic by building Digital Public Goods (DPGs) that leverage several standalone initiatives to develop an integrated national digital health ecosystem. The aim of this ecosystem is to support Universal Health Coverage through the provision of real-time data, information and infrastructure using open-source, interoperable, standards-based digital systems.

In the last decade, digital public infrastructure within India has expanded exponentially. Several initiatives like the digital identity system known as Aadhaar (for unique identification), and the Unified Payments Interface have become central to India's public service delivery architecture. The Unified Payments Interface has transformed heterogeneous payment modalities by aggregating them under one easy to use, highly secure mobile-based system for money transfer. Mobile and internet connections have expanded at a fast pace and penetrated ever deeper into rural areas. Currently over 572,000 villages out of 597,000 have mobile or network connectivity.

WORLD BANK GROUP

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM

There are nearly 1.2 billion mobile subscribers, 800 million internet users, and 510 million smartphone users. This expansion can be attributed to the cost of mobile and internet connections dropping substantially, allowing for increased digital access across the country. Within the public digital infrastructure, there are 1.24 billion unique Aadhar digital IDs in place, and it is estimated that nearly 10 billion+ eKYC (Know Your Client) transactions and 2.64 billion Unified Payments Interface transactions take place monthly. This infrastructure forms the basis of the **Ayushman Bharat Digital Mission (ABDM)**.

During the pandemic, India leveraged various digital health interventions to provide contactless health care. Some examples of the Digital Public Goods developed during the pandemic include the COVID Vaccine Intelligence Network (CoWIN) application, which provided individuals with vaccine certificates, and the Aarogya Setu application. Aarogya Setu was originally a contact tracing app that provided real-time data on active cases, containment zones and helped more than 175 million citizens assess risk in their areas. It also facilitated the booking of COVID-19 vaccinations. It has now been transformed into a national health application that allows individuals to register for a Digital Health ID, telehealth consultations, as well as functioning as an Electronic Medical Record so that individuals can access digital lab reports, prescriptions, and diagnosis.

The high volume of over 350 million CoWIN registrations prompted India to adopt a completely digital approach to its vaccination strategy. Telehealth platforms like eSanjeevini also saw a steep increase in users during the pandemic, as 85 percent of physicians adopted telehealth platforms. Use of telehealth was only at 18 percent prior to COVID-19. This emphasized the need to better incorporate cutting-edge digital technologies into health

care services to support this increased demand and to improve program coverage and enhance quality of care.

The impact of the pandemic put a spotlight on the benefits of digital innovation, technology-enabled solutions and served to accelerate their use.

> The CoWIN platform allowed individuals to register on an online portal, schedule vaccinations at government hospitals, receive digital vaccination certificates and facilitated access to vaccinations at private sector hospitals. The platform was viewed positively by those individuals using it. It gave the government access to valuable COVID-19 data.

Within this short period of implementation, it became clear that a comprehensive digital health care ecosystem was necessary to bring together existing siloed efforts, and to proactively move towards a more holistic and citizen-centric system. The government responded by creating shared Digital Public Goods for health care and developed a framework for a nationwide digital health. This initiative was a turning point for health care in India. The Prime Minister launched the ABDM on September 27, 2021, under the aegis of the National Health Authority. Within a year of its launch, the ABDM had established a robust framework to provide accessible, affordable, and equitable digital health care. With India taking on the G20 presidency in 2023, the Global Initiative on Digital Health advocates for a connected and integrated health ecosystem to bring together global efforts on digital health. It also calls for the best use of technologies for improving health outcomes and scaling-up of these technologies as Global Digital Public Goods to accelerate Universal Health Coverage. Within

Digital highways harness data, technology, and connectivity to improve the way the digital architecture is designed, built, operated, and used. This will enable high performing, and faster delivery, and an enhanced customer experience for all.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

this broad perspective, the ABDM aims to support the creation of an integrated digital health infrastructure by developing a digital backbone. The government will bridge gaps by building digital highways with the aim of improving the efficiency, effectiveness, and transparency of health service delivery in India for the myriad of different private and public stakeholders, that also encompasses alternative medicine, making it a diverse and complex ecosystem to be integrated.

Human Development Service Delivery Problem Improvement opportunities

India's vision to digitize healthcare started with the launch of the National Health policy in 2017, followed by the NITI Aayog's National Health Stack in 2018 which formed the basis for the National Digital Health Blueprint (NDHB) launched in 2019, culminating in the launch of the Ayushman Bharat Digital mission in 2021 (Sharma, R. S et al., 2023). The vision supported by previous investments in foundational technologies provided the groundwork for creating an integrated digital health ecosystem, the aim of which is to provide quality healthcare using accessible and affordable digital technology.

As detailed in the policy documents, some of the envisioned digital health interventions for addressing health service delivery reforms include:

- **Infrastructure:** Strengthening healthcare infrastructure and helping to reach the underserved particularly in rural areas.

- A**ccess to Care:** Reducing disparities that exist in access to healthcare between urban and rural areas

- **Workforce:** Building a network of trained healthcare professionals across the country, but especially in rural areas. Creating a workforce with a focus on distribution, skill mix, and performance

- **Affordability:** Improving the quality of public healthcare service delivery to all populations and the capacity to meet the demand

- **Quality of Care:** Improving overall quality and differences in health care by improving adherence to treatment guidelines, regulating prescription of medication, and appropriate use of high-end diagnostics and procedures.

Despite the burgeoning innovations, digitalization of health care in India is challenging. There are over 5 million health care professionals, and 1.2 million health care facilities serving a population of nearly 1.4 billion people. Bringing such a large number of stakeholders onto a single digital health system managed by the government in a single step was not viable, due to both the sheer volume, and the extremely varied needs. Although there has been rapid digitization in other sectors, such as finance and banking, travel and tourism, and the hospitality sectors, it must be acknowledged that digitizing health data is more nuanced and requires a more granular and involved approach. Health care data is more complex as it consists of numerous different types of files, requires stringent data protection and security regulations, and includes an infinite number of medical terminologies and definitions which are not universally understood. These include radiological images, lab reports, prescriptions, and outpatient and in-patient records. In addition, all of these

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM

are written using different standards and formats. More importantly, health care data is highly sensitive and personal in nature and poses greater risk. Therefore, the digitization of health care is more complex and challenging when compared to other sectors.

Technology Principles

The ABDM is a platform based an open *Application Programming Interface (API)*, meaning it is flexible and allows both open-source and proprietary technologies to plug in. It is an ecosystem where all the *building blocks* and components of the ABDM are designed to be interoperable to facilitate the exchange of data. The platform makes use of open standards and data exchange protocols to ensure that different systems can communicate with each other effectively. They work together seamlessly, regardless of the application or technology provider used.

Security and privacy are recognized as top priorities underpinning the design and development of the APIs, and all systems need to comply with relevant data protection and security regulations[1]. It was imperative that robust measures are put in place before deployment to protect data from unauthorized access and theft.

The systems are designed based on user-centered design principles and consider the needs and preferences of health care providers, patients, and other stakeholders. The platform utilizes evidence-based approaches to inform its design and implementation.

Finally, the program uses an evidence-based approach to inform its design and implementation to ensure that the technology is effective, efficient, and cost effective. Together all these building blocks can be scaled as well as sustained to meet the growing needs of the program as it expands and evolves over time.

A *federated architecture* has been adopted using six core building blocks that have been developed using a minimalistic approach and are maintained centrally at the national level (Figure 1). All the other building blocks are designed to be operated in a federated model that allows regional, state-level and institution-level platforms and systems to function independently, but in an interoperable fashion.

An **API** provides a way for two or more computer programs to communicate with each other. It is a software interface, offering a service to other pieces of software. It enables multiple software components to "talk to each other" using a set of definitions and protocols, such as a data dictionary. APIs are an accessible way to extract and share data within and across organizations.
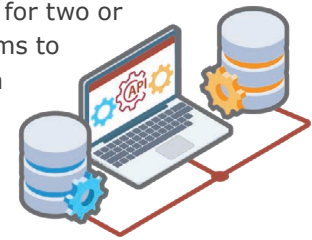
Building blocks refers to software code, platforms, and applications, that are interoperable, provide basic digital service at scale and can be reused for multiple use cases and contexts. It serves as a component of a larger system or stack, and can be used to facilitate the delivery of digital public services via functions for e.g., registration, scheduling, ID authentication, messaging, etc. The building blocks can be combined and adapted to be included as a part of a stack of technologies to form a Digital Public Infrastructure. https://digitalpublicgoods.net/DPI-DPG-BB-Definitions.pdf

---

1 At the time of writing, India's new Digital Data Protection Bill 2023 (https://www.meity.gov.in/writereaddata/files/The%20Digital%20Personal%20Data%20Potection%20Bill%2C%202022_0.pdf) had not been promulgated. Adjustments to the system described in this case study may need to be made depending on the Bill's final form, as adopted as law.

OPEN-SOURCE APPLICATIONS are built on publicly available source codes that can be accessed, modified, and distributed by anyone, are free to use, encourage collaboration, and contribute to innovations by allowing developers to contribute to the code base. They can be used by developers to build new solutions that leverage the health stack (initiative by government of India to improve digital health infrastructure) or other open-source tools, and they can be customized to meet the needs of different health care providers and patients.

PROPRIETARY APPLICATIONS: Proprietary applications, on the other hand, are built on a code that is owned and controlled by a particular company or organization. They are typically sold as commercial products, and users may be required to pay licensing fees or subscription costs to access them. In the context of ABDM, proprietary applications may be used by health care providers or insurers to manage patient data, billing information, or other aspects of their operations. While proprietary applications may not be as open or customizable as open-source solutions, they can still play an important role in the digital ecosystem by providing specialized features or services that are not available elsewhere.

While open-source applications may encourage collaboration and innovation, proprietary applications may provide specialized services or features that are not available in open-source alternatives.

Main components of the digital health ecosystem enabled by ABDM:

- **Hospital Management Information System (HMIS):** A comprehensive information system that collects, stores, and analyzes data related to health service delivery and utilization

- **Health Insurance:** Ayushman Bharat provides health insurance coverage to eligible households in India through the Pradhan Mantri Jan Arogya Yojana (PM-JAY) scheme (a public health insurance scheme)

- **e-Governance:** Digital platforms are used to manage various aspects of the health care delivery system, such as enrolling beneficiaries, managing claims, and monitoring program performance

- **Telehealth:** The program includes the provision of telehealth services to rural and remote areas, allowing patients to access medical consultations and advice from specialists

- Use of both **Open Source and Proprietary Software** and technological applications

- **Health Information Exchange**: A platform that enables the exchange of health information between health care providers and stakeholders, such as patients, insurance companies, and public health agencies.

- **Electronic Health (EHRs):** EHRs are maintained for each beneficiary enrolled under PM-JAY, and they contain a complete record of all medical treatments received by the patient

- **Health Analytics:** The data collected through HMIS and EHRs is analyzed to identify patterns, trends, and opportunities for improvement in the health care delivery system

These building blocks work together to create a comprehensive digital health ecosystem, aimed at improving access to quality health care for all Indians, particularly the most vulnerable and marginalized communities.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

As defined by ABDM, the data is federated and stored close to the point of generation. All the registries and other master databases of ABDM are built as a *"single source of truth"* on different aspects and are backed by strong data governance principles which includes clear ownership, roles and responsibilities and dedicated data governance structures established at both the central and state levels.

Figure 1 is a representation of the architecture of the Ayushman Bharat Digital Mission formerly known as the National Digital Health Mission.

The key objectives of these overarching technology principles are to ensure that:

- **Patients** can securely store and access their medical records, such as prescriptions, diagnostic reports, and discharge summaries, and share them with health care providers for assured and appropriate treatment and follow-up. In addition, patients can access accurate information on both private and public health facilities, and service providers can access health services remotely through tele-consultation and e-pharmacy

- **Health care professionals** have full access to a patient's medical history, after obtaining informed consent, to ensure they can prescribe the right interventions. This integrated ecosystem facilitates an improved continuum of care, digitizes insurance claims that can be processed for faster reimbursement, and overall enhances service provision

- **Policy makers and program managers** have access to better quality macro and micro-level data,

Federated Architecture is a pattern in enterprise architecture which allows interoperability and information sharing between semi-autonomous decentralized organized lines of business (LOBs), information technology systems and applications that share a common vision. It works well in heterogeneous environments where a central one-fits-all approach cannot be applied; and provides high flexibility and agility to the various autonomous (and interlinked) components within the system for coordinated sharing and exchange of information. There is no centralized repository of health care records either in one place or in one system; and can be stored in multiple places as per the choice of hospitals, doctors, and patients. This is known as a federated architecture in IT or digital system. Only the data collected through registries such as Health ID registry, Health care Professional Registry and Health care Facility Registry is stored centrally because these datasets are essential in providing interoperability, trust, identification, and single source of truth across different digital health systems.

advanced analytics, and usage of health biomarkers in diagnosis, which enables geographic and demography-based program monitoring and the use of preventive health care. This facilitates informed decision making to improve policy design, strengthen program implementation, and increase the accountability of health care providers

- **Researchers** can use aggregated data to study and evaluate the effectiveness of various programs and interventions, and this facilitates a comprehensive feedback loop between researchers, policymakers, and providers.
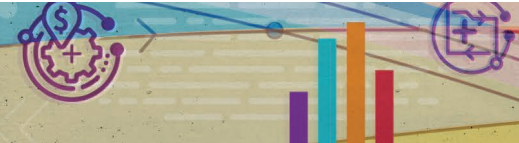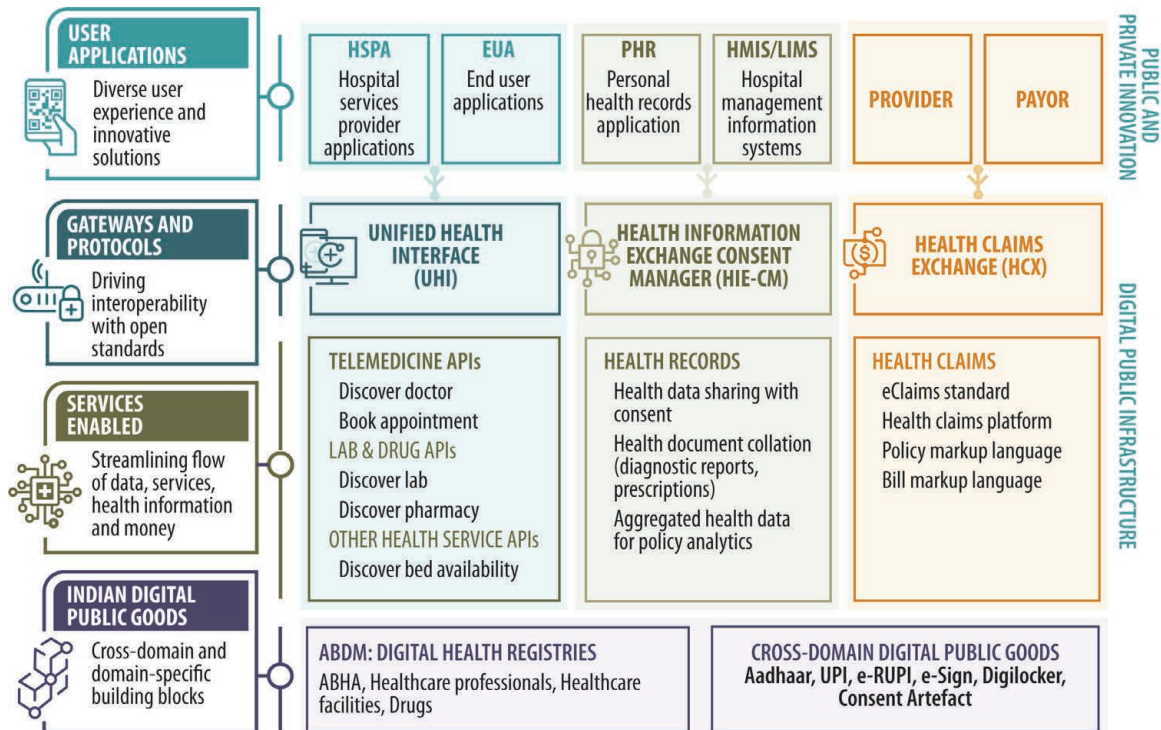
DIGITAL-IN-HEALTH FLAGSHIP PROGRAM

Figure 1   Technology Architecture of the Ayushman Digital Health mission

Source: NHA Annual Report 2021–2022_d4f624f7b5.pdf, page 86.

Major implementation milestones

The ABDM was launched in 2020 to accelerate the digitalization of health care across India by building digital highways to promote connectivity between disparate existing digital health systems, developed prior to COVID-19, and integrate existing digital health solutions to support the creation of interoperable platforms, bringing them all together under one comprehensive and holistic ecosystem. The key milestones that led to the launch of the ABDM are illustrated in Figure 2.

Since its launch, the foundations for a robust public digital health infrastructure are being laid through core registry building blocks or modules of:

- Individuals/citizens/patients (ABHA ID registry)

- Health care professionals (Health care Professionals Registry)

- Health care facilities, including but not limited to hospitals, laboratories, and pharmacies (Health Facility Registry)

In these registries, each individual entity is assigned a Unique Identifier (UID), which is used across the entire ecosystem. This helps to establish linkages through APIs and enhances accessibility of information. The aim is to digitally empower individuals, patients, doctors, and health facilities to streamline the delivery of health care services and related information. Some of the key implementation milestones since the ABDM's inception in 2018 include:

1. **Launch of a real-time HMIS through an online portal.** The HMIS is a digital initiative under the Ministry of
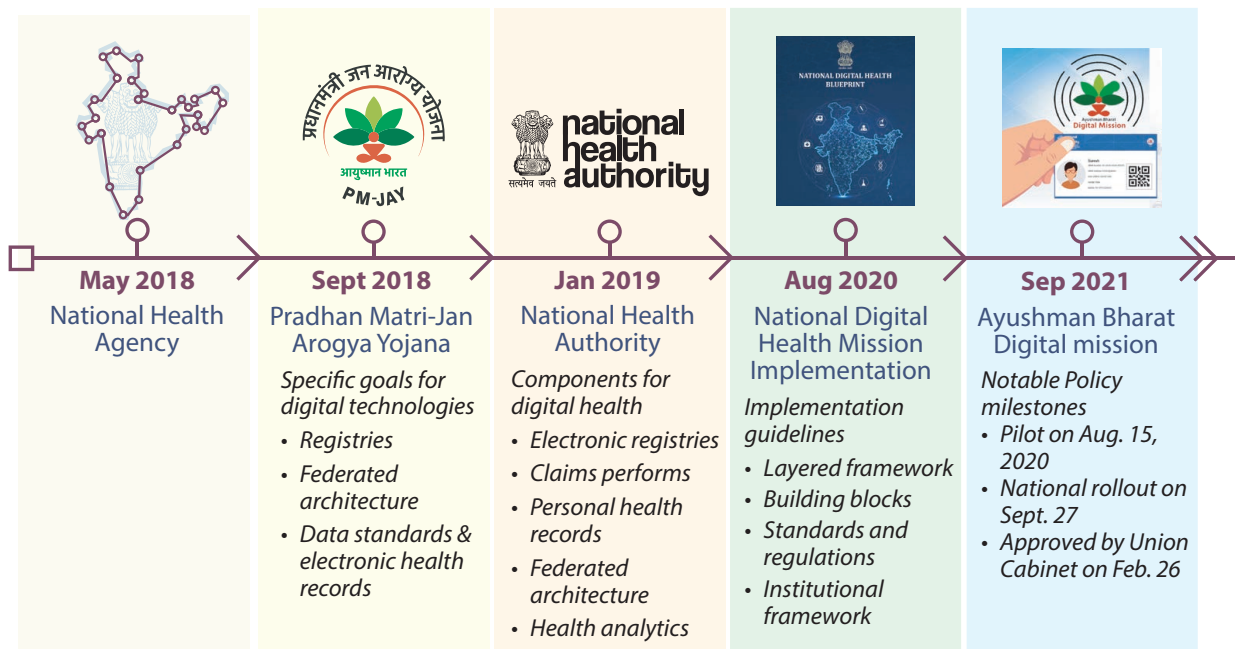
DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM
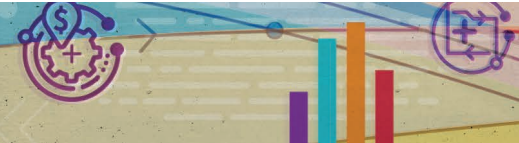
Health, and Family Welfare (MOHFW), which collects, stores, and analyzes health service delivery and utilization data. The HMIS portal uses all applicable government standards, such as standardized facility UIDs, entity names, geographic boundaries (up to the level of villages), population data and other relevant information, including Geographic Information System (GIS) based layers that are used in the Integrated Health Information Platform. APIs link it to other programs

2. Creation of individual ABHA Numbers and health accounts as a basis for a seamless online platform. ABHA numbers are comprised of a randomly generated 14-digit identification number are created either using the individual's/patient's mobile number or Aadhar number. This enables each person to get a unique health account, an Ayushman Bharat Health Account (ABHA) linked to their ID. After

obtaining the patients consent, a digital version of the health record is uploaded to the ABHA account to create a seamless online platform that allows users, insurance companies and hospitals across the country to access and share EMRs through the web application. The ABHA also enables citizens to compile a comprehensive medical history across various health care providers, thereby improving clinical decision-making. As of August 2023, nearly 442 million ABHA numbers, were generated, and 293 million patient health records were linked to the individuals' ABHA accounts (ABDM Dashboard, 2023)

3. Creation of UIDs for service providers. Using a similar approach to the UIDs for individuals, 14-digit UIDs are generated for both the Health Facility Registry and the Health Professional Registries. The Health Facility Registry is "a single centralized repository of all the health facilities in the country" to

Figure 2   Key milestones leading to the launch of the Ayushman Bharat Digital Mission

May 2018	**Sept 2018**	**Jan 2019**	**Aug 2020**	**Sep 2021**
National Health Agency	Pradhan Matri-Jan Arogya Yojana	National Health Authority	National Digital Health Mission Implementation	Ayushman Bharat Digital mission
	Specific goals for digital technologies	*Components for digital health*	*Implementation guidelines*	*Notable Policy milestones*
	• *Registries*	• *Electronic registries*	• *Layered framework*	• *Pilot on Aug. 15, 2020*
	• *Federated architecture*	• *Claims performs*	• *Building blocks*	• *National rollout on Sept. 27*
	• *Data standards & electronic health records*	• *Personal health records*	• *Standards and regulations*	• *Approved by Union Cabinet on Feb. 26*
		• *Federated architecture*	• *Institutional framework*	
		• *Health analytics*		

Source: Adapted from NHA_Annual_Report_2021_2022_d4f624f7b5.pdf page 82.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

facilitate storage and exchange of standardized data from both the public and private health facilities in the nation. Health facilities would have provision of electronic processing of documents for various purposes like for empanelment, claims processing, e-signature etc. The Health Professional Registry is also commonly known as the Digi Doctor Platform or Doctors Directory. Digi Doctor Platform is "A single, updated repository of all doctors enrolled in nation with all the relevant details of doctors such as name, qualifications, name of the institutions, qualifications, specializations, registration number with State medical councils, years of experience, etc. Doctor's Directory is one of the essential building blocks of the national e-health architecture

These provide verified digital identities to large and small public and private health facilities and professionals. This serves as a single source of truth for verified health care provider related information and connects them to the central digital ecosystem. The Health Facility Registry and Health Provider Registry help improve the identification/discovery of health care facilities and allow health professionals to build an online presence and offer their services more effectively. In addition, a Drug Registry is also being designed to create a single, up-to-date, centralized repository of all approved drugs across all systems of medicine

4. **Integration of EHRs for Pradhan Mantri Jan Arogya Yojana (PM-JAY).** As of August 2023, a total of 110 digital health services/applications have been integrated with ABDM. (National Health Authority and ABDM, 2023). The EHR forms an important part of the PM-JAY

which is a flagship health insurance scheme, launched in September 2018 to provide health insurance coverage to eligible households. To ensure timely insurance payments, EHRs are maintained for each beneficiary enrolled under PM-JAY. A dashboard has been created that has both aggregated and a drill-down view of various datasets, and it provides real time reports of transactions and analyzes utilization trends. The PM-JAY also has in place hospital registration, beneficiary identification, and transaction management system(s)

5. **Expansion and integration of Telehealth Services "eSanjeevani" with ABDM.** The program has telehealth services available, allowing patients in rural and remote areas to access digital medical consultations to solicit advice from specialists.

List of Digital services provided include:

(A) Citizen/Patient Services: (i) Single, Secure Health Id to all citizens, (ii) Personal Health Record, (iii) Single (National) Health Portal, (iv) App Store, (v) Specialized Services for Remote Areas/Disadvantaged Groups, (vi) NDHM Call Centre, (vii) Digital Referrals & Consultations, (viii) Online Appointments, (ix) e-Prescription Service, (x) Digital Child Health, (xi) National "Opt-out" (for privacy);

(B) Services by/for Health care Providers/Professionals: (xii) Summary Care Record, (xiii) Open Platform to access Emergency Services, (xiv) Technology for Practitioner (GP) Transformation, (xv) Digital Referrals, Case Transfers (xvi) Clinical Decision Support, (xvii) Digital Pharmacy & pharmacy Supply Chain, (xviii) Hospital Digitization, (ix) Digital Diagnostics;

(C) Technical Digital Services: (xx) Architecture & Interoperability, (xxi) Health Information Exchange, (xxii) Standards, (xxiii) Health Network, (xxiv) Data & Cyber Security, (xxv) Information Governance.

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM
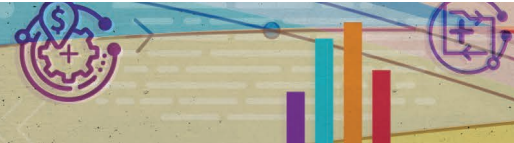
The integration allows existing users of eSanjeevani to create an ABHA account, manage their existing health records, such as prescriptions and lab reports, and to share these with the doctors on eSanjeevani for better clinical decision-making and to support the continuum of care. As of August 2023, eSanjeevani services have reached over 145 million Indians (eSanjeevani website, 2023)

6. **Launch of Health Information Exchange and Consent Manager (HIE-CM):** The HIE-CM platform was launched to facilitate the exchange of health information between health care providers and other stakeholders, such as patients, insurance companies and public health agencies. This system ensures that the identity of persons intending to share information is first verified, consent of the person/patient

is taken and logged, and only after that are the health records shared

7. **Implementation of health analytics.** The data collected through both the HMIS and EHRs is being analyzed to identify patterns, trends, and opportunities for improvement in the health care delivery system

Figure 3 highlights the different components of the ABDM and how these are linked in terms of their functionality and use.

Institutional and strategic alignment to implement change

Under a partnership between the Ministry of Health and Family Welfare and the Ministry of Electronics and Information Technology, the National Health Authority has been identified as the lead

Figure 3   Overview of the functioning of ABDM

Source: ABDM Handbook (2022).

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM
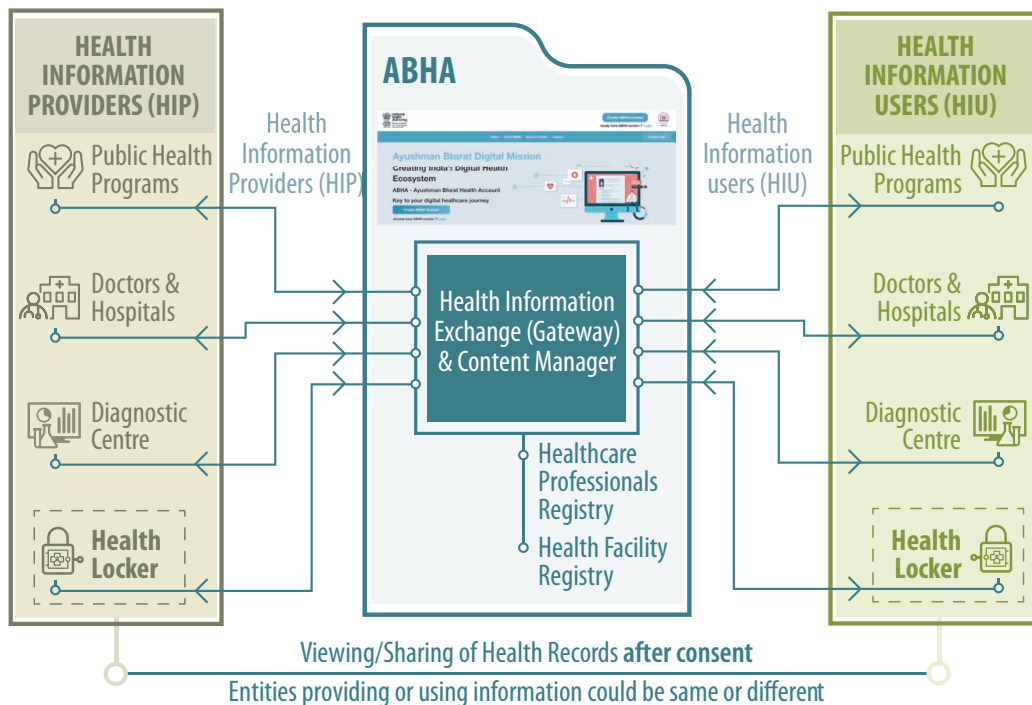
implementing agency. The National Health Authority has been entrusted with:

- Administrative and technical leadership
- Building the technological infrastructure
- Creating a national digital health ecosystem
- Developing models for self-financing within the ABDM

The National Health Authority is also tasked with:

- Implementing policies and decisions approved by the Mission Steering Group and Empowered Committee
- Developing strategic partnerships with private sector and civil society bodies

- Coordinating with the Ministry of Health and Family Welfare and States/Union Territories to resolve technical and operational issues and capacity building

The National Health Authority works in close coordination with other ministries and government departments, the private sector and civil society organizations. The multi-stakeholder mechanism through which the program operates includes the following:

1. **The National Health Authority** is the implementing agency for PM-JAY and is responsible for the overall management and program performance. It provides technical support to the States/Union Territories on program implementation

Figure 4   ABDM Stack–Modular and Interoperable

Source: ABDM Handbook (2022).

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM
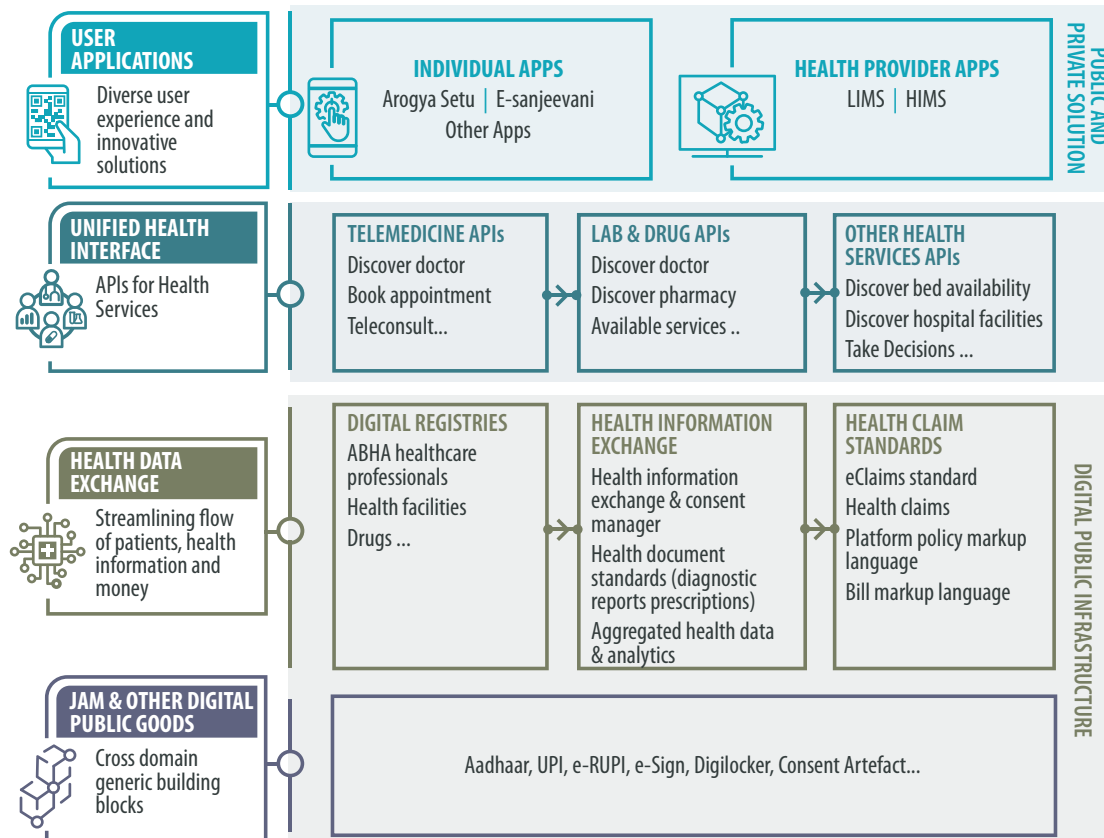
2. **State Health Agencies** have been set up by each state and have full operational autonomy and responsibility to ensure that the program is effectively implemented

3. **Insurance companies** are responsible for providing health insurance coverage to beneficiaries, managing claims and reimbursement process(es). They are selected through bidding and are paid a premium by the government for providing insurance coverage.

4. **Health care providers:** Private and public health care providers, such as hospitals and clinics, are eligible to participate in the program and provide health care services to beneficiaries. They are required to follow the standard treatment protocols and the quality standards set by the National Health Authority

5. **Technology providers** are responsible for developing and implementing the platform being used for the program, such as mobile apps and web portals, which serve to ensure seamless implementation and reduce the chances of fraud and abuse. These partners are mainly from the private sector and are recruited at competitive market rates

Figure 5 highlights the range of stakeholders present within the ABDM network, their roles in supporting patients and citizens to get comprehensive health care.

Scaling considerations and sustainability

The ABDM was launched as a pilot on 15th August 2020 in six Union Territories of India, namely Andaman & Nicobar, Chandigarh, Dadra & Nagar Haveli, and Daman & Diu, Ladakh, Lakshadweep and Puducherry, with the aim of

Figure 5   Stakeholders in the ABDM Network

Source: ABDM, 2023.

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM
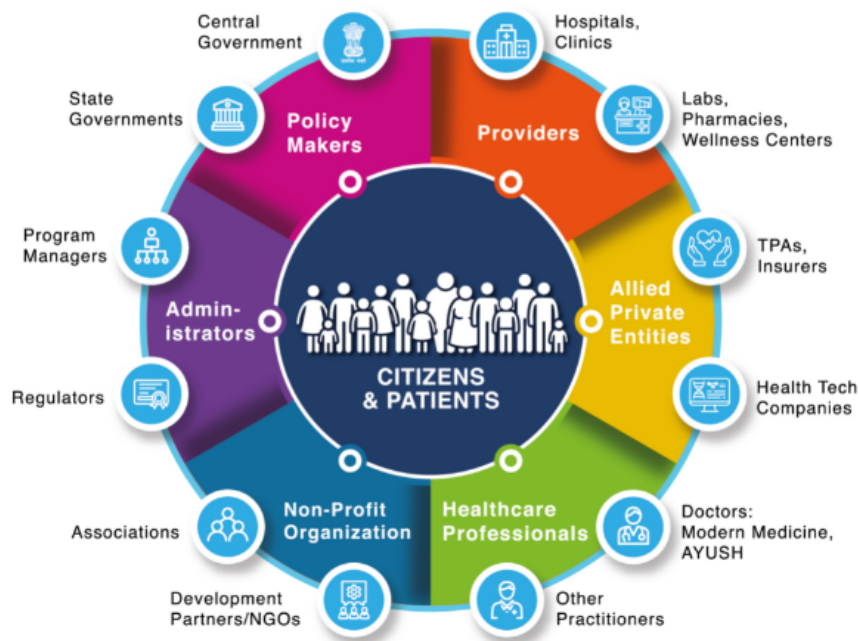
Strategic alignments as a part of service delivery reform and to implement change:

- **Distributed:** Health care delivered not only in fixed facilities, but also in workplaces, communities, and people's homes by a wider cadre of health workers, including patients themselves and their caregivers

- **Connected:** Share data with each other and systems outside of health care and be available to health workers and patients on mobile devices

- **Continuous:** Health care to serve people during the 5,000 waking hours of the year, not only the 15 minutes they spend in a fixed facility

- **Human centered:** Health care to put the patient and their caregivers at the center and empower health workers

- **Decentralized:** Decision-making to be less concentrated and put more into the hands of local leaders, health workers, and ultimately patients

- **Collaborative:** Health care to seamlessly combine the insights of non-experts, experts, and non-human agents

- **Responsive:** A system that automatically adapt itself to new data and new diseases

Digitalization is a key ingredient of this transition within the health system to ensure better service delivery and to strengthen core public health functions

establishing a national digital health ecosystem by creating an online platform, enabling interoperability of health data within the health ecosystem to create longitudinal electronic health records of citizens and facilitate delivery of health services through this digital health ecosystem. To date, three key registries namely the Health UID, Health Professional Registry, Health Facility Registry, and digital infrastructure for data exchange have been developed and implemented in these Union Territories with an estimated budget of $6.4 million.

To enhance program coverage, the 2023 budget allocation to NHA has been increased by 70 percent, and each State Digital Health Mission has been tasked with implementing ABDM within their respective territories. The State level scale-up plans were/ are in the process of being developed and they include the development and/or updating of state specific technology and infrastructure that builds

on central principles of ABDM, national policies, regulations, and standards. The state is responsible for the capacity building of health care professionals to enable them to be able to lead and implement, as well as conducting the overall monitoring and evaluation of the program in their respective states. A total of 31 states are making steady progress towards building a comprehensive digital health ecosystem. As of August 2023, about 293 million digital health records have been linked to the ABHA accounts of individuals and 442 million citizens have generated their unique ABHA allowing them to access and manage their digital health records anytime, anywhere. They can also access paper-less digital health services under ABDM. The digital linking of individual's health records with ABHA is being carried out extensively across different health facilities of the country with the support of State Governments.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

To ensure greater uptake and sustainability, the government intends to conduct public awareness campaigns to encourage individuals to enroll in the program. These will target those living in rural and remote areas, and the economically weaker percentiles. To ensure those who are unconnected, marginalized, remote, tribal, and digitally illiterate are reached by ABDM, specialized systems and offline modules are planned. The network of Panchayati Raj (local government) institutions with support from the frontline health workers, Accredited Social Health Activists and Anganwadi workers will facilitate this last mile outreach. In addition to the necessary infrastructure, the program will require an increase in the number of digitally trained health care providers and insurance companies to provide quality care to the increased number of individuals. Improved partnerships with private health care providers are planned to reduce the financial burden on the government and to improve the quality of care provided under the program.

Enablers and Challenges

Enablers contributing to the success of the ABDM include:

1. **Creation of innovative technologies and leveraging these to enhance quality of care and health service delivery.** The ABDM's digital ecosystem includes a set of digital tools, systems, and platforms that are used to implement and manage the health program. These tools include a variety of: (i) Mobile Applications used for beneficiary identification, eligibility verification, and for accessing health services; (ii) Web Portals: used by health care providers, insurance companies, and government agencies to manage the program, including enrollment of beneficiaries, reimbursement of claims, and monitoring of program's performance; (iii) EHRs used by health care providers to store and manage the health information of beneficiaries, including their medical history, treatments received, and test results; (iv) information systems like 'e-Hospital', which is a cloud-based Hospital Management Information System to connect patients, hospitals and doctors on a single digital platform; and 'e-Shushrut', incorporates an integrated computerized clinical information system for improved hospital administration and patient health care. It also provides an accurate electronically stored medical record of the patient; (v) telehealth and remote consultation services which includes video and tele-consultations and e-Sanjeevani (a web-based comprehensive telehealth solution that facilitates doctor to doctor, and patient to doctor teleconsultations); (vi) Payment systems used to manage the payments to insurance companies, health care providers, and technology providers, for example Paytm and Unified Payment Interface (vii) 'Scan and share' uses a QR code-based token system to manage queues at hospital counters and streamline the outpatient registration process in large hospitals.

In addition, there are several other user friendly and clinical decision support systems that are under development and have the potential to overhaul the health care sector of India. Some of these include the Internet of Medical Things to digitize and connect all critical care units of a hospital such as the ICUs, operating rooms, ventilators, navigation systems and artificial intelligence with

DIGITAL-IN-HEALTH FLAGSHIP PROGRAM

advanced diagnostic capabilities and remote diagnosis, 3D printing technology, robot assisted diagnosis and treatment of diseases, including minimally invasive surgeries, wearable health care devices, etc. is planned. The ABDM leverages these emerging technologies by using Block Chain technology and tracks their development and updates via the Innovation Wing in the National Health Authority.

2. **Establishment of a standardized digital health care ecosystem that supports stakeholders to connect in a trusted environment.** The digital ecosystem under the ADBM provides a conducive and interoperable platform for all the above-mentioned applications to work together seamlessly via different digital pathways through the Unified Health Interface. The Unified Health Interface enables all health care service providers and end-user applications to interact with each other on its network and provides a seamless experience for service discovery, appointment booking, teleconsultations, ambulance access, and more. The Unified Health Interface is based on open network protocols and can address the current challenge of different digital solutions being unable to communicate with each other. Moreover, it gives the stakeholders a trusted environment, promotes innovations to enhance quality of care in an efficient, transparent manner. The Government of India has also routinely allotted a sizable budget for technological advancement and digitization in the health care sector. Digitization of health care records is key for making the benefits of the new technology more scalable, and the Union Budget has made provisions for a planned rollout

of the digital registries, ABHA numbers, consent framework, and others that aid in universal access to health facilities.

3. **Development of succinct policies, strategy, regulations, and standards for a unified digital health ecosystem**. A series of policies, guidelines, regulations and standards across all levels and core components of the ABDM have been developed and operationalized/deployed and are regularly updated with a view to strengthening the digital health care infrastructure. Some of these include:

- **ABDM Strategy Overview and Action Plan:** presents the broad context, scope, rationale, key constructs or building blocks, implementation strategy, outcomes, and institutional structure for developing a digital ecosystem for health care services in the country

- **National Digital Health Blueprint** lays out the framework of key building blocks essential for the evolution of the National Digital Health Ecosystem. It recommends a Federated architecture, Universal Health ID, Electronic Health records, Metadata and data standards, Health informatics standards, Registries for Non-Communicable Diseases (NCDs), Directories of Providers, professionals and paramedical(s), Legislation and Regulations on Data Management, with focus on privacy and security, and data analytics

- **Guidelines and strategies related to the digital infrastructure** across the different levels of health care. These guidelines ensure that

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

the requisite digital infrastructure is in place, is regularly maintained and upgraded. There are policies related to the availability of technology and the connectivity of health care providers, for example

- **Development of technical standards and regulations** to ensure that the technology and different applications used meets the required standards for security, reliability, and privacy

- **Hardware guidelines** for states and health care institutions

- **Interoperability guidelines** to ensure that digital tools used under the program can communicate and exchange data with other digital health systems used for e.g., EHR etc. This helps to promote innovations, contribute to quality of care, and long-term program sustainability

- **Data protection and privacy policies** and strategy outlines the minimum standards for data privacy protection to be followed by all participants/stakeholders of ABDM. There are a set of robust laws to protect digital data for e.g., Health Data Management Policy. These laws help to promote and implement e-health standards, protect patient privacy and security, and regulate the storage and sharing of EMRs

- **Data Management policies and regulations** ensure that data generated is stored, used, shared, and managed securely

and efficiently, and it is used to improve the quality of care provided in line with the privacy and security data standards

Apart from developing policies specifically for the digital health architecture, additional guidelines and regulations are developed by the health sector to ensure that quality of care meets the PM-JAY standards. Some of this includes standards for health care providers, insurance companies, technology providers, and for the quality of care provided to beneficiaries. There are also policies related to the financial sustainability of the program, effective and efficient use of resources, prevention of fraud and abuse, monitoring the performance of health care providers, insurance companies, technology providers, and program evaluation. Together these policies and regulations help to ensure the transparency, accountability, and efficiency of program. These are continuously reviewed and updated to ensure that they are aligned with the ever-evolving needs of the beneficiaries and the program.

4. **Public-private partnership is the nucleus of the ABDM and has played a pivotal role in its evolvement.** The private sector plays a pivotal role in the establishment of the ABDM's comprehensive and interoperable digital architecture. The private sector has joined hands with the National Health Authority and is involved in the following ways:

- **Technology providers:** The private sector through "small start-ups" and "developers" is

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

involved in the development and implementation of the technology platform, and other innovative applications like the mobile apps, and web portals to ensure seamless implementation and reduce the chances of fraud and abuse

- **Health care providers:** Private health care providers, such as hospitals and clinics, are eligible to participate in the program and provide health care services to beneficiaries. They are required to follow the standard treatment protocols and the quality standards set by the National Health Authority. The private sector also plays a role in building the capacity of health care providers and improving the quality of care. This process is currently a bit slow with only 5 percent of private sector hospitals participating. Data security concerns relating to the use of sensitive and confidential data from HIV, AIDS, and TB patients, for example, there is a reluctance to participate in ABDM

- **Private insurance companies:** provide health insurance coverage, manage claims and the reimbursement process. They are selected through a bidding process and are paid a premium by the government for providing insurance coverage

Through a stakeholder engagement plan, the ABDM informs, communicates and problem solves with the private sector in an efficient and consultative manner.

Some of the key challenges faced under the ABDM include:

- **Uncertainty related to private sector engagement:** ABDM has provided guidelines for public-private partnerships. In this short implementation period, though the private sector and insurance companies have worked well within the ABDM network, there are some concerns on the inclusion of private sector beyond the technology related companies and startups. Clarity is needed on how to increase the engagement of private sector hospitals, and integration of small clinics and independent doctors into the ABDM ecosystem. While there are many advantages to the partnerships with technology companies and start-ups, there have been several implementation and technical challenges encountered. Some of these issues include data security, data privacy, and challenges integrating ABDM with private sector hospital software persists, incentives for the private sector to merge with the ABDM and the need for a legislative framework to ensure their cooperation in a national mission are required

- **Need to strengthen data privacy and cybersecurity across the ecosystem:** It is widely acknowledged that the program has strong multiple gateways to ensure data privacy and cybersecurity. At the entry point, the 14-digit UID format is the same for individuals, service providers and health

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

facilities. This format makes it difficult for hackers to penetrate; and even when a theft is successful it would be difficult to gauge the type of data. Additional steps that have been put in place include strong data privacy and cybersecurity laws and regulations that specify that health data should not be stored in a government owned cloud or server. The data stays at its original source and can be retrieved as and when needed, but only after obtaining the patient's consent. Despite all these robust data privacy and cybersecurity safeguards, there is concern among private sector service providers that the health insurance companies can still access patient information simply by virtue of being in the ecosystem, analyze disease trends, and then use this information to increase insurance premiums. To ensure additional safety, there is also a need to encrypt stored data, distribute this data across various independent servers to prevent the original sensitive data from being recovered by hackers and tag the encrypted data to ensure proper authentication and consent from the concerned authorities. Though the consent of an individual is being taken to access and store data it must be made mandatory, and additional consent needs to be taken to anonymize personal information so that it can be included in public datasets. The consent for sharing anonymized data needs to be taken at grassroots levels, such as at the health care facility, and service provider levels. These anonymized indices can then be made public to

help detect patterns, trends and used for other statistical analysis

- **Need for incentives to enhance compliance:** According to a recent report titled 'Leapfrogging to a Digital Healthcare System (FICCI, 2020)', it is estimated that there are over 500 software providers who provide HMIS software to hospitals and the adoption of EHR in India is less than 10 percent and is characterized by fragmentation and low digital penetration. Adopting ABDM requires doctors to write prescriptions on their laptops/computers/tablets, which is a huge behavioral change. Given the workload on them, incentivizing them to use computers and laptops is a big challenge that needs to be addressed through awareness campaigns. The same is true for other healthcare professionals like nurses, pharmacy etc. In such campaigns, efforts are being made to show the doctors and healthcare staff the advantages of ABDM: time saved due to prefilled prescriptions, ability to quickly look at records chronologically rather than *searching paper records*. To address this issue a Digital Health Incentive scheme has been developed to provide financial incentives to health facilities, diagnostic laboratories, and Digital Solution companies to enhance adoption of the ABDM

- **Need to address inequities:** In many hospitals, particularly small hospitals, there is lack of investment in computer hardware and digital storage space in health facilities, which are prerequisites for ABDM.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

At some remote places, internet connectivity issues also exist

- **Financial sustainability:** There is a perception that the ABDM is expensive, and it is not clear if the government can bear the cost of the entire program rollout, hence the financial sustainability of the program remains an area of concern

In short, additional work is needed to secure public trust for more citizens to continue to enroll into the program allowing it to reach critical mass and offer better value for money.

Advice for others

ABDM is an ambitious program that has the potential to revolutionize health care access in India. During its short implementation period, the mission has brought to focus several efficiency related concerns to the fore that create challenges the health system and were exacerbated by the pandemic. The program has been able to bring about large-service delivery reform and has overhauled the country's health care data systems. Some of the key lessons learned from ABDM's short implementation period include:

1. It is a voluntary scheme and relies on the trust and consent of its citizens. The mission is built on principles of fundamental rights and other legislation such as the IT Act 2008, and the Aadhar Act. The Digital Personal Data Protection Bill 2023, under discussion in the Parliament, will provide safeguards for personal data protection and processing. It is also informed by core democratic principles of cooperative federalism and is presided over by Supreme Court judgements

2. India has adopted an incremental and a phased approach to implement ABDM. This approach allows for feedback loops and lessons learned from each phase, are utilized, monitoring results and experiences of the early adopters for further improvements

3. Instead of one standardized, centralized system, a multi-stakeholder approach has been adopted and the national e-health system is flexible to adapt to the needs of the various stakeholders at all levels yet weaving them together under one common platform

4. A national strategy exists that guides the adoption and implementation of the Mission. This strategy is tailor-made for each region and considers their strengths, weaknesses and adapts well to areas which are remote and/or have poor digital connectivity. Furthermore, the strategy recognizes that digitization process will take many years and has scope to incorporate new advances in technology

5. The government has invested in establishing the required digital ecosystem, such as information system architecture, clinical coding and standards, process harmonization and information governance as a core foundation before moving on to the implementation of the technology

6. Instead of focusing on the development of an IT system, the digital health program is linked to the Primary Health Care system and focuses on the end goal of delivering quality health services for all. Changes are made to clinical protocols, institutional culture, and administrative workflows with digitalization

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM

7. A network of stakeholders across all the core components were engaged in the design and implementation of the ABDM using a public-private partnership model. Under this model, the roles and responsibilities of each stakeholder in the whole ecosystem are clear and well defined. Stakeholders include the government themselves, policymakers, private health providers, allied private entities like health technology companies, doctors, NGOs, and various administrators like program managers and regulators. This arrangement addresses some of the earlier challenges that the government had with the private sector regarding payments. The government, through the involvement of multiple stakeholders and the private sector, has now established effective payment mechanisms across the ABDM platform to reconcile bills and pay health care providers

8. Public-private partnerships with technology companies, startups and private hospitals are an integral piece of the ABDM's strategy to streamline health care processes. Technology companies play a pivotal role in innovation and the creation of new digital health solutions. The ABDM keeps the platform up to date which means it complements the private sector technology that plugs in to it. This technology is regularly updated and upgraded, but issues of data privacy and cybersecurity still need to be addressed from time to time. Newer technologies like Artificial Intelligence, the Internet of Things, Block Chain (Blockchain Technology can guarantee that the data that is

created is encrypted and cannot be altered), and Cloud Computing are also being explored to make the ABDM more efficient and effective. Unlike the partnerships with technology companies that are more well established, partnerships with private sector hospitals are still in their nascent stages and will continue to evolve with time.

9. The UIDs for individuals, service providers and health facilities are the key to interoperability across the entire digital health ecosystem. It also serves as the first step in ensuring data privacy. To further enhance security, the government has developed data management and sharing standards which are governed by a robust legal system

10. Under the ABDM, all digital services are available in various regional languages and have been designed in ways to make them accessible and user friendly

11. The government is currently working on a mass awareness raising campaign to promote the use of ABDM and generate demand

12. The expansion in health insurance coverage to reach over 500 million people makes PM-JAY one of the largest health insurance programs in the world. It is critical to providing financial protection for the economically weaker sections of the society in case of medical emergencies. It alleviates poverty stemming from high out of pocket health expenses. The scale of the program is extremely impressive and other countries have much to learn from this huge mobilization effort.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM
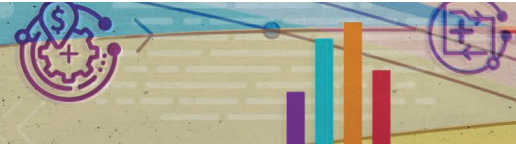
References

ABDM. (2023). Retrieved from https://abdm.gov.in/abdm.

ABDM Dashboard. (2023). Retrieved from https://dashboard.abdm.gov.in/abdm/.

Bajpai, N., Wadhwa, M. (2020). CSD Working Paper Series – India's National Digital Health Mission. In. Towards a New Indian Model of Information and Communications Technology-Led Growth and Development. Retrieved from https://csd.columbia.edu/sites/default/files/content/docs/ICT%20India/Papers/ICT_India_Working_Paper_36.pdf.

Bajpai, N., Wadhwa, M. (2020). India's National Digital Health Mission. ICT India Working Paper # 36. CSD Working Paper Series: Towards a New Indian Model of Information and Communications Technology-Led Growth and Development. Retrieved from https://csd.columbia.edu/sites/default/files/content/docs/ICT%20India/Papers/ICT_India_Working_Paper_36.pdf.

Bargnagarwala, T. (2022). How India is creating digital health accounts of its citizens without their knowledge. Retrieved from https://scroll.in/article/1031157/how-india-is-creating-digital-health-accounts-of-its-citizens-without-their-knowledge.

eSanjeevani website. (2023). Retrieved from https://esanjeevani.mohfw.gov.in/#/.

National Digital Health Mission. (2020). Strategy Overview Making India a Digital Health Nation Enabling Digital Health care for all. Ministry of Health and Family Welfare (MOHFW), Ministry of Electronics and information technology and national health authority. Retrieved from https://abdm.gov.in:8081/uploads/ndhm_strategy_overview_1aebd4820e.pdf.

National Health Authority. (2022). A brief guide on Ayushman Bharat Digital Mission and its various building blocks. Retrieved from https://abdm.gov.in:8081/uploads/ABDM_Handbook_19_10_2022_24c5078481.pdf.

National Health Authority. (2022). Draft Revised Health Data Management Policy. Retrieved from https://abdm.gov.in/publications.

PIB Delhi. (2022). Press Information Bureau (PIB), MOHFW. Government of India accessed on 20th Feb 2023. Retrieved from https://www.pib.gov.in/PressReleasePage.aspx?PRID=1884387.

Saha, P. (2020). India's National Digital Health Mission: A New Model to Enhance Health Outcomes. The Open Group. Retrieved from https://blog.opengroup.org/2020/08/19/indias-national-digital-health-mission-a-new-model-to-enhance-health-outcomes/.

Sharma, A. (2022). India's progress in digital health care ecosystem: Evolution of Policy regulations and future. Business World India. Retrieved from https://www.businessworld.in/article/India-s-Progress-In-Digital-Health care-Ecosystem-Evolution-Of-Policy-Regulations-And-Future/24-06-2022-433956/.

Sharma, R. S., Aishwarya Rohatgi, Sandeep Jain, and Dilip Singh. 2023. "The Ayushman Bharat Digital Mission (ABDM): Making of India's Digital Health Story." CSI Transactions on ICT, March. https://doi.org/10.1007/s40012-023-00375-0.

Singh, A. (2022). Strengthening Ayushman Bharat Mission through AI adoption. Centre for Strategic and International studies. Retrieved from https://www.csis.org/blogs/new-perspectives-asia/strengthening-ayushman-bharat-through-ai-adoption.

Sudan, P. (2022). A digital health revolution to empower citizens. The Tribune. Retrieved from https://www.tribuneindia.com/news/comment/a-digital-health-revolution-to-empower-citizens-373953.

DIGITAL-**IN**-HEALTH FLAGSHIP PROGRAM