Ayushman Bharat Digital Mission: India's Healthcare ODE

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Open Digital Ecosystems: The New Paradigm of GovTech

India is at the cusp of revolutionising the way digital platforms are created and deployed at scale. From Aadhaar for identity verification to Unified Digital Payments (UPI) for democratised payments and CoWIN for vaccination delivery, India has been at the forefront of building large scale digital platforms for transformative social, economic and governance impact. These digital platforms comprise foundational digital public infrastructure (DPIs), like Aadhaar and UPI, as well as digital public goods (DPGs) like FHIR standard, Beckn protocol, DIVOC software etc. DPIs and DPGs are key to creating 'digital ecosystems' that have the potential to transform public service delivery at scale and bring significant efficiency gains across sectors in the economy. Examples of such digital ecosystems in India include the Ayushman Bharat Digital Mission (ABDM) for healthcare, National Digital Education Architecture (NDEAR) for education, Open Network for Digital Commerce for democratising e-commerce, and more.

Taking the digital ecosystem discourse a step further, the Open Digital Ecosystem (ODE) approach is a unique concept that builds on the potential of DPIs and DPGs, while giving equal primacy to the 'non-tech' layers of governance and community beyond these 'tech layers'. Put simply, an ODE is an ecosystem of digital public infrastructure and digital public goods where the potential of technology is bolstered through institutional support, robust governance structures and sustained community engagement to provide citizen-centric services at speed and scale.[1] A report by Omidyar Network India (ONI) and BCG estimates that 10 potential National Open Digital Ecosystems (NODEs) can collectively create an economic value of USD 500+ billion ~equivalent to 5.5% of India's GDP; and generate USD 200+ billion in savings.

Impact potential of Open Digital Ecosystems (ODEs): Examples

Agriculture: India Digital Ecosystem of Agriculture (IDEA) Framework

The IDEA Framework is a digital ecosystem for end-to-end delivery of services to farmers. To cite an example of how this can benefit the end user, consider the example of Raju - a small farmer in India. Raju needs to furnish a number of documents such as land records, crop history data, etc. to be able to get a loan. Given the fragmentation in marketplace services and procedural delays, gathering these documents requires several visits to the local government office and results in lost time and wages. With the IDEA framework all these services can be brought together and Raju can visit his nearest Common Service Centre (CSC) to remotely access the one stop lending portal, check for available loan offers and select the appropriate loan for his requirement by simply providing his Unique ID/Aadhaar information. The IDEA framework can facilitate the exchange of relevant information to enable the entire process.

Skilling: DESH Stack

Akin to the agricultural sector, the present skilling and jobs ecosystem is ridden with friction. In order to access even basic services like job search and skill verification, a job seeker needs to visit multiple online portals. This is mainly due to the lack of a single source of information on the availability of job opportunities and training programs. DESH Stack is an e-portal that provides skilling, upskilling and reskilling opportunities as well as allows candidates to discover relevant jobs through API-based platforms. An open digital platform that connects employers with job seekers and training institutes with skill seekers can help match the supply and demand efficiently, leading to benefits for all stakeholders. Such a platform can also provide the job/skill seekers access to counselling and funding options, thereby allowing them to plan better.

[1] https://www.opendigitalecosystems.net/about.html

Over the last few years, several papers have attempted to bring structure to the concept of digital ecosystems by breaking down the technical aspects, outlining governance mechanisms, exploring funding models, identifying ways to involve the community, etc. Examples of such initiatives include the India Digital Ecosystem Architecture 2.0 paper by MeitY, Strategy for National Open Digital Ecosystems (NODEs) consultation whitepaper by MeitY, Building Digital Highways: Potential of Open Digital Ecosystems (ODEs) report by Omidyar Network India (ONI) and BCG, and Widening India's Digital Highways: The Next Frontiers for ODEs report by ONI.

A common thread in all these papers is the importance given to building a holistic digital ecosystem that lays emphasis not only on the tech elements, but also the 'non-tech' elements of governance and community. This aspect has especially been stressed upon in the Strategy for NODEs consultation paper by MeitY and the ONI-BCG report on Building Digital Highways. Drawing from these resources, this case study maps ABDM against 15 principles (figure 1) that underpin a robust ODE. These principles are mapped across three layers - **technology, community and governance** - which are defined in the following manner:

- **The technology layer** refers to creating and leveraging digital platforms to develop new and inclusive user-facing solutions. This layer includes components such as data registries, core application software, open APIs, and open standards and protocols.

- **The community layer** represents the vibrant community that is the driving force behind ODEs. This includes builders (public and private institutions, start-ups, developers), end-users (consumers of the digital services) and facilitators (private and public entities that finance development, drive adoption, ensure last-mile access and maintain oversight).

- **The governance layer** refers to the framework that establishes the rules of engagement between stakeholders, ensures institutional accountability, transparency, and enables fair and equitable access and outcomes for all stakeholders.

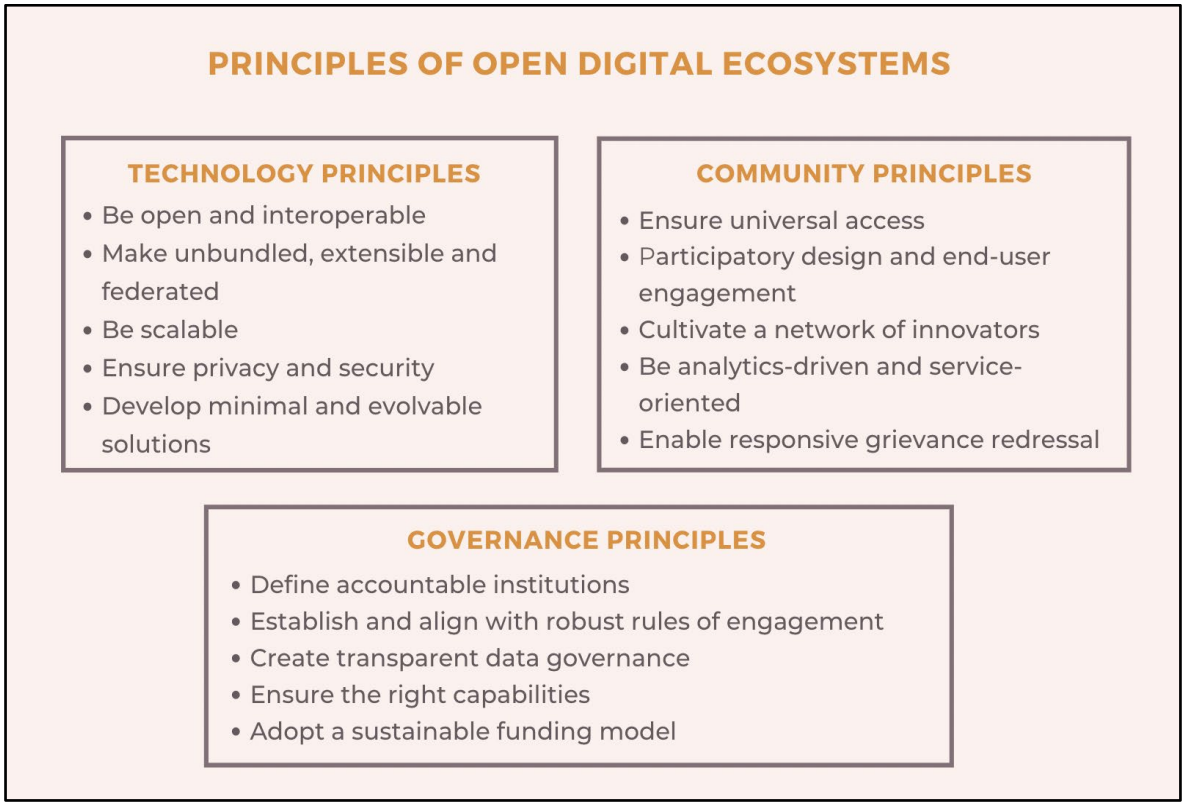

Figure 1: ODE Principles

Implementation Blue Book for building ODEs

Given the rapid pace at which digital public infrastructure is being developed in India and globally, *The Quantum Hub (TQH)* has developed an *'Implementation Blue Book'* for building ODEs. In addition to identifying best practices, this blue book presents a detailed framework outlined as a checklist (see table at the end of this case study) to help practitioners from within the government, as well as non-government stakeholders, operationalize the key principles and design elements that characterise robust ODEs. The hope is that this framework will assist the many actors involved in the development of ODEs to systematically assess design choices and adopt best practices to realise the benefits of the ODE approach while mitigating potential risks. The framework envisages the following key characteristics for ODEs:

- **An 'ecosystem' approach to public service delivery** that takes a holistic view of the many elements in the ecosystem including their interlinkages, rather than the traditional 'monolithic tech systems' approach.
- **Government as an enabler and regulator** rather than the end-to-end service provider, with a focus on creating the minimal base digital infrastructure layer to enable innovators to build solutions on top.
- **Collaboration between the public and the private sector** for designing demand driven citizen-centric solutions rather than provider driven solutions.
- **Empowered community of users and innovators** with tools to participate in the new digital ecosystems, and demand accountability.

While the 15 design principles (figure 1) provide high level guidance, the implementation blue book is meant as a 'how to' guide to help ODE builders put these principles into practice. It unpacks these 15 principles that have been drawn from the reports referenced earlier and breaks them down to identify specific design choices, recommendations and best practices to inform the design and implementation of ODEs. The blue book can be utilised by a broad range of stakeholders including the institutions building ODEs, policymakers responsible for setting up the governance mechanisms, and civil society actors looking to strengthen delivery of public services through digital platforms.

Consider the example of a state government IT department that is tasked with building a State Service Delivery ODE. In such a case, this implementation blue book can assist the department in building the required features for operationalizing the 15 principles. For instance, to operationalize the principle concerning privacy and security, the blue book helps practitioners incorporate access controls, end-to-end encryption and anonymization; minimal data collection; full disclosure, purpose limitation; and seeking meaningful consent which is free, informed and specific, easy to withdraw and unambiguous. **Bringing in this level of specificity, the blue book serves as a comprehensive framework for policymakers and ODE builders to identify specific provisions that must be built into ODEs to protect rights of users, create accountability, drive adoption, incentivize innovation and ultimately deliver citizen-centric services.**

The case study that follows seeks to map the Ayushman Bharat Digital Mission architecture against the implementation blue book to understand how ABDM is being operationalized as an ODE. This can aid in identifying ABDM's many strengths and help map areas of improvement, while presenting an important use case for other emerging ODEs.

Ayushman Bharat Digital Mission: Overview

The ABDM is envisioned as an 'ecosystem' that creates a "holistic, comprehensive and interoperable digital architecture" to support universal health coverage in an "efficient, accessible, inclusive, affordable, timely and safe manner."[2] The core idea behind the framework is to encourage collaboration between public and private stakeholders and leverage digital infrastructure to provide better healthcare facilities to people.

The National Digital Health Blueprint outlines the architecture, core principles, building blocks, standards and regulations that govern the digital health ecosystem. It seeks to develop building blocks like Health Registries,[3] unique Ayushman Bharat Health Account (ABHA) numbers,[4] Health Locker,[5] Health Information Exchange and Consent Manager (HIE-CM),[6] among others. These building blocks form the **National Health Stack (NHS),** which refers to the basic infrastructure layer of ABDM.

Ayushman Bharat Digital Mission: The core idea

Currently, the healthcare system in India is riddled with complexities. The absence of an interoperable platform to facilitate sharing of health records across different stakeholders in the health ecosystem means that health data in the country continues to exist in silos and remains unusable. At an individual level, this results in patients finding it difficult to avail medical assistance in an easy and seamless manner; and at an aggregate level, disconnected datasets hinder research and disease surveillance efforts of the government.

By enabling seamless exchange of health records (with consent) across different Health Information Providers (HIPs)[7] and Health Information Users (HIUs),[8] the ABDM framework seeks to streamline the health data ecosystem in the country. This means that when a patient visits a healthcare facility, an Electronic Medical Record (prescription, lab report, etc.) of the patient is generated and stored securely in the health locker linked to the patient's unique ABHA number. Over time, these Electronic Medical Records get tied together to form a longitudinal Electronic Health Record of the patient. This comprehensive health record of the patient can then, at the request of the patient, be shared with healthcare providers, insurance providers, banks and financial institutions, etc. to avail better and more customised services. Further, at an aggregate level (without individual identifiers), standardised health data can become an invaluable resource for health research in the country.

The ABDM ecosystem (comprising the NHS along with the rest of the digital health ecosystem) seeks to provide a holistic environment for different stakeholders to come on board and build products and services on top of these building blocks. Keeping user-wellness at the centre of the ABDM framework, all the building blocks and applications are governed by principles such as being wellness-centric, inclusive by design, ensuring security and privacy of data, etc. Since many of these principles and ideas are closely aligned with the ODE framework, **ABDM can be considered India's Healthcare ODE.**

[2] India.gov.in. 2021. Ayushman Bharat Digital Mission (ABDM) | National Portal of India. [online] Available at: <https://www.india.gov.in/spotlight/ayushman-bharat-digital-mission-abdm>

[3] Health Registries refer to the master data of all the entities in the ecosystem, including doctors, hospitals, clinics, laboratories, pharmacies, and insurance companies.

[4] ABHA number is a randomly generated 14 digit number used for the purposes of uniquely identifying persons, authenticating them, and threading their health records (only with their informed consent) across multiple systems and stakeholders.

[5] Health lockers enable patients to store a copy of their digital health records through their lifetime safely in their own cloud store.

[6] The Health Information Exchange would be responsible for authentication and authorization of all data exchange requests and, if authorised, for routing the request to the providing applications.

[7] Health Information Provider (HIP) is any entity that creates health information pertaining to a user and is ready to share it digitally with users by adopting compliant software.

[8] Health Information User (HIU) is any entity that intends to view health records of an individual, with their informed consent using compliant software.

Ayushman Bharat Digital Mission: India's Healthcare ODE

This section is divided into three layers - Technology, Community and Governance. Under each of these layers, the case study will map the relevant elements of the ABDM framework against the principles and sub-principles in the implementation blue book to highlight the elements of ABDM that are already in line with ODE principles and comment on the ones that are not. As ABDM is not a monolith, but an aggregation of the various building blocks, we will be mapping the more developed building blocks against the principles and sub-principles in the implementation blue book (like ABHA, UHI and HIE-CM), and will also clearly delineate which building block we are referring to during the mapping. The objective of this exercise is to acknowledge the strengths of ABDM as well as map areas of improvement.[9]

Technology layer

Healthcare is a sector riddled with complex processes involving multiple stakeholders and touch points. This merits the creation of public infrastructure and regulatory frameworks to govern the ecosystem in an effective manner. As laid out in the NDHB, there are certain fundamental **technology principles** and **domain principles** at the centre of the ABDM framework. While the **technology principles** emphasise the **need for platforms to be interoperable, conform to open standards, be based on open-source software and adopt open API**, the **domain principles** of ABDM **outline the importance of the ecosystem to be inclusive, wellness-driven, ensuring security and privacy by design**.

Openness and Federated Architecture

The NDHB envisages that all the building blocks in ABDM will adopt the **Policy on Open Standards and Open Source Software,** and the **Open API policy** notified by MeitY. The ABDM Blueprint recommends the gradual adoption of internationally recognised open health standards such as **FHIR Release 4[10], SNOMED CT[11]** and **LOINC[12]** by the Health Information Providers (HIPs) in the ecosystem. The source codes for HIU and HIP components are also available on GitHub. Further, the Unified Health Interface (UHI), envisaged as an open and interoperable IT network for digital health in India, has openness at the heart of it. It also goes a step ahead and invites the developer community on GitHub to contribute to the open code and help refine existing protocols as well as build new protocols currently not part of UHI.

National Health Stack: Open-source framework

In July 2018, NITI Aayog released a Strategy and Approach document on the National Health Stack (NHS) that outlined a framework for designing a set of core building blocks related to health to "achieve convergence among the IT systems of the diverse stakeholders such as the Governments, the Payers, the Providers and the Citizens." By making it open source, it aimed to ensure flexibility in feature enhancements, giving full code control to program implementers, avoiding vendor lock-in, and allowing third party entities to build solutions on top of the platform. Source code for components like Consent Manager, Health Information User (HIU) and Health Information Provider (HIP) can be found under ProjectEKA[13] on GitHub. Project EKA is MIT licensed, which is a permissive licence (a type of open licence). This allows users to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software. The source code for UHI is also available on GitHub, and this also has a permissive license.

[9] This section will map the more well developed components of the ABDM framework against some of the elementary principles and sub-principles of the Implementation Blue Book. A comprehensive mapping of the ABDM framework against all principles and sub principles of the Blue Book is provided in a table at the end of this case study.
[10] Standard for clinical information exchange
[11] Standard for clinical terminology
[12] Standard for observation, measurement, test-panels, test items and units
[13] Project EKA is an endeavour to create reference solutions for exchanging patient health information upon patient's consent in Indian Healthcare context. The architecture and solutions are largely inspired by the proposed National Health Stack (NHS)

The ABDM framework, through the health records building block, also underscores the importance of adopting a **federated architecture** and the need for a **minimalist approach** while designing the building blocks. The ABDM federated health records system enables the patients' records to be stored at the local facility level, whose access can be given to health care providers through the appropriate gateways. As long as the entities (health care providers and users) adopt software/application that is compliant with ABDM standards, data can be rapidly shunted across the digital health ecosystem in a seamless manner. As seen in figure 2, all the digital health data is held in a decentralised manner across three levels - **National, State** and **Facility.** Even as health data is stored at **one level**, termed as the System of Record (SoR), the other levels are provided with selective access to the same as and when required. Further, each level has four layers that consist of **replaceable** and **extensible** building blocks that can be loosely coupled when building applications. For example, Consent Manager is a building block that can be repurposed across applications to ensure that the data flows only with the free and informed consent of the data principal. A minimalistic approach is followed while developing these building blocks as it gives flexibility to modify them based on user experience. This helps **scale the solution horizontally and vertically** in an agile manner.

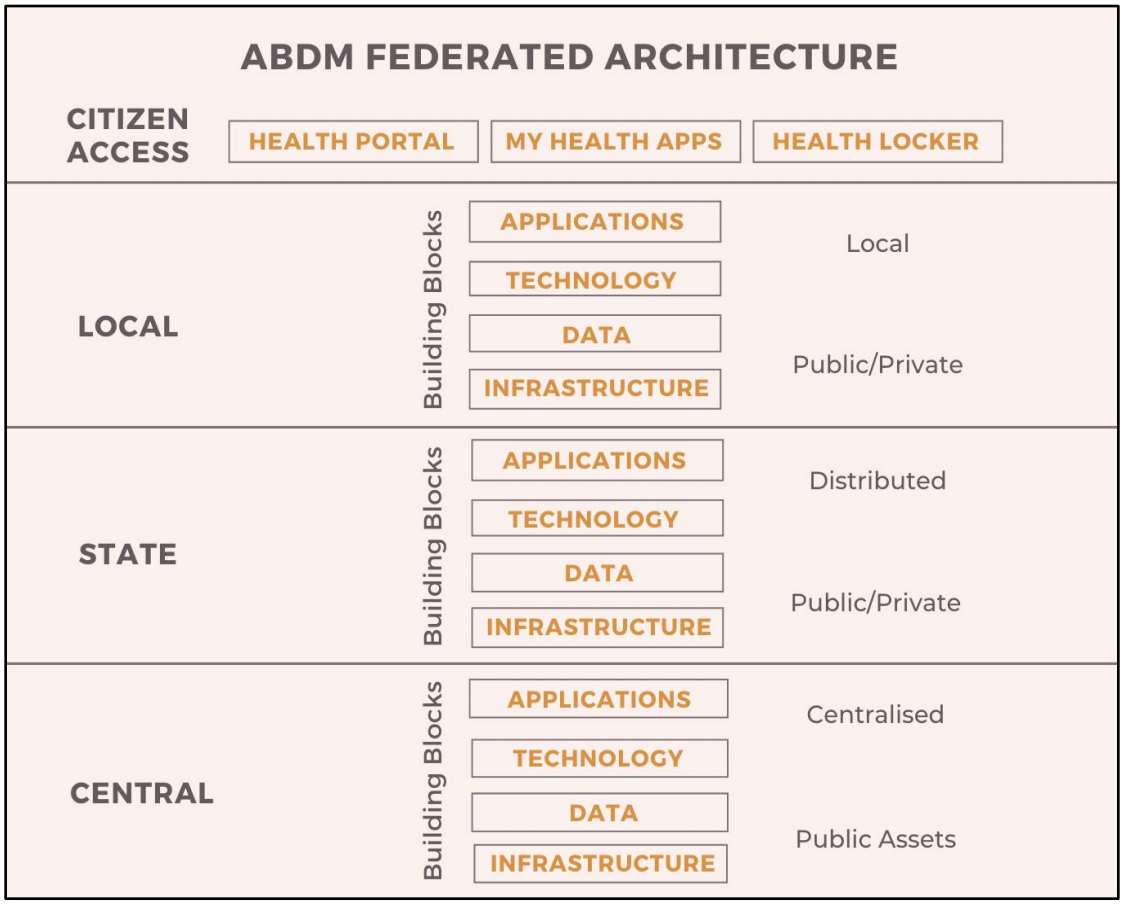

Figure 2: Federated Architecture of ABDM

Privacy and Security

Given the large amounts of data being collected, stored and processed within the ABDM ecosystem on a routine basis, it becomes necessary to ensure that it is being handled in a safe and secure manner. This is crucial to prevent data leaks, minimize misuse of data, and engender trust in the ecosystem. To this end, ABDM seeks to create building blocks such as **Consent**

Manager,[14] **Anonymizer**[15] and **Privacy Operations Centre**[16] to put in place mechanisms to maintain the confidentiality, security and privacy of health data. The Consent Manager places the data principal in complete control of their data; the Anonymizer removes all personally identifiable information before sharing the data; and the Privacy Operations Centre monitors the overall process to enhance trust in the system. While modules such as the anonymization-as-a-service are not yet developed, the future Data Protection Bill is expected to set the standards and provide a framework for such anonymization procedures.

In December 2020, the government approved the **National Health Data Management Policy,** which was revised again in April 2022. The Policy lays down the guiding principles of the *Security and Privacy by Design* element under ABDM and provides detailed guidelines for **data minimisation**, **purpose limitation**, **collection**, **use and storage limitation**, and **informed and free consent for data-sharing**. It also mandates data fiduciaries to **"maintain accurate and up-to-date records** to document the important operations in the data lifecycle including collection, transfers, and erasure of personal data." This would help in tracking a record's complete journey from the original source of the data to the details of the subsequent modifications by individuals/entities handling the data. The document also outlines the various rights of the Data Principals including the manner of consent being given, knowing who can access their data, and the right to opt out of the Ayushman Bharat Digital Health Ecosystem (deleting their ABHA number and de-linking their personal data across data fiduciaries). The NHA also released a Consultation Paper on **Health Data Retention Policy** that lays down guidelines for data retention by health facilities and seeks to ensure that data retention guidelines are in sync with all applicable legal and regulatory compliances.

Unified Health Interface: Interoperability with consent

Consider the case of Juhi, a 54 year old patient who wishes to consult an orthopaedist. Ideally, Juhi should approach a doctor with her entire medical history and with all her previous health records available for ready reference. Unfortunately, this becomes a challenging task in the current scenario because a person's health records are not consolidated in one place; healthcare databases across hospitals/ applications are fragmented with health records existing in silos.

ABDM seeks to make health record-keeping and access seamless by integrating the different platforms into one ecosystem. It envisions the creation of a **Unified Health Interface (UHI),** an open protocol that facilitates interoperability of health data across the ecosystem in a smooth manner. It seeks to provide an end-to-end framework for data exchange where people can avail Service Discovery, Service Booking, Service Fulfilment, Financial Settlement and Post Fulfilment from any app of their choice using the UHI Network. It **is envisioned to be similar to the Unified Payments Interface (UPI), where UHI will form the foundational infrastructure layer and private service providers can build on top of it.** To ensure data security and privacy, the UHI network uses other ABDM building blocks such as the **Health Information Exchange & Consent Manager** to allow exchange of health records between entities, only with the free and informed consent of the patient.

With this infrastructure in place, Juhi can now use any app of her choice to find a doctor (by using core registries like the Healthcare Professionals Registry[17] and Health Facility Registry[18]), book an appointment and make the payment. Thereafter, **she will get a consent request for access to her health records**. If she accepts the request, the health records associated with her ABHA number will be shared with the corresponding doctor. Through this process, Juhi can connect with her

[14] The goal of the Consent Manager is to ensure that the citizen/ patient as the data principal, is in complete control of what data is collected, and how/with whom it is shared and for what purpose, and how it is processed.
[15] The Anonymizer takes data from the Health Locker and/or other health data sets, removes all personally identifiable information to protect privacy and provides the anonymized data to the seeker.
[16] Privacy Operations Centre (POC) monitors all access to private data, reviews informed consent artefacts, audits services for privacy compliance, and seeks to establish trust and strategic control in the usage of health data in the ecosystem.

[17] Healthcare Professionals Registry is the master data of information on doctors, nurses, paramedical staff, ASHAs and other healthcare professionals cadres.
[18] The Health Facility Registry will consist of one record and a unique identifier for each healthcare facility in the country – hospitals, clinics, diagnostic centres, pharmacies etc, across all systems of medicine and covering both public and private health facilities.

orthopaedist at a mutually decided time, in a transparent and efficient manner, while retaining complete control over who can access her personal information.

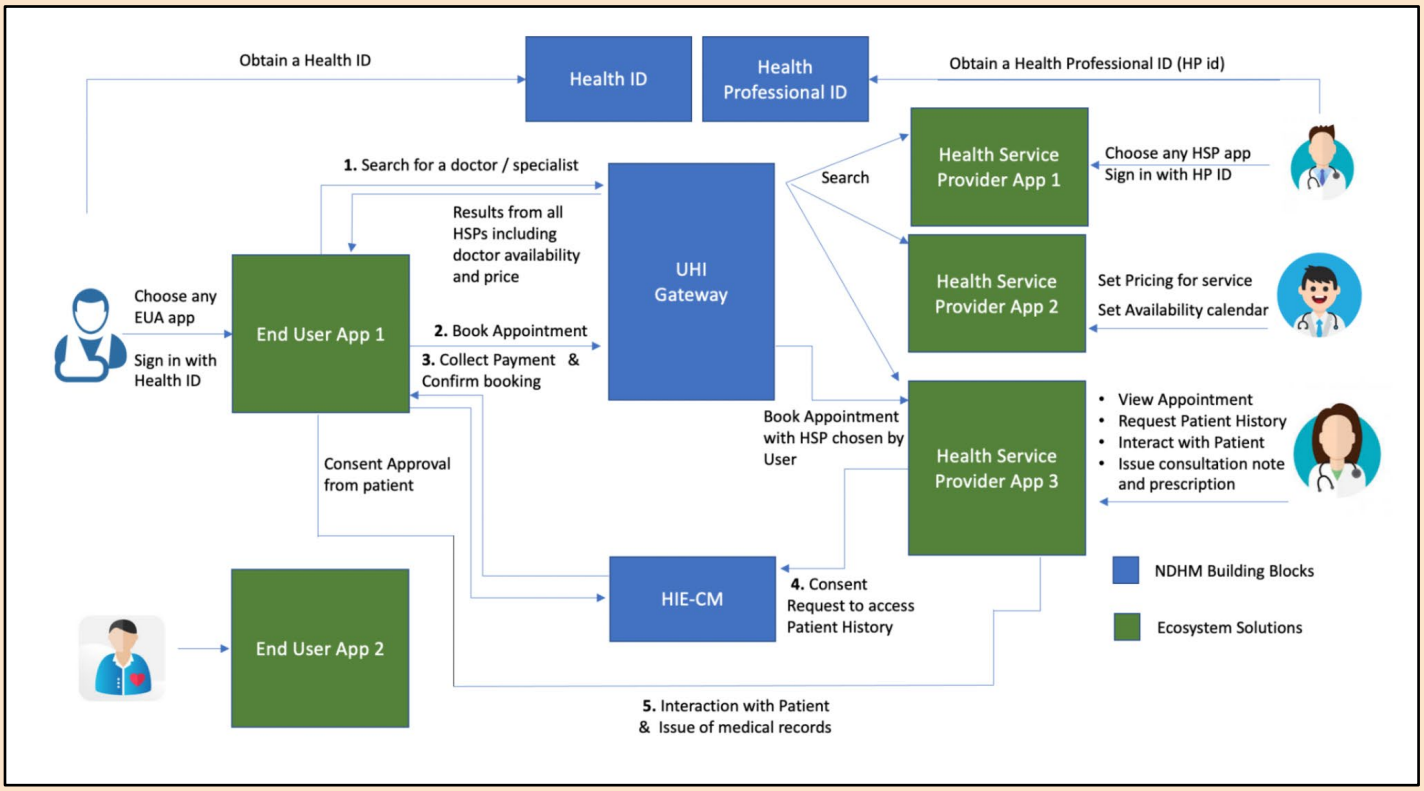

Figure 3: UHI Protocol for Teleconsultation (Source: UHI Consultation Paper)

Consent

While the ABDM consent framework seems comprehensive otherwise, some instances suggest gaps in the consent architecture. Consider the case of CoWin[19], for example. Several people took to social media when they noticed that their vaccine certificates contained a unique ABHA number, implying that their vaccination registration was used to create a UHID without explicit and specific consent from the beneficiaries.

As ABDM develops, it would be important to ensure that it has robust and enforceable consent mechanisms in place, and that beneficiaries understand the contents (and implications) of any privacy/ consent policy. While this is not the most straightforward task, and experts around the globe are grappling with the issue, there has been some encouraging research recently. A study by Centre for Social and Behaviour Change at Asoka University[20] found that consent can be more informed by employing behavioural nudges such as requiring the reader to stay on the terms and conditions page for a few minutes or

[19] CoWIN is a web portal for COVID-19 vaccination registration, owned and operated by the Ministry of Health and Family Welfare.
[20] Centre for Social and Behaviour Change and Busara Center, 2020. Behavioural Experiments in Data Privacy. [online] Available at: <https://busaracenter.org/report-pdf/InAct_Report.pdf>

creating a 'privacy rating' that can help citizens understand the consent framework better to make informed decisions. Awareness campaigns and stronger outreach initiatives to educate the masses also seem to make a difference.[21,22]

Community layer

Inclusivity

The need for inclusivity in providing digital healthcare services in a country with a large digital divide cannot be emphasised enough. Developing a digital ecosystem for healthcare undoubtedly brings immense benefits, however, it can also lead to greater exclusion due to low digital literacy, lack of internet connectivity, complicated app interfaces and rigidity in platform design (read: absence of vernacular language translations, lack of an offline alternatives, etc.). Hence, it is imperative to design **inclusive systems** to mitigate these risks and ensure that the vulnerable sections of the society are not left out of these digital ecosystems.

Accessibility

ABDM recognises this aspect and has several mechanisms in place to ensure that the framework is inclusive in nature. It envisions the **ABDM building blocks to be user-friendly and simple to use** so that citizens can access them without any training. While the NDHB does not explicitly state that a user-friendly UI/UX will be designed for easy access and navigation, it seeks to follow a **people-centric approach** for all applications and give adequate weightage to end-user comfort when developing and upgrading systems.[23] However this vision has not completely translated to improved accessibility features in ABDM components. For example, as per the reviews on Google Play Store, the ABHA App (app for creation of Health IDs) has issues that prevents users from completing their profile, uploading documents, verifying OTP, etc.

ABDM also aims to develop specialised systems to **extend the ABDM framework to the digitally illiterate residing in remote and hilly areas**.[24] This includes the usage of mobile phones, call centres, common service centres and social media platforms to extend services. Given the rapidly expanding smartphone coverage in the country, ABDM seeks to adopt a '**Mobile First**' principle whereby all digital services will be designed such that they can be delivered through smartphones.[25] In line with this principle, NHA recently launched a mobile application which allows users to create their ABHA address (an easy-to-remember username linked to their ABHA number) as well as access their health records anytime (Figure 4).[26] Going forward, it also seeks to develop a **voice-based service in vernacular languages** to overcome the language barrier.[27] While these are steps in the right direction to mitigate the exclusion risk, the framework is still at a nascent stage and it remains to be seen whether these steps are implemented in spirit going forward.

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[21] Centre for Social and Behaviour Change and Busara Center, 2020. Behavioural Experiments in Data Privacy. [online] Available at: <https://busaracenter.org/report-pdf/InAct_Report.pdf>

[22] Pande, V. and Bhadra, S., 2021. Privacy policies online are illegible, and 'consent' is broken. New ideas are needed. The Indian Express, [online] Available at: <https://indianexpress.com/article/opinion/columns/privacy-policy-online-consent-illegible-7150434/>

[23] 2019. National Digital Health Blueprint. [online] Ministry of Health and Family Welfare, Government of India, p.10. Available at: <https://main.mohfw.gov.in/sites/default/files/Final%20Report%20-%20Lite%20Version.pdf>

[24] 2022. National Digital Health Mission: Strategy Overview. [online] National Health Authority, p.7. Available at: <https://old.abdm.gov.in/publications/ndhm_strategy_overview>

[25]2019. National Digital Health Blueprint. [online] Ministry of Health and Family Welfare, Government of India, p.10. Available at: <https://main.mohfw.gov.in/sites/default/files/Final%20Report%20-%20Lite%20Version.pdf>

[26]Ministry of Health and Family Welfare, 2022. National Health Authority announces revamped ABHA mobile application to manage health records under Ayushman Bharat Digital Mission. [online] Available at: <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1827816>

[27] 2019. National Digital Health Blueprint. [online] Ministry of Health and Family Welfare, Government of India, p.26. Available at: <https://main.mohfw.gov.in/sites/default/files/Final%20Report%20-%20Lite%20Version.pdf>

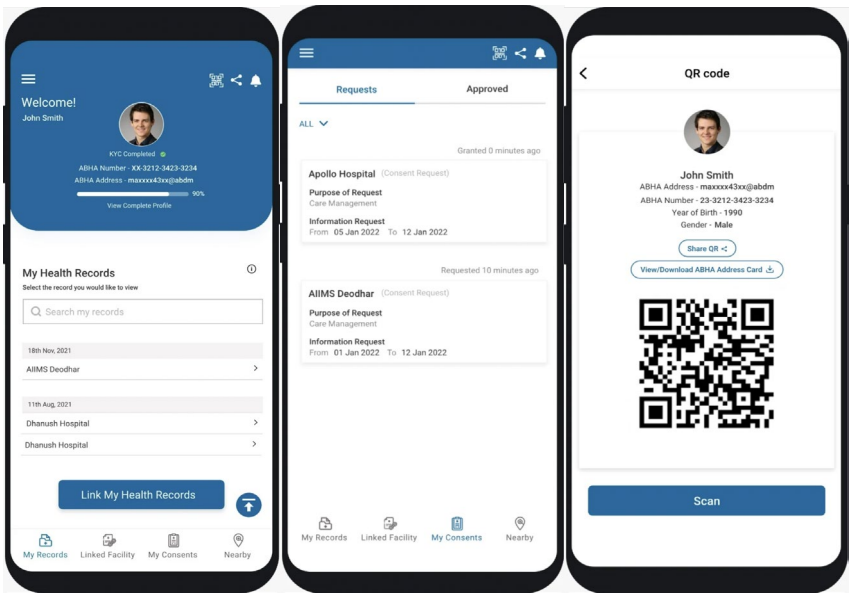

Figure 4: ABHA app interface

Best Practices

Assisted Digital: A step towards an inclusive digital system in the UK

As a part of the Government Digital Strategy, the UK government launched Assisted Digital – an initiative to support those who are not as comfortable with the internet to ensure that they are not excluded from digital services. As more and more government services move towards a digital-by-default design, the need for an initiative like **Assisted Digital** becomes imperative. This initiative in the UK seeks to enable 'offline' people to *"access a service face to face, by phone, or in another appropriate non-digital way, with someone either inputting the data on their behalf, or helping them put their data into the digital service themselves."*

Since the offline delivery mode for different digital services may vary based on the type or the age demographic of the audience, the UK government aims to develop a few common models of offline delivery of services based on the category of services/type of audience. Thereafter, all government departments would be required to adopt these common models to ensure cross-departmental consistency in service delivery. The government is also developing a dedicated Digital Programme Team to ensure cooperation and collaboration across different government departments to ensure that the execution is smooth and efficient.

Fostering Community Involvement

In addition to designing inclusive systems, there is a need to **educate and empower citizens** on the various benefits and opportunities of ABDM since this plays a major role in driving its wide-scale adoption. There is also a need for the government to proactively engage with the builder/developer community to foster innovation. The NHA has been actively engaged on this front. To cite an example, after NHA completed the consultation process that sought public feedback on the technical and functional design elements of UHI, it announced that the Decentralised Health Protocol (DHP) will be adopted as one of the core protocols of UHI. Envisioned as an open protocol to bring interoperability into the health ecosystem, the NHA then

invited developers to further contribute to the protocol which was hosted on GitHub for public review and contribution.[28] This is a welcome approach as involving the community in deciding technical specifications and protocols can go a long way in not only enhancing public trust in these systems, but also reduce hiccups at advanced stages of implementation.

The NHA also conducts innovation challenges like Healthathon 2020, ABDM Hackathon Series and the recent Kickstarting UHI Hackathon, to drive innovation and ideation in the digital health ecosystem. Along with webinars and open house discussions to appraise the public of the architecture of ABDM, NHA is also hosting conventions and inviting Expressions of Interest (EoI) from stakeholders to develop innovative solutions in the digital health space. Going forward, there is a plan to focus on **development, beta testing before going live for all ABDM components**. However, the extent of community involvement in these initiatives remains to be seen.

While both the NHA and the Ministry of Health and Family Welfare have made substantial progress in involving developers and innovators in the developments of ABDM, the success with respect to onboarding of private health facilities and health professionals have been less emphatic. For example, as of 7 July 2022, out of the approximately 1 lakh health facilities registered under ABDM, around 97% were government facilities. Furthermore, only 43,236 doctors[29] (out of an estimated 13 lakh doctors in India[30]) have registered with ABDM. A common suggestion to improve uptake of ABDM has been to consider selective tie ups with health facilities based on selective specialties of those facilities.[31] Furthermore, given the paucity of time availability for healthcare professionals, creators of software solutions like HMIS should ensure they create the easiest to use software with least data entry requirements and include solutions like voice to text conversion, auto complete, predictive text etc.

Paytm: India's largest consumer platform to create ABHA numbers

In December 2021, Paytm announced that it made the necessary integrations in compliance with the terms set out by the NHA to allow people to create their ABHA numbers through the Paytm application. By creating their ABHA numbers, people will be able to book tele consultations, upload and retrieve diagnostic reports, and organise their other health information in their unique health locker, all within the Paytm app. Leveraging the UHI framework, Paytm also launched a Health Storefront that aggregates all the health service providers under one umbrella so that people can choose and contact their doctors, pharmacies, diagnostic centres and insurance providers with ease. The company aims to enable over 10 million people to create their ABHA numbers within six months of its launch.[32] As of June 2022, there are 40 health service applications that have been on-boarded by ABDM, with another 867 currently in the ABDM Sandbox stage.[33] Going forward, we can expect more such companies to come on board and leverage the ABDM ecosystem to provide services to people.

Engaging with the Developer Community

The **ABDM sandbox environment** (explained in Figure 5) provides opportunities for developers to test new solutions. This is a good way to engage the developer community. The government has also previously released information in the open domain to seek feedback and design product improvements. For instance, when the Aarogya Setu app was launched during the COVID-19 pandemic to facilitate contact tracing, the government released its source code and launched a bug bounty program to identify

[28] National Health Authority, 2021. Decentralised Health Protocol to form the core of the Ayushman Bharat Digital Mission's (ABDM) Unified Health Interface (UHI). [online] Available at: <https://old.abdm.gov.in/assets/images/media/press_releases/DecentralizedHealthProtocol.pdf>
[29] As of 29/9/2022.
[30] https://www.youtube.com/watch?v=tKIn0ahi_OA at 12:00- Dr. Ambrish Mittal speaking at NHA's Aarogya Manthan event.
[31] https://www.youtube.com/watch?v=tKIn0ahi_OA at 21: 50- Dr. Praveen Gedam speaking at NHA's Aarogya Manthan event.
[32] LiveMint, 2021. Paytm users can now create their Health ID. [online] Available at: <https://www.livemint.com/technology/paytm-users-can-now-create-their-health-id-know-its-benefits-11640596211499.html>
[33] The Economic Times, 2022. 40 digital health service applications successfully integrated with Ayushman Bharat. Available at: <https://health.economictimes.indiatimes.com/news/health-it/40-digital-health-service-applications-successfully-integrated-with-ayushman-bharat-digital-mission-abdm/91504390>

vulnerabilities in the source code. Instituting such **periodical bug bounty programs** can help enable improvements in the platform's performance and reduce future risks. Going forward, it will be important to have mechanisms in place to collect feedback from end-users to gauge adoption barriers and involve builders to help improve system performance. The proposed **National Health Analytics Platform,** which seeks to measure and publish performance of different stakeholders in the ABDM ecosystem through real-time monitoring and visualisation tools, is a welcome step in this regard. Through the **Health Analytics** building block, the aggregated datasets can be used to advance medical research and improve health outcomes. Furthermore, NHAs Value Based Incentive system[34], provides an opportunity for monitoring of factors like quality of treatment and care, patient satisfaction etc. through public dashboard, self-reporting by patients etc. Going forward, it would also be a good practice to **proactively publish these non-sensitive and non-personal health datasets in a machine-readable format on an open platform** to encourage more wide scale access and use of health data.

ABDM Sandbox: A tool for innovation

A sandbox is a controlled environment that allows live, time-bound testing of innovations under a regulator's oversight. Allowing innovators to test their new products/services before rolling them out can help improve business models, reduce time to market and generate buy-in for newer, more radical ideas. Sandbox testing can also benefit the government by allowing regulators to mitigate future risks by working with innovators, thereby giving them a ring-side view of potential problems.

The ABDM Sandbox is a framework that allows live testing of technologies or products in a secure environment (in compliance with the standards and regulations set out by ABDM) to accurately ascertain consumer and market reactions to the product/service being provided. The primary objective of the Sandbox is to **"foster integration of current systems and IT platforms in healthcare to be integrated with ABDM building blocks, and also enable responsible innovation in health tech services, promote efficiency and bring benefit to consumers."**

ABDM Sandbox Process

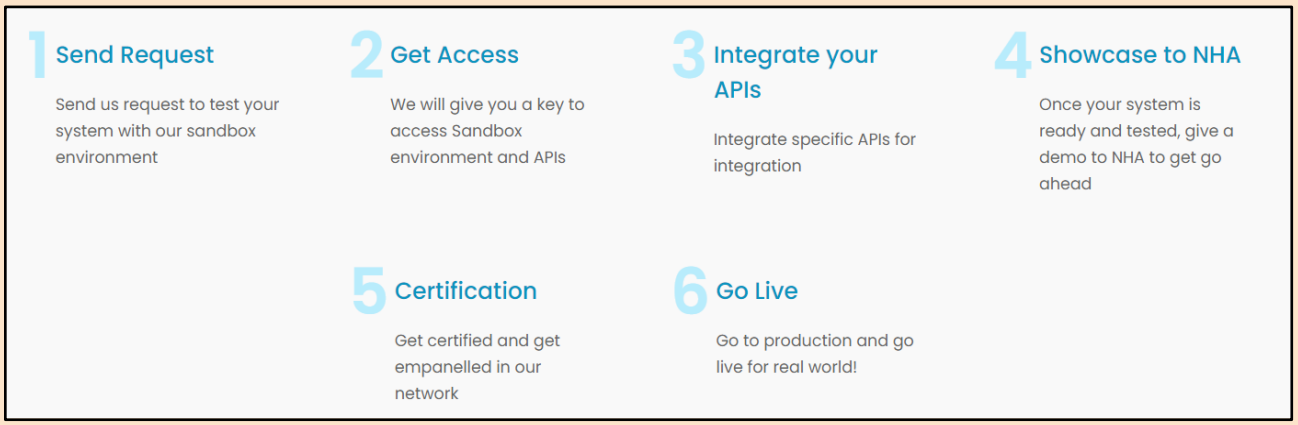

Figure 5: ABDM Sandbox Process

Grievance Redressal

Since any delivery of healthcare services is likely to involve large amounts of personally identifiable data, it will also be important to have online and offline **grievance redressal mechanisms** to enhance user experience and build accountability and trust. Guidelines for grievance redressal should include those that are related to the functioning and operation of the platform, as well

[34] A new initiative to reward the health care providers for providing quality healthcare.

as ones that relate to the quality of services provided. **Ideally, such a grievance redressal mechanism should be legally backed to protect the rights of the users.**

While the grievance redressal mechanism set out in the National Digital Health Blueprint is fairly comprehensive, it is not backed by a legislation. The mechanism seeks the appointment of a Data Protection Officer and a Grievance Officer responsible for addressing the complaints put forward by the data principal in a **timely and effective manner**, and the Health Data Management Policy states that the **complaint must be resolved by the Grievance Officer within a period of one month.** In line with the provisions of the National Digital Health Blueprint, the Ministry of Health and Family Welfare recently Shri Sanjeev Talwar as the Grievance Redressal Officer for ABDM.[35]

Governance layer

The need for trust in digital platforms is paramount for driving population-scale adoption, and this can be established only when there is a robust governance framework in place that can ensure transparency and accountability in the ecosystem. A dedicated accountable institution tasked with the overall management of the platform can play a crucial role in engendering trust in the platform. Ideally, such an institution should also be **accountable to the general public,** either by virtue of being covered under the RTI Act or through another mechanism specific to the institution**.**

Accountable Institutions

In the case of ABDM, there are three accountable institutions, viz. **Ministry of Health and Family Welfare (MoHFW), Ministry of Electronics and Information Technology (MeitY),** and **National Health Authority (NHA).** The Ministries are responsible for the legal and regulatory framework of the Mission, and the NHA is tasked with the primary role of the implementation of ABDM, which includes managing day-to-day operations, developing strategic partnerships with private and civil society organisations, coordinating between various ministries and departments, etc. For instance, the NHA recently issued tenders to invite and onboard Managed Service Provider, Managed Cloud Services Provider, etc. It developed strategic partnerships with Swasth Alliance and iSPIRT, which have been onboarded on a volunteer basis in compliance with the Volunteer Guidelines laid down by NHA, for technical assistance in building the health data consent manager. To promote transparency in governance, NHA recently launched an online public dashboard as a one-stop solution for real-time information relating to ABHA numbers, Healthcare Professionals Registry (HPR) and Health Facility Registry (HFR).[36]

Rules of Engagement

Given that the health ecosystem has multiple touch points and stakeholders, it becomes imperative that the accountable institution lays down the **rules of engagement between various entities**. This includes outlining the roles, rights, responsibilities and liabilities of various actors in the ecosystem. In the case of ABDM, the National Health Authority has released several policy documents laying down the rights and responsibilities of the involved stakeholders. Some of these documents include the Health Data Management Policy (HDMP), Guidelines for Health Information Providers, Health Repository Providers, Health Information Users and Health Lockers and ABDM Sandbox Guidelines. The HDMP lays down the manner of data sharing between HIUs and data fiduciaries, method of obtaining consent, guidelines in case of a data breach, guidelines for processing children's data, guidelines for rectifying inaccurate or misleading personal data, etc. The Guidelines for Health Information Providers and Users, on the other hand, outline the various obligations and duties of HIUs and HIPs in the ecosystem. In addition to these documents, the ABDM Strategy overview and National Digital Health Blueprint are also reliable documents where the rules of engagement for data consumers, processors, and citizens are mentioned in detail. These documents

[35] https://abdm.gov.in:8081/uploads/OM_regarding_GRO_Mr_Sanjeev_Talwar_e2aeb31f74.pdf
[36] LiveMint, 2022. NHA launches online public dashboard for Ayushman Bharat Digital Mission. [online] Available at: <https://www.livemint.com/news/india/nha-launches-online-public-dashboard-for-ayushman-bharat-digital-mission-11653901462650.html>

are available on the ABDM website for anyone who wishes to get acquainted with them. The website also provides access to webinars, consultation papers and synopsis of these documents for easy reference to the reader.

Data Protection

Apart from the aforementioned ABDM specific regulations, there are other existing frameworks such as Telemedicine Practice Guidelines, E-pharmacy regulations and the IT Act that extend to ABDM as well. An important regulation that would shape ABDM going forward is the future **data protection law**. This law would most likely define institutions, legal and regulatory policies and processes that are needed to control, manage, share and protect data. While these are sound principles on paper, it will be incumbent on the NHA to put them into practice in the context of ABDM.

Funding Model

The ultimate success of an ODE depends on its **funding model** and its **ability to acquire and retain high quality talent**. In terms of funding, since ABDM is envisioned as *Digital Public Infrastructure*, it is slated to receive **budgetary support from the government in the early years** to finance initial capital and operating costs. In February 2022, the Union Cabinet approved the nationwide roll out of ABDM with a budget of ₹1,600 crore for the next five years.[37] Going forward, ABDM seeks to **co-opt public and private players in building and operationalising other building blocks like Health Exchange, ABHA numbers, etc.** The National Digital Health Blueprint also states that it may raise a part of the funding through a **transaction fee**, however, this would be on the lines of a toll-pricing model without a profit motive as it could otherwise dilute its 'public good' utility.

Talent Acquisition

With respect to talent acquisition, there is a need to have sound recruitment practices and processes in place to onboard and retain employees who can contribute to the technical development and maintenance of ABDM along with bringing expertise in other cutting edge services like **data analytics, consumer behaviour research and vendor management.**

Best Practices

UIDAI: Volunteer and Sabbatical/Secondment Officers

The UIDAI has a unique talent acquisition model, where it encourages experts from academia and industry to work with UIDAI on cutting edge projects and strategic work areas. Given the uniqueness of UIDAI in terms of its design, scope and implementation, it is necessary that it employs world-class professionals with the requisite technical and domain expertise to help the project grow and scale. To this end, UIDAI invites experts from cross-sectional domains to work with it as Volunteers or Sabbatical/Secondment officers for a specific duration. It lays down the recruitment guidelines for volunteers and sabbatical/secondment officers where it details the manner of engagement, selection criteria and the code of conduct. Through this approach, UIDAI is able to attract industry and academia experts to bring their expertise to government projects.

Currently, NHA is recruiting contractual personnel for various technical positions within NHA as well as engaging with civil society organisations by onboarding them as volunteers. Since the framework is still at a nascent stage, the specific talent acquisition and retention mechanisms that will ensure effective service delivery have not been detailed yet. Going forward, these policies will need to be fleshed out.

[37] ThePrint, 2022. Cabinet approves roll-out of Ayushman Bharat Digital Mission, allocates Rs 1,600 cr budget. [online] Available at: <https://theprint.in/india/union-cabinet-approves-nationwide-roll-out-of-ayushman-bharat-digital-mission/849109/>

Progress of ABDM as an Open Digital Ecosystem

Layer	Principle	Sub-principle	Evaluation criteria	ABDM Evaluation
Technology	Be open and interoperable	Free and Open Software	1. Yes 2. To some extent 3. No	**Yes**: ABDM building blocks will be in compliance with the Policy on Open Source Software by MeitY. Further, UHI is powered by open protocols whose source code is available on GitHub for use and modification.[38]
		Source code available in the public domain	1. Yes 2. To some extent 2. No	**To some extent**: Source code for building blocks like UHI, Consent Manager, Health Information User, and Health Information Provider can be found on GitHub. Other building blocks (like HCX) are still in the building phase but will most likely be open.
		Open licences	1. Permissive licence 2. Copyleft licence 3. Not open	**Permissive licence**: Source codes for Consent Manager, Health Information User, and Health Information Provider is MIT licensed, which is a permissive licence. This allows users to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software.
		Open standards	1. Yes 2. To some extent 3. No	**Yes:** All the building blocks and components of ABDM conform to open standards. ABDM Blueprint also recommends the adoption of open health standards such as FHIR Release 4, SNOMED CT and LOINC
		Open APIs	1. Yes 2. To some extent 3. No	**Yes:** ABDM building blocks will be in compliance with MeitY's Open API Policy. ABDM has also published API standards documentation for ABHA Number, Health Data Consent Manager, Gateways, Health Repository, HIP and HIU. Also, UHI seeks to ensure adoption of open interoperable specification that allows an open API health ecosystem where any player can participate.
		Open data	1. Yes 2. To some extent 3. No	**To some extent**: Clause 29.1 and 29.2 of HDMP allow for anonymised or de-identified data in an aggregated form for the purpose of facilitating health and clinical research, statistical analysis, policy formulation, etc. but only through a set procedure and subject to approval by the nodal agency. The ABDM dashboard also provides granular data related to ABDM, which can be freely accessed, used and shared.
	Make unbundled, extensible and federated	Unbundled	1. Yes 2. To some extent 3. No	**Yes**: ABDM building blocks will have a standalone, useful, reusable and implementable capability in the health domain.
		Extensible	1. Yes 2. To some extent	**Yes**: ABDM building blocks will have cross-functional value, be interoperable with other building blocks and

[38] https://github.com/NHA-ABDM/UHI/blob/main/LICENSE

			3. No	applicable to multiple use cases.
		Federated Architecture	1. Yes 2. No	**Yes**: The ABDM health records system enables the patients' records to be stored at the local facility level, whose access can be given to health care providers through the appropriate gateways, thereby providing a federated architecture. Refer to Figure 1.
	Be scalable	Scalable	1. Yes 2. Yes but with limitations 3. No	**Yes**: "Think Big, Start Small, Scale Fast" is at the core of ABDM, and the building blocks are developed with this principle in mind.
	Ensure privacy and security	Data security	1. Yes 2. Yes but with limitations 3. No	**Yes but with limitations**: Anonymiser, Privacy Management Centre are some of the building blocks that have been proposed. However, modules such as anonymisation-as-a-service still need to be built.
		Data minimization & purpose specification	1. Yes 2. Yes but with limitations 3. No	**Yes but with limitations**: The HIUs are expected to follow the principle of data minimisation and obtain the consent of the data principal only for such personal data that is necessary for the purposes for which such consent is being sought. However, there is a need for equipping the HIU staff with the necessary skills and tools to implement this in spirit.
		Use, disclosure and retention limitation	1. Yes 2. Yes but with limitations 3. No	**Yes**: Clause 10 of the HDMP, provides for use and disclosure information to be provided in the privacy notice. Clause 10.3 also provides that the privacy notice should contain information on the period of time for which the personal data shall be retained, or where the period of retention is not known, then the criteria for determining this period.
		Consent: a) Free	1. Yes 2. Yes but with limitations 3. No	**Yes but with limitations**: As per clause 9.1 of HDMP, data fiduciaries can collect or process personal data only with the consent of the data principal. It is the responsibility of the data fiduciary to ensure that the consent given by the data principal is valid. The consent must be free, informed, specific, clearly given and capable of being withdrawn. Further, the Consent Manager places the data principal in complete control of their data. However, given that over-reliance on consent can be problematic, it would be critical to design interventions and use behavioural nudges to ensure that beneficiaries understand the contents (and implications) of any privacy/ consent policy.
		b) Informed and specific	1. Yes 2. Yes but with limitations 3. No	
		c) Easy to withdraw	1. Yes 2. Yes but with limitations 3. No	
		d)Unambiguous	1. Yes 2. Yes but with limitations 3. No	

	Develop minimal and evolvable solutions	Build minimally and iteratively	1. Yes 2. To some extent 3. No	**Yes**: ABDM adopts a combination of strategies such as taking a minimalistic approach for designing each block, prioritising and sequencing of the development/ launch of the building blocks, and designing a technology architecture that can scale horizontally and vertically.
Community	Ensure universal access	User-friendly UI / UX	1. Advanced 2. Intermediate 3. Basic	**Intermediate:** As per the reviews on Google Play Store, the ABHA App has issues that prevents users from completing their profile, uploading documents, verifying OTP, etc. Aside from these issues the UI/UX of the app is simple and intuitive. The End User App/Health Service Provider App reference apps for UHI, are also being launched soon, and the design of these apps will be key to ensuring universal access.
		Vernacular	1. All major languages 2. Most major languages 3. Only a handful languages	**Most major languages**: ABDM Blueprint mentions special efforts to launch voice-based services using appropriate tools customised to work in spoken Indian languages. Currently English and Hindi options are available, with more language options likely to come soon.
		Accessible Design	1. Yes 2. No	**No:** The app is still in its nascent stage with the functionalities requiring a more robust UI/UX design. Perhaps going forward, the app will have tools like 'text-to-speech' converters and QR codes to make it more disability friendly.
		Omni-channel access through tech	1. All major tech channels 2. Most major tech channels 3. Only a few tech channels	**All major tech channels**: Omni-channel access is one of the core building blocks of ABDM including the use of call centres, mobile phones, social media platforms. An example of such assisted mode of access includes using networks of ASHA workers, by leveraging apps like Desh ka Doctor.
		Omni-channel access through offline mediums	1. Yes 2. To some extent 3. No	**To some extent**: For the ABDM pilot phase, NHA and the Common Service Centres entered into a partnership that allowed CSCs to provide Health IDs to beneficiaries across 10 states. It remains to be seen whether CSCs will become a part of ABDM as well. There have been other state-level initiatives as well. For instance, the Bihar government rolled out a health records digitisation pilot in Nalanda district in partnership with health-tech company eHealthSystems and enrolled over 3000 people. However, more such initiatives are required to make ABDM ubiquitous.
		Users have right to avoid denial of services	1. Yes 2. No	**Yes**: Since ABDM is voluntary by nature, one will always be able to avail healthcare services whether or not they are a part of the ABDM ecosystem. The FAQs on the ABDM website also state "ABDM does not aim to exclude anyone from equitable access to healthcare on account of absence

				of Health ID, or participation by healthcare provider."
	Participatory design and end-user engagement	Participatory Design and Development	1. Exemplary effort 2. Satisfactory effort 3. Minimal effort	**Satisfactory effort**: NHA has been routinely engaged with the community by organising open house discussions, conventions, public consultation discussions, etc. Going forward, there is a plan to focus on development and beta testing on ABDM components. It remains to be seen the extent to which these will be implemented going forward.
		End-user adoption	1. Exemplary effort 2. Satisfactory effort 3. Minimal effort	**Satisfactory effort**: NHA has been actively engaged in conducting webinars to educate people about ABDM and it has also published various documents and FAQs to detail its implementation mechanism. It has also developed ABHA Mobile (PHR) Application as a reference PHR application that is available on the Android platform. NHA is also developing a reference app for UHI, which is currently in the alpha testing stage. While these initiatives are welcome, there is a need for more such awareness measures to ensure that people, even at the lowest strata in the society, understand the benefits of ABDM and voluntarily sign up for the same.
	Cultivate a network of innovators	Proactively engage with tech experts to build the base infrastructure layer	1. Exemplary effort 2. Satisfactory effort 3. Minimal effort	**Satisfactory effort**: The NHA takes proactive steps to involve tech experts in building the base infrastructure layer of different ABDM components. For example, it invited community of developers to build on and improve the UHI initiative by joining the Decentralised Health Protocol (DHP)[39] open community hosted on the GitHub platform at https://github.com/dhp-project, to further refine existing protocols and build new protocols for use cases currently not a part of DHP. Going forward, there is a need to institute initiatives like bug bounty programs to continue the involvement of the community in building and refining the tech ecosystem.
		Proactively engage with innovators to build solutions on top of the base infrastructure layer	1. Exemplary effort 2. Satisfactory effort 3. Minimal effort	**Satisfactory effort**: NHA has previously organised hackathons to encourage developer communities to participate in creating the ecosystem. The ABDM Sandbox and the recently conducted "Kickstarting UHI Hackathon" are good examples of such initiatives. With further development of the ABDM base infrastructure layer, a more concerted effort to include innovators will be required.
	Be analytics-driven and service-	Analytics-driven for continuous user-focus	1. Yes 2. To some extent 3. No	**Yes**: The ABDM dashboard provides granular data related to ABDM, which can be freely accessed, and used for analytics and improvement of services. Furthermore, the

[39] DHP is an open source project that aims to define interoperable protocol specifications for creating a decentralized network of health and wellness services including tele consultation and various other services.

	oriented			proposed National Health Analytics Platform seeks to measure and publish performance of different stakeholders in the ABDM ecosystem through real-time monitoring and visualisation tools.
		Service-oriented	1. Yes 2. To some extent 3. No	**Too early to comment**: There is a Monitoring and Evaluation team at NHA - but it's possibly too early to comment on how comprehensive it's role will be.
	Enable responsive grievance redressal	Set up a responsive grievance redressal system	1. Yes 2. Can be made more robust 3. No	**Can be made more robust**: While the grievance redressal mechanism set out in the National Digital Health Blueprint is fairly comprehensive, it is not legally backed.
Governance	Define Accountable Institutions	Design an accountable institution	1. Yes 2. Yes but with narrower remit 3. No	**Yes**: There are three accountable institutions -. the Ministry of Health and Family Welfare (MoHFW), the Ministry of Electronics and Information Technology (MeitY), and National Health Authority (NHA), with clearly delineated duties. The NHA is also covered under the RTI Act, thus providing additional accountability.
		Maintain government oversight	1. Public 2. Public Private Partnership (PPP) 3. Private with strong government oversight 4. Private with no/weak government oversight	**Public**: The Ministries are responsible for the legal and regulatory framework of the Mission, and the NHA is tasked with the primary role of the implementation of ABDM. The NHA itself is an attached office of the Ministry of Health and Family Welfare with full functional autonomy. This structure is further bolstered by a Mission Steering Group comprising senior officials of relevant central ministries, relevant state ministries, NITI Aayog etc.
		Multi-stakeholder engagement in governance	1. Yes 2. To some extent 3. No	**To some extent**: While there is lack of an organisational structure that involves independent advisory groups, consumer ombudsman etc., the inclusion of domain experts from fields such as Insurance, Health care providers, Economics, Public Health, Management, etc. contributes to multi-stakeholder engagement to some extent.
	Establish and align robust rules of engagement	Establish and align robust rules of engagement	1. Outlined through publicly available standard norms/MoUs that apply uniformly to each category of stakeholder 2. Decided on a one-on-one basis through MoUs that are available in the public domain 3. Lack of	**Outlined through publicly available standard norms/MoUs that apply uniformly to each category of stakeholder**: The NHA has released several policy documents laying down the rights and responsibilities of the involved stakeholders. Some of these documents include Health Data Management Policy (HDMP), Guidelines for Health Information Providers, Health Repository Providers, Health Information Users and Health Lockers and ABDM Sandbox Guidelines.

			transparency	
	Create transparent data governance	Easy-to-understand	1. Yes 2. To some extent 3. No	**Yes**: Documents like the ABDM Blueprint and Strategy overview lay out the framework of the ABDM ecosystem clearly with help of diagrams for easy understanding. The documents can be found on the ABDM website with the corresponding webinar, synopsis and consultation papers hyperlinked alongside the main document.
		Adopt mechanisms to create audit trails and ensure data validity	1. Yes 2. Can be made robust 3. No	**Can be made more robust:** HDMP mandates the maintenance of accurate and up-to-date records to document the important operations in the data lifecycle including collection, transfers, and erasure of personal data by the data fiduciaries. To implement this in spirit in the future, there is a need to have a framework to ensure proper data collection and recording at the facility level, especially in the rural areas.
		Drive adherence	1. Yes 2. Can be made robust 3. No	**Yes:** Certain components of ABDM specifically provide for adherence to transparent data governance systems. For example, joining the ABDM framework after exiting from the ABDM Sandbox requires Web Application Security Assessment (WASA) certification as per OWASP standard. This assessment is then put in front of a technical committee for final sign off.
		Ensure end-user ownership	1. Yes 2. To some extent 3. No	**To some extent**: HDMP provides for data principals to rectify any inaccurate or misleading personal data, complete any incomplete personal data and update any out-of-date personal data. It also allows for erasure of data under certain circumstances.
	Ensure the right capabilities	Talent management	1. Yes 2. Can be made robust 3. No	**Can be made robust**: Currently, NHA is recruiting contractual personnel for various technical positions within NHA as well as engaging with civil society organisations by onboarding them as volunteers. The talent acquisition and retention mechanisms still need be fleshed out, but forward looking policies like engagement of Young Professionals bode well for the future.
		Agile Procurement Policies	1. Yes 2. Can be made robust 3. No	**Can be made robust**: While the NHA uses more traditional RFP models currently for procurement, the process could be made faster through adoption of Agile procurement policies. Agile procurement is a way of acquiring solutions according to the outcomes the organization seeks, rather than by prescribing a set of a detailed requirements and specifications, and more details can be found in Section 3.7 of MeitY's Agile India document. Furthermore, the state level

				tenders for ABDM have not seen adequate uptake[40] due to various factors, including a lack of expertise in end to end digitization of health. Support to states to customize their tenders for specific needs could be considered by the NHA/ Ministry of Family and Health Welfare.
	Adopt a sustainable funding model	Allocate sufficient funding for initial design and development	1. Sufficient initial funding 2. Under-funded 3. No initial funding	**Sufficient initial funding**: In February 2022, the Union Cabinet approved the nationwide roll out of ABDM with a budget of ₹1,600 crore for the next five years
		Adopt a sustainable business model for operations and maintenance (O&M)	1. Fully sustainable through own revenue generation 2. Generates revenue but not enough to make it self-sustaining 3. No revenue generation	**Too early to comment:** While ABDM has initial funding from the government, there is a need to have a sustainable funding model for supporting its operations in the future. To this end, it seeks to co-opt public and private players in building and operationalising other building blocks like Health Exchange, ABHA numbers, etc. It also seeks to raise a part of the funding through a transaction fee. That being said, it is still in its early stages and these ideas need to be fleshed out further.
		Diversified pool of funders	1. Private support through a diversified pool of funders 2. Private support through one funder 3. No private funding support	Not enough information available to comment

Way Forward

The digital health ecosystem in India is currently evolving at a rapid pace. As ABDM integrates different building blocks and brings together more stakeholders, it will be important to not lose sight of the fundamental principles that underpin robust open digital ecosystems. Through the above case study, we have attempted to map the ABDM framework against these fundamental principles with the hope of setting a standard for evaluating progress. We encourage ODE builders, policymakers and researchers to refer to our detailed Implementation Blue Book to assess their own ODEs and use it for developing robust and comprehensive digital ecosystems in the country.

[40] https://the-ken.com/story/indias-rs-1600-crore-digital-health-id-mission-is-being-squeezed-at-two-ends/?utm_source=daily_story&utm_medium=email&utm_campaign=daily_newsletter