MICHIGAN ROSS

itihaasa
Research and Digital

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

Krishnan Narayanan,
Co-founder and President, itihaasa Research and Digital
(www.itihaasa.com)
&
Venkat Ramaswamy,
Professor, University of Michigan Ross School of Business
(www.venkatramaswamy.com)

September 2022

Contents

1. The eXperience-verse revolution

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

In the first report[1] in the "Digital India Innovation and the Experience-verse Revolution" series, we explored the contours of digital India innovations. We undertook a brief historical tour of India's computing journey, and examined the role of research and educational institutions, the IT industry and startups, and the government, in pushing the boundaries of computing.

We then undertook a brief historical tour of enterprise value creation – looking at the four eras of Industrial Revolution, the accelerating pace of digital transformation of private, public, and plural sector enterprises in a tech-intensive modern world, and touched upon some important management frameworks of value creation (such as value chain, platform business, ecosystem innovation, and co-creation).

Next, we proposed a new framework of interactional value creation in this post-pandemic world – the "eXperience-verse (X-verse) Revolution". (See Figure 1.) Unlike the previous four Industrial revolutions driven by technology, this new era requires an "experience-first" frame of reference of interactional value creation by every enterprise.[2] We also explored several examples of the X-verse in practice.[3]

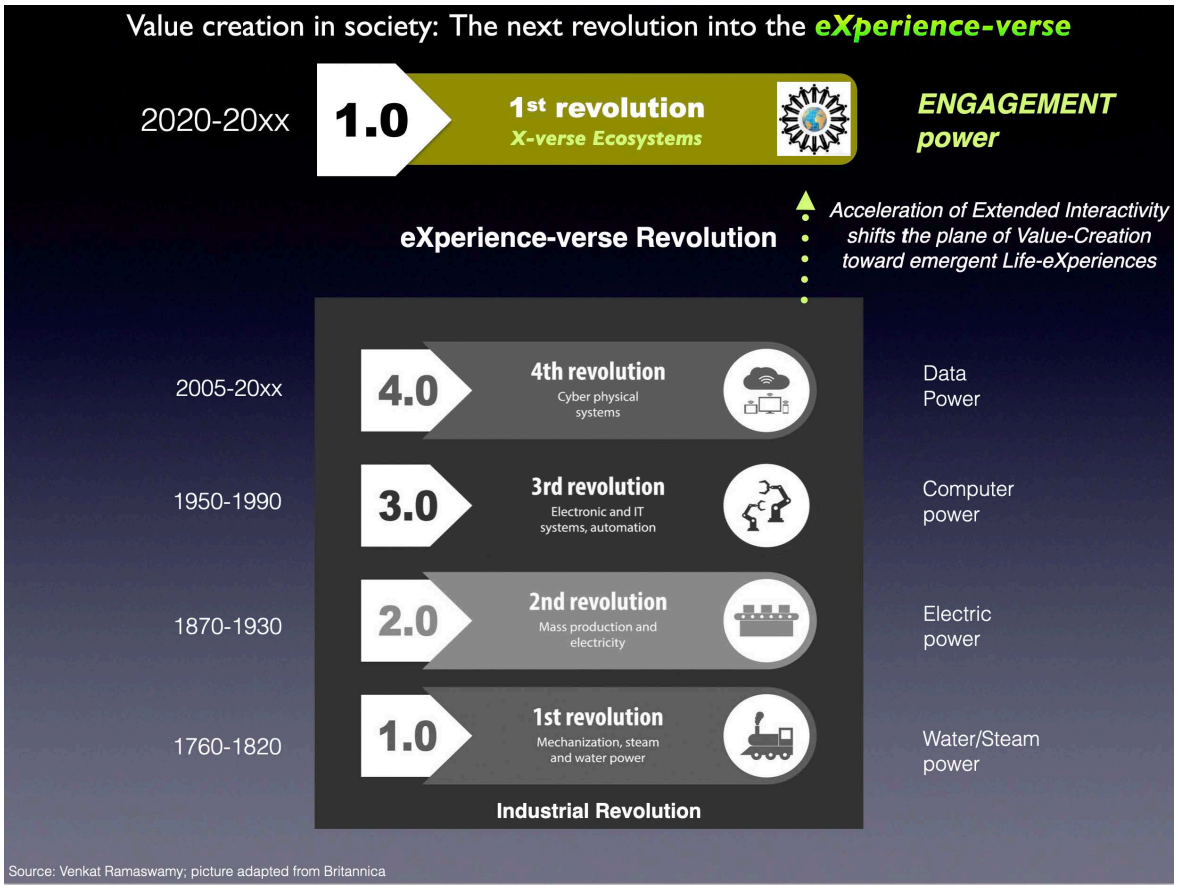

Figure 1: The eXperience-verse Revolution (Source: Venkat Ramaswamy Picture adapted from Brittanica)

One such example is that of AB InBev, the largest brewer in the world. It uses Microsoft Azure Digital Twins to create a live digital model of their breweries and supply chain. AB InBev's brew masters can get a real-time view into the complex brewing process and are able to adjust the biological and chemical process parameters based on active conditions. Frontline operators leverage AI algorithms to automatically compensate for bottlenecks in the packaging process. They use mixed reality for remote assistance and to ensure uptime on the machines. Routing algorithms help the delivery trucks transport the beer cases so they achieve the lightest carbon footprint and ensure that the right beers are delivered to the consumer at the local pub for the perfect sip.

Emerging technologies are leveraged at the moment of engagement between the enterprise and the experiencers – the brew masters and digital-twin maintenance expert. The goal is to engender value to the individual-as-experiencer. This value to experiencers comes first in the form of various outputs and outcomes – such as maintenance service provided and uptimes. Then, value is created through not only optimized processes and high-quality products but also through enhanced environments of emergent experiences throughout the brewing ecosystem.

We then presented the **PIE X (Platforms, Impacts, Engagements, eXperiences)** lens, that helps visualize opportunities and challenges for risk-managed experience-centric innovation and multi-stakeholder value creation in interactive ecosystems of the X-verse. (See Figure 2.)

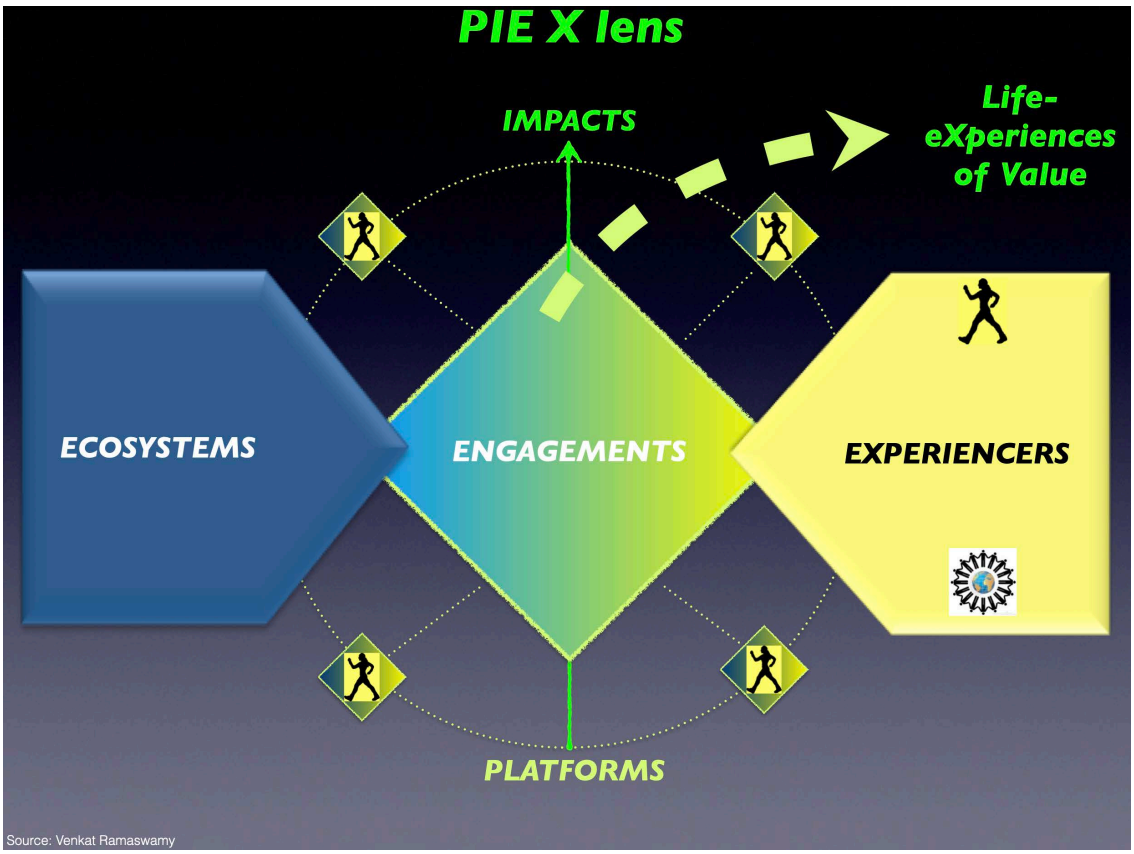

Figure 2: PIE X lens (Source: Venkat Ramaswamy)

In the second report, under the "PIE X Lens and the Experience-verse Revolution" series,[4] we visualised the **education X-verse** and applied the PIE X lens to various learning and skill development experiences in India and the world. We also introduced three sets of PIE X Ecosystem transformation levers, associated with Platforms, Engagements, and Impacts in the context of a detailed illustration in the education X-verse.

In this report, we will understand the **healthcare X-verse** and apply the **PIE X lens to various digitalized health and insurance experiences**. We will then build on the levers for expanding the value-creating innovation pie introduced in the second report, while introducing two more sets of levers of PIE X Ecosystem transformation, this time associated with experience ecosystems and growing the pie of interactional value creation across all stakeholders-as-experiencers. We discuss these transformation levers in the context of the healthcare X-verse. These levers can help identify new pathways for private, public, and plural sector enterprises on the next frontier of digital innovation, and co-creating risk-managed value of wellbeing impacts with stakeholders.

2. Visualising the healthcare X-verse

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

The shift towards digital healthcare

Digital health refers to the use of digital technologies for providing healthcare. It encompasses concepts like eHealth and mHealth, and refers to provision of healthcare leveraging advanced technologies like big data and analytics, artificial intelligence, IoT, and genomics.

The digital health technology categories, adapted from those proposed by the Stanford Center for Digital Health, include:[5]

- **Artificial intelligence** (AI), machine learning (ML), and algorithms (including deep learning, image processing, and advanced analytics)
- **Health IT,** infrastructure, and data management (including Electronic Health Record systems)
- **Mobile and web applications** (including online SaaS platforms, cloud-based software tools, and social media)
- **New clinical care models** (including telemedicine, patient engagement, and patient–physician interaction)
- **Wearables** sensors, and other devices
- **Genomics and genetic technologies** (including technologies for genomic sequencing, editing and diagnostics like CRISPR, recombinant DNA, DNA array, functional genomics including mRNA analysis, computational biology and bioinformatics).

The journey towards digital health has been a long and arduous one. Innovations in healthcare have much slower ramp-up curves than in other industries like manufacturing and technology. New techniques and technologies need to be understood by research scientists, doctors, and clinicians, not to mention patients, and trialed carefully, while managing attendant risks, and then adopted into practice. Typically, it takes several years for new innovations to become mainstream in modern medicine. The history of adoption of technologies in healthcare tells a fascinating story – telemedicine started 150+ years back, data analysis in healthcare began over 100 years ago, and AI in medicine over 50 years back.[6]

However, the COVID-19 pandemic has forced a sea change among patients, healthcare professionals and policy makers. It has catalysed the adoption of digital technologies in the provision of healthcare services – telemedicine, point of care diagnosis, digital epidemiological surveillance, and so on.

Another factor driving this adoption is the frenetic pace of change of emerging technologies. Information technology and biotechnology are entering the proverbial second half of the technological chessboard – Moore's Law governing the growth of computing power has reached its breaking point, and we are witnessing an explosion of AI-enabled applications in healthcare and other walks of our lives; similarly, Flatley's Law governing DNA sequencing is on overdrive, and we are consequently beginning to see several applications involving genetic sequencing and gene editing like mRNA vaccines, CRISPR based cures and diagnostics, and personalised medicine. Further, innovations are occurring at the intersection of domains – developments in other seemingly

unrelated fields (e.g., chemistry, metallurgy, electronics, quantum physics etc.) are often major contributors to healthcare advances.

The healthcare ecosystems of the future will be centered on patients (see Figure 3)[7], as experiencers, but also as active co-creators of their wellness.[8]

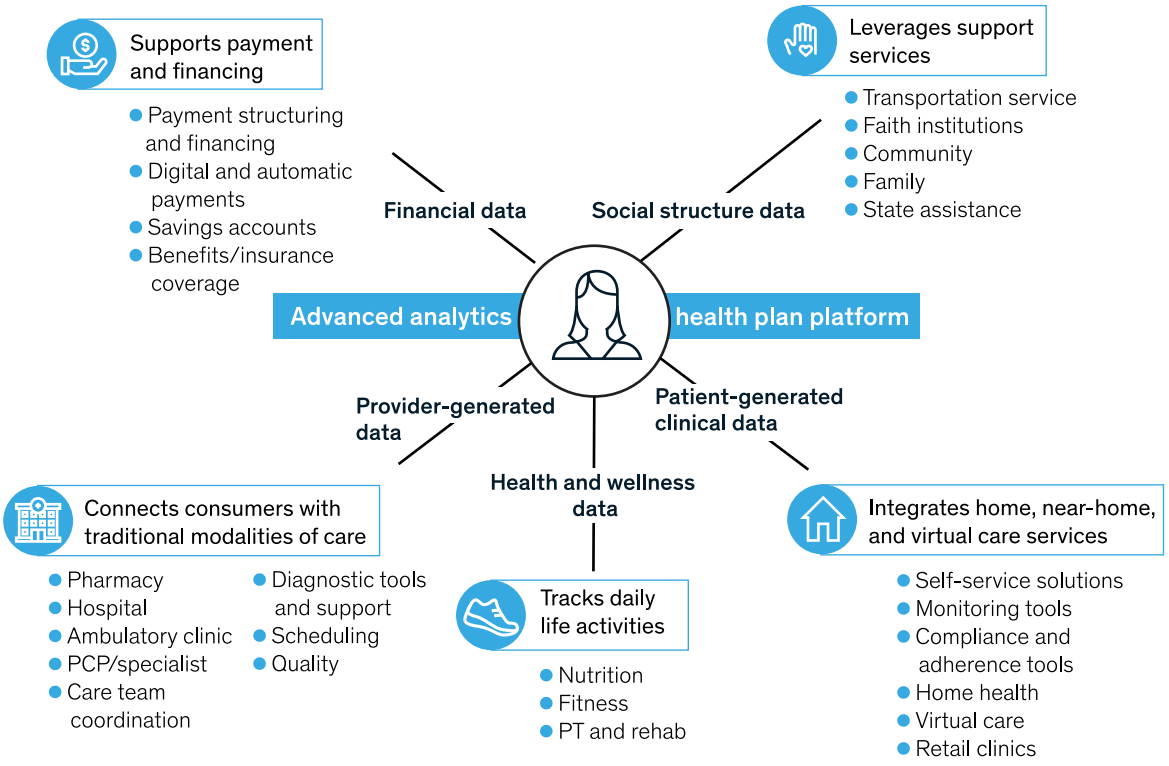

Figure 3: Patient centric healthcare ecosystems of the future (Source: McKinsey)

The capabilities and services that such an ecosystem will provide are shown in Figure 4, and include aspects of traditional care, home care, social care, focus on wellness and financing support.[9]

Modalities of traditional care	*Direct care and pharmaceuticals administered by providers, across traditional sites of care*
Home and self care	*Patient engagement, self and virtual care, remote monitoring, and traditional care that can increasingly be delivered near or in the home*
Social care	*Social and community networks related to a patient's holistic health focused on community elements of unmet social needs*
Daily life activities	*Patient actions and habits enabling wellness and health, including fitness and nutrition*
Financing support	*Operations and financial infrastructure supporting industry care events, including payment and financing solutions*

Figure 4: Capabilities and services of a patient-centric healthcare ecosystem (Source: McKinsey)

The future of digital healthcare will be determined, ultimately, in a battle between the faster arc of digital transformation, the inexorable shift towards patient-centricity, and the slower curve of societal transformation (in terms of accepting new technologies in personal health, medical ethics, etc.).

IT architectures influencing evolution of digital health systems

The digital health systems have evolved over the years and have been influenced by IT architectures that progressed from mainframes to minicomputing, to personal computing, to mobile computing and then to Internet-of-Things.[10] Let us consider a healthcare provider perspective. In 1965, the Laboratory of Computer Science in Massachusetts General Hospital developed, for the first-time, a mainframe computer (PDP-1) based remote-access, time-sharing system for admission discharge census, laboratory reporting, and medication ordering. As the IT architectures moved towards the personal computer and client-server era and later embraced the Internet, the Hospital Information / Management System (HIS or HMS), a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, emerged.

Healthcare providers are shifting from their current monolithic, EHR-centric IT systems to a Digital Health Platform (DHP) architecture as part of their digital transformation and in order to keep pace with business, clinical and consumer expectations. (See Figure 5.)[11]

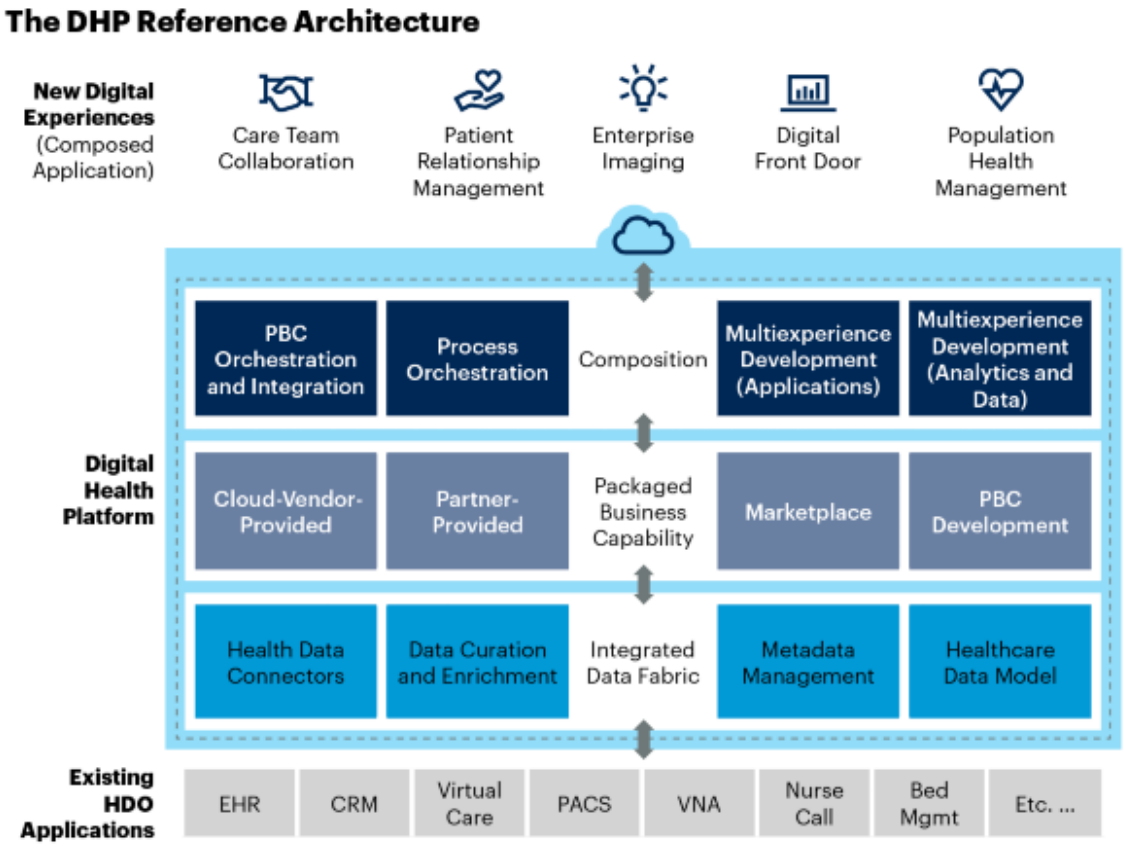

Figure 5 : Digital Health Platform reference architecture (Source: Gartner)

This architecture in a healthcare provider enables rapid deployment of digital capabilities and creation of new digital experiences using modern cloud services. DHP architecture contains three important elements:

1. An integrated data fabric layer that providers use to connect and interface with existing healthcare applications to deliver data and metadata management for the other layers. For example:
a. Health data connectors using industry standards;
b. Data curation services that standardize incoming data, including patient de-identification;
c. Ability to retain patient-provided data consent and privacy flags.

2. A packaged business capabilities (PBCs) layer consists of a library of prebuilt software components or business functions that providers can leverage to orchestrate new applications. Many vendors offer prebuilt healthcare specific applications in a cloud-based Software-as-a-Service (SaaS) offering. For instance:
a. Microsoft Cloud for Healthcare offers the AI-powered Azure Health Bot as a conversational interface for patients.
b. AWS offers Amazon Comprehend Medical that uses machine learning to extract knowledge from clinical notes and free text.
c. Philips HealthSuite Digital Platform provides an end-to-end oncology care pathway to hospitals.

3. A composition layer consists of tools that enable providers to build tailored digital experiences across a broad range of stakeholders as experiencers:
a. User interface / experience design in creating new patient forms.
b. Tools that support low-code development and rapid deployment of new applications.
c. Event-driven Application Programming Interfaces (APIs) to facilitate management of events (e.g., what happened, where, when, why, and how?).

Such architectures help deliver better digital experiences for clinicians, patients and other stakeholders as experiencers, and augment the flexibility and resilience of healthcare organizations in co-creating unique value with all stakeholders.

Transformational shifts in the healthcare X-verse

Let us now understand some key transformational shifts that take place in the healthcare X-verse. Enterprises need to visualize strategic opportunities and manage risks at every moment of engagement of an eXperiencer in a digitalized interactive X-verse ecosystem. Rather than merely focusing on the activities in the value chain, enterprises now have to consider the lived-journey of engagements of all stakeholding individuals-as-experiencers and the extended reality of experiences that emerge from their interactions via new digital interfaces – from pure reality to mixed reality to pure virtuality.[12] Moreover, enterprises can no longer continue to measure their success only in terms of profits, revenues and earnings per share, but go beyond to include the personal, social, cultural, ecological and economic wellbeing of all stakeholders.[13]

The major transformational shifts taking place can be viewed along five different loci of value creation: locus of interaction, locus of innovation, locus of value, locus of strategy, and locus of performance. (See Figure 6.)[14]

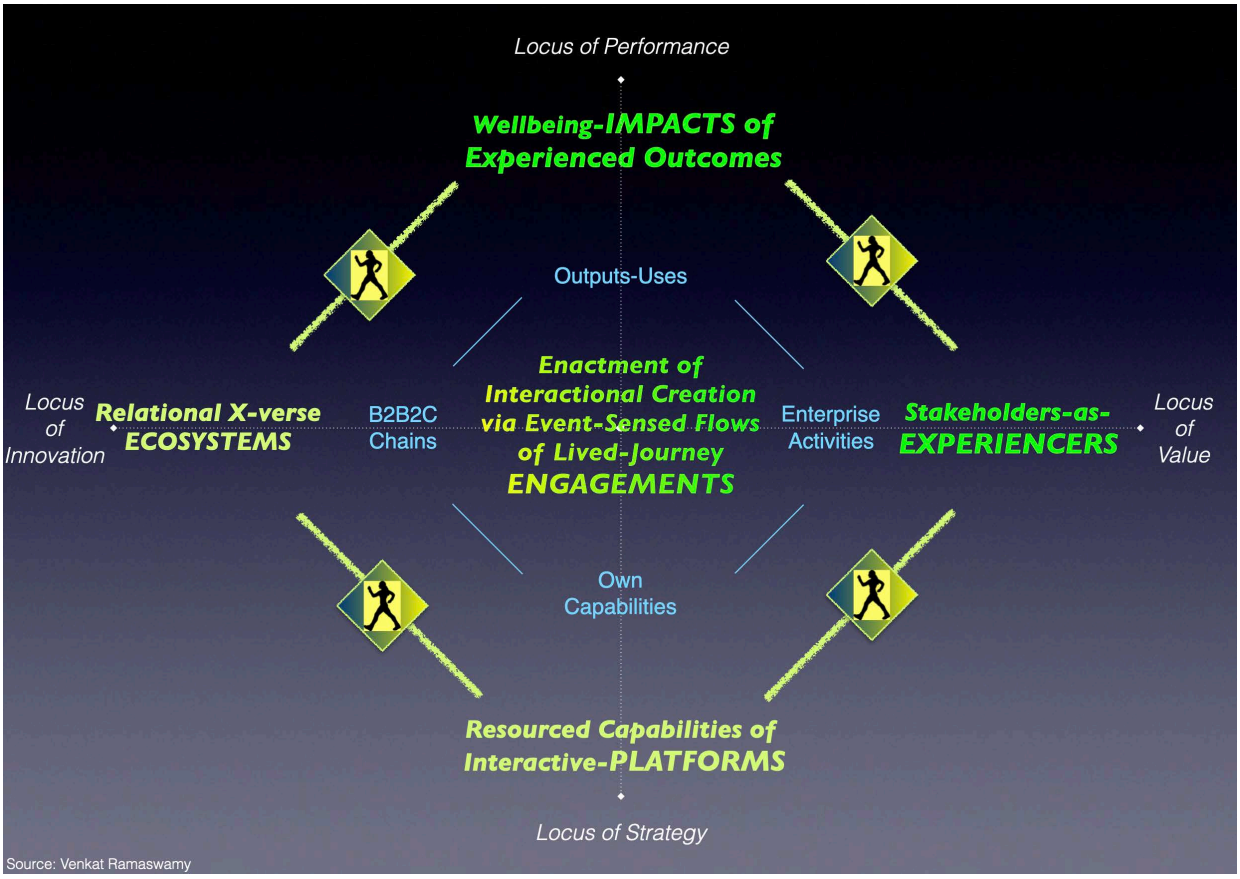

Figure 6 : Transformational shifts in value creation in the X verse (Source: Venkat Ramaswamy)

1. The locus of interaction shifts beyond 'industry boundaries of goods and services' to 'event-sensed flows of lived-journey engagements' of individuals-as-experiencers. The experiences happen at moments of engagements between the enterprise (say the healthcare provider) and the experiencer (say the patient or the nursing staff).

a. Earlier the locus of interaction was centred on the hospital, and predominantly from the hospital to the patient. For instance, the hospital had a set of doctors and medical equipment, and the patients had to go to the hospital for medical consultation.

b. In the X-verse, the focus of interaction is on the patient, who may be collecting information about her health from multiple sources and updating her "digital-patient model", an idea similar to a "digital twin" from the manufacturing industry. The measurements from her fitness trackers, health-sensors, previous medical examination and tests are available through a secure cloud when she meets her doctors next, and this provides data required for offering a personalized treatment plan. Such a personalization falls under interactional creation via event-sensed flows of engaged health-monitoring.

2. The locus of innovation shifts beyond 'B2B2C chains / goods-services' to 'relational ecosystems' in the X-verse.

a. Earlier a patient had to go to a hospital for healthcare services. The emphasis was on the hospital – typically the physical space where the healthcare provider was situated. Value got created through the healthcare services that the hospital offered.

b. In the X-verse, the emphasis shifts to relational ecosystems of digitalized interactive experiences. We are seeing the emergence of digital-first healthcare models. A patient can plug into a healthcare network, in which this hospital is a member. This also means that the experience-centric value creation is not just happening within a single enterprise, but across an enhanced network of multiple healthcare enterprises – hospitals, diagnostic laboratories, payers, home-care service providers and others.

3. The locus of value shifts beyond 'activities of enterprises' to 'interactivity of all stakeholders-as-experiencers', i.e., the interactive experiences of stakeholders as creators of value in their own lived-journeys of engagements.

a. Just like flipped classrooms, we have flipped clinics / hospitals – activities, like collecting samples and running tests, that have typically taken place in clinical settings, are being done in new locations and by leveraging new technologies. The pandemic has catalysed the adoption of telehealth among both patients and healthcare providers. Home-based care models are gaining popularity.

b. This shift applies to all stakeholders-as-experiencers, not just the patients. In the case of hospital, the locus of value creation shifts beyond the process of hiring of resources by the hospital administration to the onboarding and lived-journey experience of the doctors and nursing staff, as well as the healthcare partners in the interactive experience ecosystem.

c. An important aspect is to consider the lived-journeys of stakeholders-as-experiencers, and as creators of wellbeing impacts in the interactive X-verse ecosystems in which they participate. Take the example of connecting with the 'patient-as-experiencer' environments of interactions through a smart-connected product like a cardiac pacemaker.[15] There are various experience scenarios if we consider the lived-journeys of patients – such as experiencing a crisis while out of town, or feeling uneasy and wanting to remotely consult the patient's primary doctor. (See Figure 7.) [16]

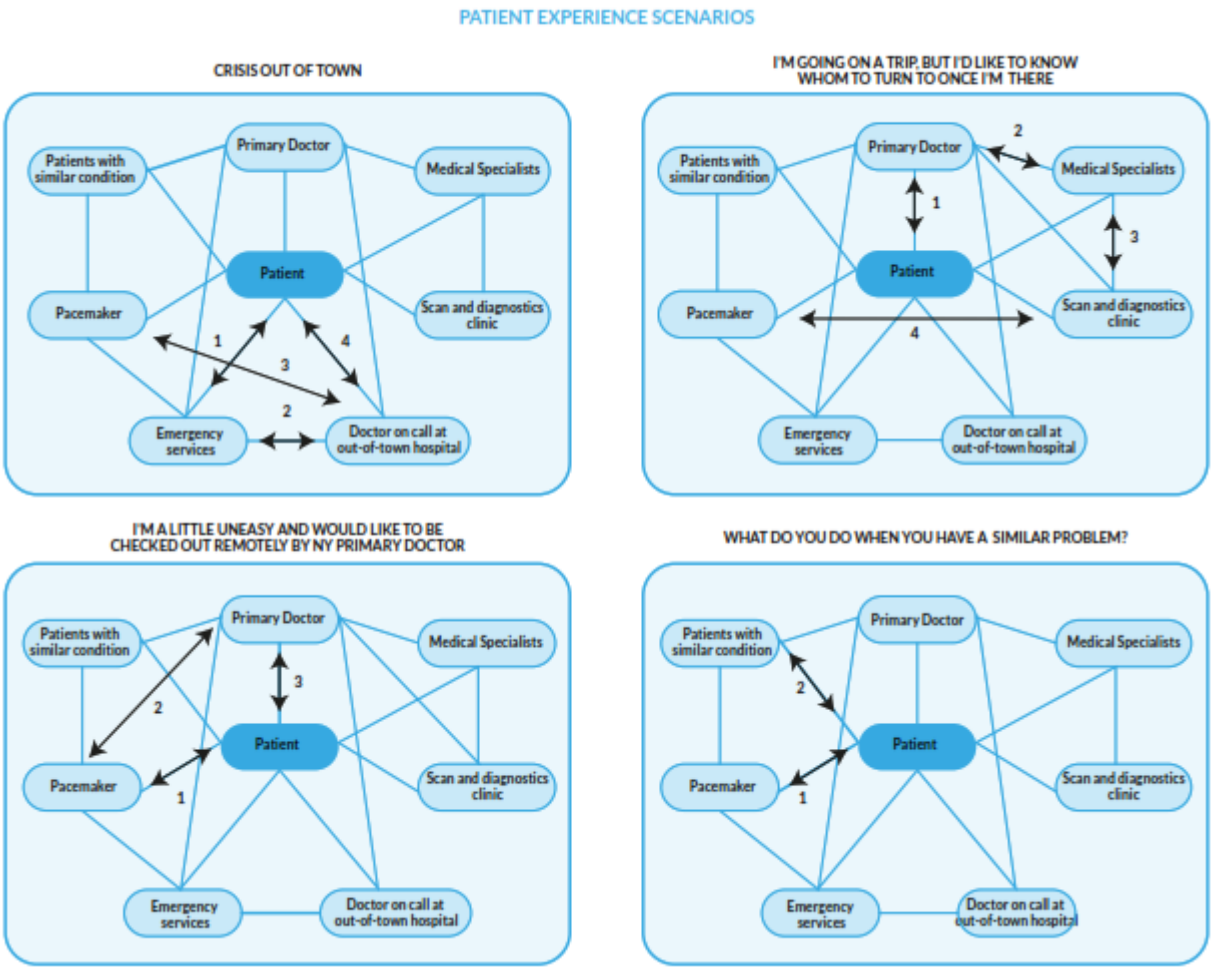

Figure 7: Patient Experience Scenarios (Source: Venkat Ramaswamy)

d. Do the activated ecosystem entities (doctors, hospital staff, diagnostic clinicians, specialists, and medical devices including the pacemaker) have the capabilities to recognise these lived-journey situations and offer relevant healthcare services to its patients? Lived-journeys of employees, partners and other collaborators may also be considered. Such a perspective helps expand the "pie of value" for the enterprise.

4. The next shift is, then, on the locus of strategy – beyond 'own capabilities' to 'resourced capabilities of platforms'.

a. This manifests in multiple ways – from a healthcare provider providing medical services in one specific space, the hospital, to locations where the patients are present through telehealth – a shift from the physical to the virtual world. Ecosystem processes in the underlying network must be selectively and dynamically activated to enable personalized network-to-individual-to network interactions and outcomes of value. This goes beyond modular, standardized processes that are interchangeable with multiple entities in the ecosystem toward "on-demand" dynamic process capabilities.

b. It also manifests as a shift beyond a system of records (like an ERP system in a hospital) to a system of engagements (for example, the hospital may want to embed a patient-service workflow within a collaboration tool used to communicate with the patient).

5. Finally, the locus of performance goes beyond just 'outputs-uses' to 'sustainable wellbeing impacts'.

a. For a healthcare provider, the traditional performance metrics have centred around number of patients serviced, profits and revenues (and other medical equipment utilisation measures). Value accrues from the interactions and emergent positive experiences of the patient receiving care in the comfort of her home, activated through digitalized ecosystems, and the sense of relief that other family members experience knowing that urgent care can be accessed easily, and that they can be notified in case of emergencies.

b. The performance impacts has also focused on leveraging digital technologies to make sophisticated health interventions possible – like AI technologies assisting in medical diagnosis and prognosis or 5G technology enabling real-time remote surgery.

c. This is shifting to an additional focus on the wellbeing of patients that includes both their physical and mental wellness and also a focus on preventive healthcare. At the country-level, especially in developing countries, healthcare providers are now increasingly thinking about how to address gaps in achieving Universal Health Coverage.

d. Digital divide in the society poses challenges to the increasing usage of technology in healthcare. Those on the 'right side' of the digital divide are benefitting much more from using the Internet in every domain including healthcare than people on the 'wrong side' of the digital divide.[17] We must ensure that the digital divide does not create new forms of health inequities.

Let us now apply the PIE X lens to some real-world digitalized health experiences.

3. Applying the PIE X lens to digital health and insurance experiences

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

Digital Health in India: Ayushman Bharat Digital Mission, Aarogya Setu, and Co-WIN

Indian healthcare presents a study in contrast. On the one hand, it faces significant resource constraints and consequently does poorly on overall national healthcare coverage. On the index value of Universal Health Coverage (UHC), which involves all people receiving the high quality health services they need without experiencing financial hardship, India has progressed in the last three decades from 27 (in 1990) to 47 (in 2019).[18] But the latest score is below the world average (60) and India needs to improve on these UHC parameters substantially.[19] The key challenges that an Indian healthcare ecosystem suffers from include: i) lack of resources in the form of lower per-capita availability of doctors and other healthcare professionals ii) skewed access and variable quality – the density of doctors and nurses in urban areas is 4 times that in rural areas iii) lack of affordability of healthcare – over 62% of healthcare expenditure is an out-of-pocket-expense.[20]

On the other hand, it produces high-quality talent in terms of doctors and healthcare professionals and healthcare startups, and possesses pockets of world-class healthcare facilities (typically in private and urban facilities). In recent years, and especially as part of the COVID-19 pandemic response, a number of initiatives have been undertaken in India that focus on creating, monitoring, and analysing healthcare data.

In 2020, India launched the Ayushman Bharat Digital Mission (ABDM) that aims to create an 'open digital health ecosystem'. (See Figure 8.)

Figure 8: The ABDM Ecosystem (Source: Ayushman Bharat Digital Mission)

Ecosystem & Experiencers

In a typical scenario in India of a patient visiting a clinic, the doctor's administrative assistants would handle aspects like appointment booking and billing. And the doctor would take care of the medical aspects and write a prescription for appropriate medicines, which the patient would typically take to the attached pharmacy for fulfilment. However, during the pandemic, people were hesitant about going to a clinic for a medical check-up; and not unless the situation demanded a hospital visit. Consequently, there was an adoption of telehealth for regular consultations.

The doctor would talk to the patient over a telephonic call or use popular video-call applications like WhatsApp video during the consultation. The administrative staff were not utilised in this process. Thus, aspects like appointment booking and billing were done directly between the doctor and the patient. Prescriptions would be sent as a WhatsApp message, and the fulfilment of the medicines did not take place at the pharmacy at the doctor's clinic.

While perforce a lot of teleconsultations took place during the pandemic, the doctor's experience with telehealth was not satisfactory. Since they largely leveraged generic communication apps / platforms for consultations, they faced a lot of subsequent administrative issues. They were reluctant to utilise more sophisticated telemedicine platforms for their consultations for fear of getting tied to a specific technology / vendor.

It is in this context that ABDM proposed a **Digital Health Stack** which would enable the creation of an open and interoperable network for digital health services. (See Figure 9.) The key building blocks include standardized health registries of doctors and healthcare facilities like hospitals and diagnostic centres, a unique patient identity (Health ID), and federated health records (PHR and eMR).

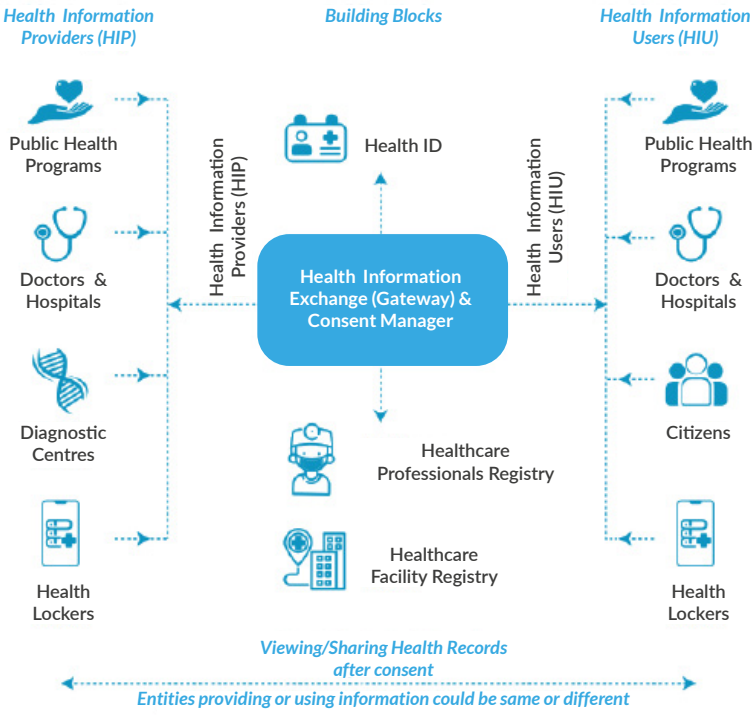

Figure 9: Digital Health Stack Building Blocks (Source: Ayushman Bharat Digital Mission)

Platforms & Engagements

The Unified Health Interface (UHI) in ABDM's digitalized ecosystem, a revolutionary concept and probably the first-of-its-kind in the world, ensures that a digital health service can be delivered between any end-user application (such as a digital app providing telemedicine service) with any health service provider (such as individual doctors, hospitals, and labs) in this ecosystem.[21] (See Figure 10.)

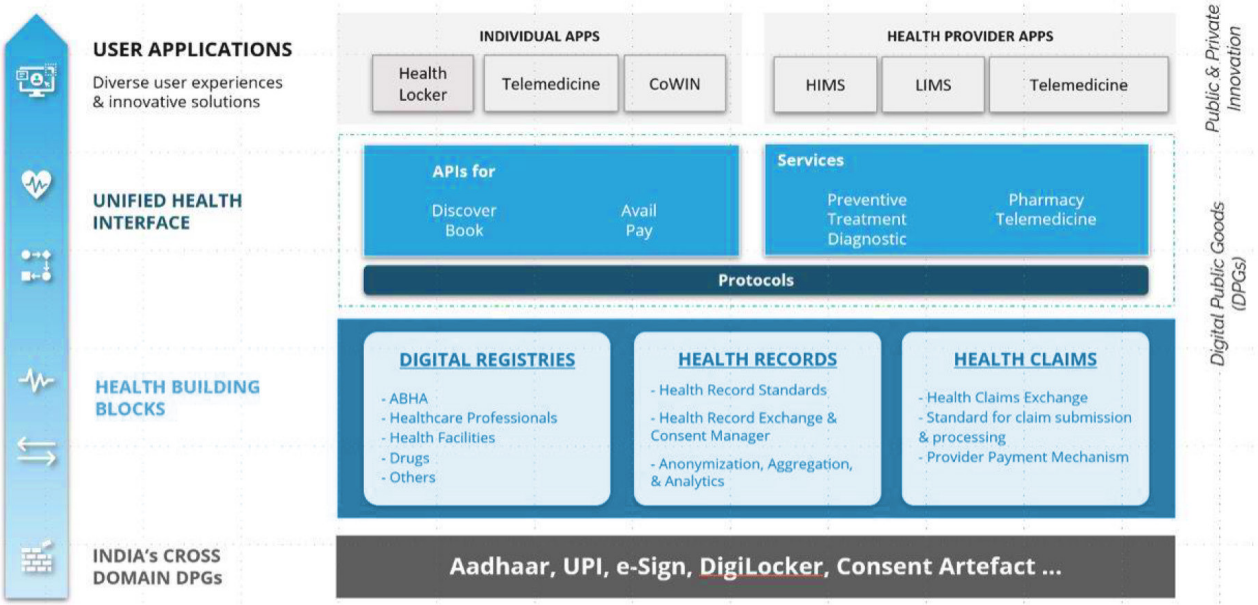

Figure 10 : UHI Layer in the ABDM Architecture (Source: Ayushman Bharat Digital)

The digital public goods or the public IT stacks that India has developed, such as UHI for digital healthcare, or Unified Payment Interface (UPI for financial payments), are in a way unique illustrations of the Web3 principles of open, decentralized and federated architectures.[22] The Indian digital health stack has some key differentiators when compared to a traditional Hospital Management System (HMS) – they have protocol-driven architectures, are available as digital public goods, are patient (citizen) centric with consent architecture, and allow for ecosystem (government, private and plural sectors) to innovate on the digital stack:

- The mechanism is protocol driven – these protocols are open to all; any company can leverage the protocol and create a healthcare delivery or claims application which a consumer or other healthcare stakeholders may use.
- The identity of the patients is authenticated by healthcare providers with the Ayushman Bharat Health Account (ABHA) Number. This in turn is authenticated using an eKYC process driven by Aadhaar (India's identity platform). The ABHA number allows patients to access and share their health records digitally, and enables their interaction with participating healthcare providers (digital lab reports, prescriptions and diagnosis). In this unique model of Web3, the public IT platform plays a role of a trusted intermediary, a requirement in the prevalent levels of low digital literacy in India.
- Since the transactions conform to standards set in the UHI protocols, they are matched by the respective healthcare players (providers, payers, third party administrators, etc.) without a need for another intermediary healthcare services player.

- Data sharing in the ecosystem conforms to the Data Empowerment and Protection Architecture (DEPA). DEPA's technology architecture is a consent-driven, interoperable, secure, and privacy preserving framework for data sharing.

COVID Management – Aarogya Setu and Co-WIN

During the COVID-19 pandemic, the Government of India undertook large-scale programs – first, in April 2020, to do contact tracing of people affected by the virus, and then, in January 2021, to run the world's largest COVID-19 vaccination drive.

Consider the context of vaccination in India. Two vaccines were approved in the initial days – Covishield (2 doses separated by 6 to 8 weeks) and Covaxin (2 doses separated by 4 to 6 weeks). Further, the vaccination was offered in a staggered manner depending on whether the person was a health / frontline worker, their age, and whether they had any comorbidities. Also, the vaccine shots were made available in both public and private healthcare facilities, at different price points. It was indeed a mammoth task of vaccinating hundreds of millions of Indians in different cities and villages and coordinating with the healthcare providers, government health department executives, vaccine manufacturers, supply chain executives who ensured that vaccines reached every nook and corner of the country, and other stakeholders. (See Figure 11.)

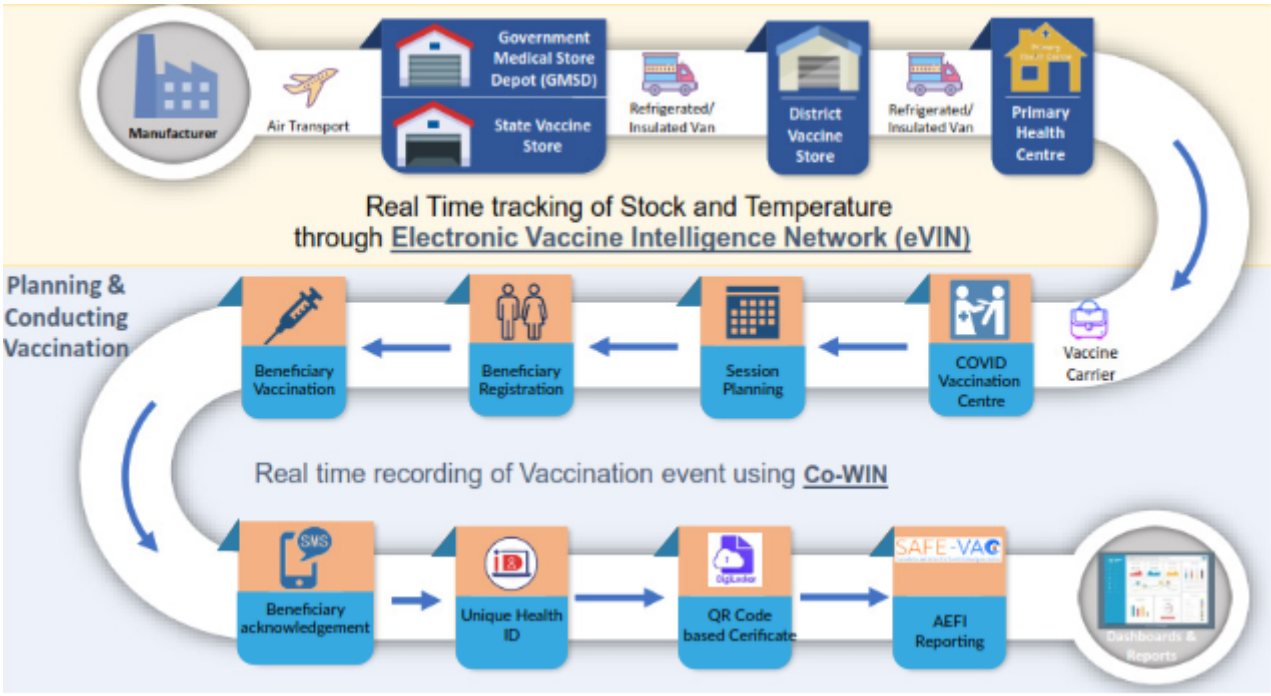

Figure 11 : COVID Vaccine Delivery Management Process (Source: Cowin.gov.in)

The government created and leveraged digital platforms – Aarogya Setu and Co-WIN (Winning Over COVID-19) – to manage these programs.

Now, consider the following engagement scenarios, for instance. The patient could book a doctor's

appointment on “Arogya Setu” app that she had on her mobile, while the doctor would receive and accept this booking on a hospital specific app that he used. The doctor’s prescription could be processed by an online pharmacy on its own platform. Although each of the actors in this engagement were utilising their own application / platform, they were able to seamlessly interact with each other because all the applications conformed to the UHI protocols. This is similar to how users may use different email apps (Gmail, Outlook etc.) and send mails to each other thanks to open protocols (SMTP).

While UHI based digital health system offers a lot of flexibility, it also poses certain risks. For instance, for a hospital in the ecosystem, its doctors, who would have traditionally been available exclusively on its premises / own digital platforms or in select few other locations, would now be discoverable by any patient in the open network. This poses a potential risk of revenue leakage for the hospital. How well such risks are addressed will determine the extent of success of the UHI model.

Aarogya Setu and Co-WIN were developed / managed under the aegis of the Ministry of Information Technology (MeitY), and involved a unique public-private-plural collaboration of National Informatics Centre (NIC) and volunteers from industry, academia and civil society. Eventually their management was transferred to the National Health Authority under ABDM.

Aarogya Setu made use of cutting-edge Bluetooth technology, algorithms and artificial intelligence to monitor Covid-19 cases and manage the pandemic. Later, innovative capabilities were added to it including features like e-pass, QR code scanning, and open application programming interface (API) service for organizations to obtain information on the health status of their employees in real time. Even as it garnered over 176 million users, it faced questions related to its application security and privacy protection capabilities.[23]

Co-WIN was created as a tech-based platform facilitating the planning, implementation, monitoring, and evaluation of Covid-19 vaccination in India. It offered features such as beneficiary registration management, vaccination appointment scheduling, beneficiary verification and vaccine administration, and vaccine certificate issuance. (See Figure 12.)

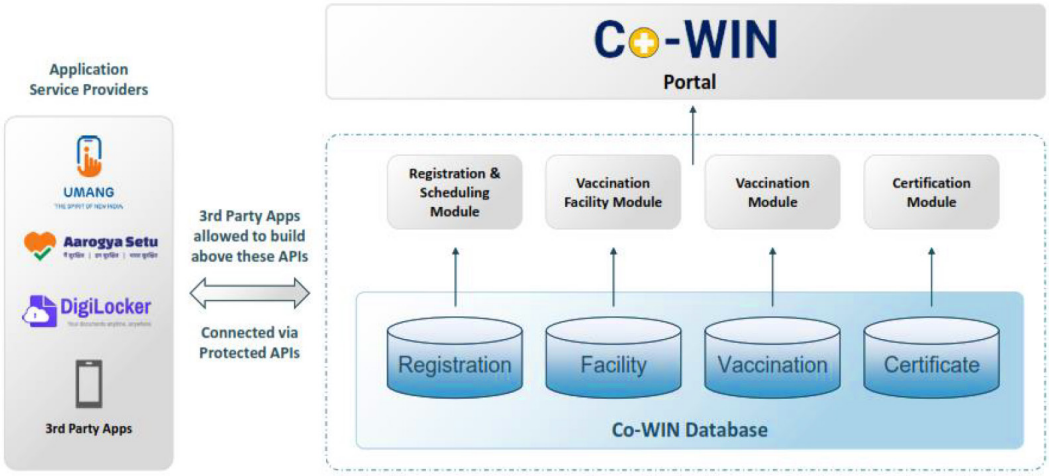

Figure 12 : Architecture of Co WIN (Source: Cowin.gov.in)

For example, citizens could register on Co-WIN by simply providing their mobile phone number and an identification number, such as that of their Aadhaar (India's unique identity platform), and schedule their vaccination slots at the nearest vaccination centres. Under ABDM, they can register using their Ayushman Bharat Health Account (ABHA) ID. Since these are authenticated IDs, the system can determine eligibility of the person for the vaccine corresponding to the phase of the vaccination drive (age, first dose or second dose etc.).

For citizens who did not have access to the Internet or a smart phone and who could not register online on Co-WIN, the process was tweaked to allow them to register on the spot at the primary healthcare centre for their first shot of the vaccine. Their information was captured in the Co-WIN back-end, and made available online when they revisited the centre for their second shot.

Cross-sector initiatives like Aaraogya Setu and Co-WIN have been initiated not just by the Government, but also by the private sector and the civil society, often coming together as volunteering networks. An illustrative list of these digital health initiatives in India is shown in Figure 13.[24]

Digital Health Initiatives Government	*National Digital Health Mission called Ayushman Bharat Digital Mission*
	The Government of India developed AarogyaSetu, a contact tracing app to track COVID 19 patients, and CoWIN, a digital platform to support the pandemic vaccination drive Indian SARS
	CoV 2 Genomics Consortium (INSACOG) has been set up for genomic surveillance of SARS CoV 2 in India
	The Department of Biotechnology started the "Genome India Project" with the aim to collect 10,000 genetic samples from citizens across India, and to build a reference genome an exhaustive catalogue of genetic variations for the Indian population
Digital Health Initiatives Private sector & Civil Society	*Several private hospitals have embraced digitalisation and adopted telemedicine. For instance, the Apollo 24/7 initiative integrated 2,500 of hospital beds and another 2,000 hotel beds, plus home care, to create a complete COVID 19 solution, making it the largest effort outside government in India*
	The Tata Trusts are using the 'digital nerve centre' (DiNC) technology platform to connect the top Cancer Hospitals in the National Cancer Grid. This allows data sharing across these centres, and enables delivery of comprehensive cancer care service to patients
	Swasth Alliance, under Swasth Digital Health Foundation, is a not for profit consortium of 150+ players in the healthcare ecosystem hospitals, health tech firms, pharmacies, and investment funds and aims to help India provide quality healthcare using digital technologies
	Project StepOne is a collation of technologists and 7000+ volunteer doctors helping governments manage the COVID 19 crisis through free telemedicine. Their solution works without smart phone or internet or the need for the caller to be literate as they can speak in their own language with the IVR & doctors

Figure 13: Digital Health Initiatives in India

Impacts

ABDM Pilots

ABDM pilots have been launched in the Union Territories of Chandigarh, Ladakh, Dadra and Nagar Haveli and Daman and Diu, Puducherry, Andaman and Nicobar Islands and Lakshadweep. And as of March 2021, nearly 10 lakh Health IDs have been issued.[25] In the next few years, as these pilots become full-fledged implementations across the nation, several benefits will accrue to India from such a digital health stack:

- Digital health interventions can help address health system challenges such as geographical inaccessibility, low demand for services, delayed provision of care, low adherence to clinical protocols and costs to individuals/patients.
- The disparate systems will become integrated and healthcare processes will get streamlined. More health data is available to both the healthcare provider and the patient, and hence medical care will shift from episodic treatment to a focus on wellness.
- Telemedicine may be the compelling use-case for digital health adoption in India, like Direct Benefits Transfer has been to digital payments. It will allow doctors in cities to consult patients in rural areas, thus alleviating the problem of skewed distribution of healthcare professionals in the country. In villages, community healthcare workers can do an initial assessment using a checklist and then turn to teleconsultation with a qualified doctor. The Government's e-Sanjeevani platform (for telemedicine), launched in April 2020, completed over three lakh consultations in a short span of six months.

COVID Management – Aarogya Setu and Co-WIN

By August 2020, more than 6.6 million contacts were traced using Aarogya Setu. The technology proved to be highly effective – it identified nearly 4 times more percentage of COVID-19 positive cases as compared to the national-level serosurveys (27% Vs 7%). More than 30,000 disease hotspots, with pin-code level accuracy, were identified and shared with state governments in whose jurisdictions they fell.[26]

In terms of the Co-WIN portal, the numbers are staggering – it was one of the fastest platforms to reach 200 million registrations in under four months; and the platform was robust enough to handle over a billion visits a day (achieving a peak of 3.1 billion hits in a single day)! In terms of its impact, the numbers are equally stunning. As of 31 August 2022, 2.12 billion doses of the COVID-19 vaccine had been administered.[27] Over 95% of the eligible population in India had received at least one shot. India is one of the few countries in the world to have a completely digitised vaccination certificate program – certificates with QR codes for easy authentication anywhere, encrypted, digitally signed, and available on any smartphone.

Let us turn our attention to the digital health initiatives at Apollo Hospitals, one of India's largest private hospital chains.

Apollo 24/7 Platformized Ecosystem

Ecosystem & Experiencers

Apollo Hospitals consists of over 10,000 beds across 73 hospitals, 4500+ pharmacies, over 300 clinics, 1100 diagnostic centres and 200 telemedicine units across 17 countries.[28] Its digital health initiatives have evolved over the last two decades.

- Apollo in fact ushered in telemedicine in India in 2000-01, when it partnered with the Indian Space Research Organization partnered to launch satcom-based telemedicine services by connecting Apollo Hospital Chennai with a healthcare facility in the village of Aragonda in Andhra Pradesh.

- Apollo Tele Health Services, formed in 2010, is the partner for community health care in rural villages, under Common Services Center (CSC) program of the Government of India.

- In February 2020, just as the Covid-19 pandemic broke out, Apollo Hospitals launched its Apollo 24/7 platform, offering a full bouquet of healthcare services ecosystem – 24×7 consultation with 7000+ Apollo doctors across 55+ specialties, medicine delivery at home across 15,000 pin codes of India, diagnostic test booking and doorstep sample collection, digital health records and more.

- In June 2021, Apollo created India's largest omni-channel healthcare entity called 'Apollo Health Co' by merging its online and offline pharmacies and telemedicine businesses.[29]

A multitude of eXperiencers – from healthcare professionals (such as doctors and nurses) in the hospital, healthcare workers at remote tele-clinics, and heterogeneous patients from urban and rural India, engage 24x7 with Apollo's healthcare ecosystem. They all have differing expectations through their varied and complex nature of interactions. They range from patients seeking basic information regarding their symptoms to possible solutions for a wide range of health symptoms before they would consult the doctors. It has about 3 to 5 million weekly active users, of which 85 percent come in only for content.[30]

Platforms & Engagements

The Apollo 24/7 platform offers an experience-centric solution that leverages cloud-powered clinical intelligence and connected devices, with online personal health records. It uses Microsoft Azure for enabling patients to access and transact on the platform securely and at scale. The platform also uses Azure Communications Services for building rich and secure communication experiences including chat, voice, video and text messaging.[31]

One of the advantages of being a vertically integrated omnichannel platform is that when patients come through its consumer-facing app, their subsequent diagnostic or surgery requirements may be recommended and fulfilled from within the Apollo system. This capability extends to fulfilling pharmacy needs arising from a tele-consultation. Apollo 24/7 has the ability to deliver medicines from its nearby physical pharmacies within 2 hours to several thousands of PIN (Postal Index Number) codes in India.

As patients seek highly customised treatment solutions, it launched ProHealth, a unique end-to-end personalized, proactive health management program that brings together predictive risk analysis, cutting-edge diagnostics with physician evaluation, and a personalized path to wellness. The program was created based on data from 22 million health checks in their hospitals.[32]

Doctors seek data analytics solutions to help in their clinical assessments. For instance, in 2018, Apollo Hospitals partnered with Microsoft to develop an India-specific heart risk score and better predict cardiac diseases for the general population. This analysis was based on seven years of clinical and lab data of 400,000 patients from master health check-ups conducted at its hospitals between 2010 and 2017. The accuracy of their model for the Indian population in predicting the probability of coronary disease in the future was twice that of existing ones.[33]

Impacts

Apollo has become India's highest earning tele-health platform, and has served over 27 crore people in 500 days of its launch.[34] Apollo 24/7 has over 10 million registered users, with over 20% of them transacting through its platformized ecosystem of orchestrated capabilities. It offers tele-consultation to patients from about 400 cities in India and services about 17,000 PIN codes in the country (for pharmacy delivery).[35] From a health equity perspective, Apollo's tele-clinic services play an important role in bringing high-quality healthcare to the remote corners of India. It offers tele-consultation services through 60,000+ village level Common Service Centres (CSCs) in India, which are Information and Communications Technology (ICT) access points, created under the National e-Governance Project of the Indian government. Apollo has also established partnerships with a number of state governments to offer services in their village-level primary healthcare centres.[36]

Apollo, which is the largest provider of cardiology services in India, is also working on better understanding of cardio-vascular diseases (CVD) in the country. Apollo Hospitals has partnered with Abbott Laboratories to set up the first National Cardiac Registry in India, which will help collect data to enable researchers to better understand the causes of CVD. Data from 16,000+ employees of Apollo have already been screened and added to this registry.[37]

Digital health initiatives in India have been anchored not just by public and private organizations but also by plural institutions. Let us look at the example of how Swasth Alliance is creating a digital public good in health insurance, the Health Claims Data Exchange (HCX).

Health Claims Data Exchange (HCX)

Ecosystem & Experiencers

Consider the existing mechanisms for health insurance claims processing in India. Patients provide the hospital with their policy details (or a third party administrator (TPA) card). The hospital fills out the pre-auth/claim form by hand, scans all the required documents, and forwards these to the appropriate insurance or TPA by email or in company-specific portals. The insurer/TPA then verifies the form and adjudicates the claims, often manually. A response to the pre-auth/claim is sent back to the hospital over email.

The existing health insurance claims filing and processing system in India is highly inefficient, with high variability and non-standardization of processes between insurer/TPA/provider, and is fairly manual in nature including data flows across the ecosystem. This results in multiple follow-ups, lack of visibility in the process, long receivable cycles, a lack of scalability and a high cost of processing. The patient experience for claim processing is cumbersome.

The ABDM digital health stack is expected to have a transformative effect on health-insurance claims processing. Based on the recommendations of the Joint Working Group of the National Health Authority (which manages ABDM) and the Insurance Regulatory and Development Authority of India (2019), a collaborative and open effort was anchored by Swasth Alliance,[38] a non-profit consortium of 150+ players in the Indian healthcare ecosystem. More than 80+ volunteers from 60+ diverse organisations have so far contributed to the development of the HCX protocol, which will continue to evolve.

The larger vision was to enable a comprehensive health benefits network, with HCX as the fundamental infrastructure and insurance envisaged as the initial domain. The aim was to create a Health Claims Data Exchange as a public platform, where health providers (like hospitals, primary care centres, or diagnostic labs) submit their e-Claims, and insurers / TPAs receive these claims via standard APIs. (See Figure 14.)

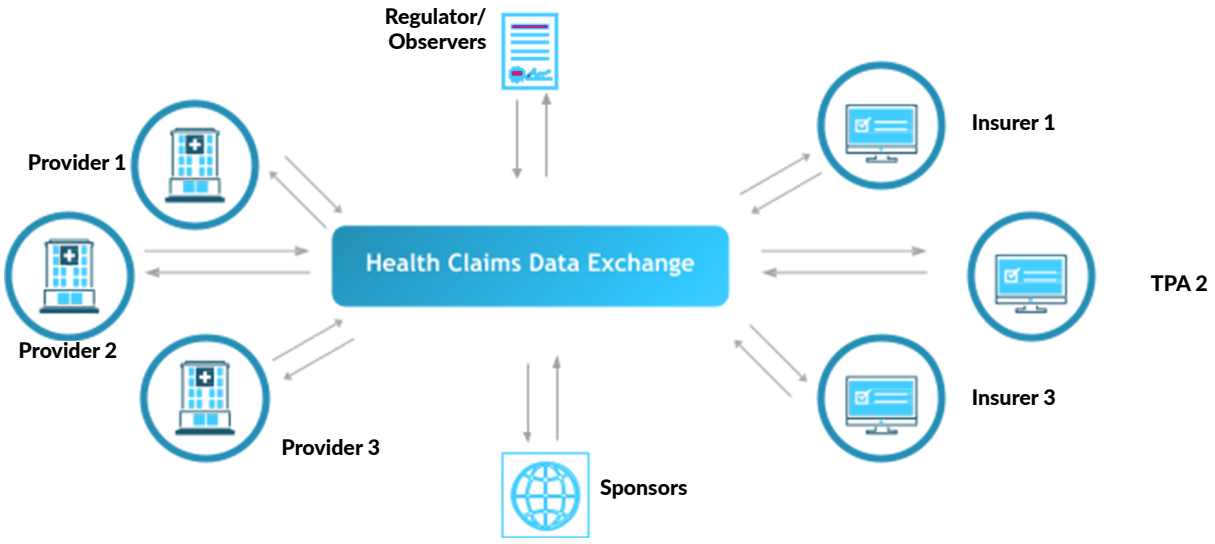

Figure 14 : Health Claims Data Exchange (Source: http://hcxprotocol.io/)

Platforms & Engagements

The HCX, which is analogous to email exchange networks that allow exchange of mails between disparate email applications, provides a protocol for exchanging claims-related information between relevant actors - payers, providers, beneficiaries, regulators/observers, and sponsors.

HCX consists of the following key building blocks:

- Specifications - this layer defines the blueprint for different aspects of the claims network. These include communication protocols, data packet specifications, taxonomies, privacy and security specifications, network policies (onboarding and deboarding rules), business rules, operational specifications, etc.
- Reference Health Claims Exchange software - A reference gateway implementation built as per the standards defined above.
- Compliance sandbox - Implemented using the above reference software, it helps the ecosystem test its specific components against the network standards defined above and get certified to become part of the network.
- Health Claim Platform runtime(s) - Operating instances of the health claims platform that enable real-world claims interactions on the network. There can be multiple such running instances that are expected to be interoperable by adhering to the standards defined.
- Participating platforms - These are digital technology systems of the network participants (payers, providers, regulators, observers, and sponsors).

Impacts

The expected benefits of HCX include the following:

- Expand insurance penetration – due to standardisation and usage of electronic means to receive and process claims, the administrative costs will come down. This in turn may spur the introduction of new insurance products that cover use cases such as OPD (out-patients) and pharmacy. It may also lead to an increased acceptance of cashless claims (even in smaller hospitals). HCX aims to handle at least 50% of India's cashless claims.
- Facilitate insurance innovation in the form of highly personalized policies, auto adjudication, better fraud and abuse prevention.
- Better patient experience with respect to claims processing.
- Increase trust among payers and providers through a transparent, rule-based mechanism.
- Later, HCX will enable a broader health-benefits network such as supporting community wellness / shared health risk models and electronic healthcare voucher-based digital payment systems.

HCX may entail certain perceived risks, especially for strong incumbent players in the ecosystem. For instance, the TPAs who have already built strong interfaces with payers / providers, and which is a source of their competitive advantage, may resist joining or promoting such open platforms.

Let us now consider a few global examples of innovative digitalized offerings and business models in health insurance.

Swiss Re and Gro Health

Ecosystem & Experiencers

Insurance and Technology (InsurTech) have converged to create new digitalized experiences and interactive X-verse ecosystems. In the car insurance sector, for instance, telematics products are being leveraged to understand how a person is driving, and based on the data potentially lower their insurance premiums. Lemonade, an insurtech startup, launched Lemonade Car insurance, after acquiring Metromile, which augmented Lemonade's substrate of experience-oriented technology capabilities that it had built from the ground up with its property and casualty insurance offerings. Powered by telematics and architected to learn from the data it generates, with Metromile's proprietary data and machine learning algorithms, Lemonade Car seeks to get better and efficient at quantifying and underwriting risks, with "precision pricing". It is designed to break the conventional tradeoff between *contextualization* and *efficiency* (as we also discussed in the previous report on education X-verse innovation through the DIKSHA example).[39] Lemonade was founded to make insurance into a social good, and its choice to become a B Corp as well as a public-benefit corporation legally commits it to a double bottom line. In the car insurance ecosystem, a car company can also get into the action directly. For instance, Tesla offers its car owners an insurance product that uses metrics of real-time driving behaviour such as aggressive turning, hard braking, and unsafe following distance, to determine customers' insurance rates.[40]

Such "behavioural precision priced insurtech offerings" are also evolving in healthcare ecosystems. For instance, a diabetic and obese person with habitual smoking is rewarded by the insurer with a lower premium once the policyholder demonstrates an active health fitness regimen, with weight loss, dietary changes, giving up smoking, etc., and bringing diabetes under control. This movement in risk management towards "prevention" that creates "win-win" wellbeing impacts underlies new insurtech offering ecosystems and business models.

Consider the Swiss Re Group, one of the world's leading providers of reinsurance and insurance. It was looking to redefine the health insurance underwriting process – to change from something that is done once, for the insurer's benefit only, to a practice that is part of an ongoing assessment that helps individuals better manage their own health risks. It aims to improve long-term engagement with policyholders and for insurers to be seen as partners in helping them lead healthier lives. Swiss Re partnered with Gro Health, an evidence-based behaviour change platform that tackles non-communicable diseases, for a Diabetes Management Programme. Its digital health and nutrition platform provides access to one of the world's largest and most active support communities for diabetics, pre-diabetics and those overweight. It involves a 12 week structured programme to address all aspects of modifiable risks including sleep, nutrition, activity and stress.[41]

Platforms & Engagements

The digital platform consists of a smartphone app that includes many functionalities of a typical fitness-tracker app – such as recording daily food intake and exercise, and integration with wearables, etc. It also includes diabetes-specific features such as integration with smart blood glucose monitors.

The app leverages AI to personalise support and recommendations, in the form of structured video modules, how-to guides and coaching, to each user so that they stay engaged with the programme for a long time.

Impacts

The programme is remarkably successful with 70% of users remaining engaged 12 months after downloading the app, and 39% having put their type 2 diabetes below the threshold.

Swiss Re's research shows that consistently using an app like the Gro Health Diabetes Management Programme could lead to health improvements that translate into up to 5% lower claims costs. Insurers may choose to pass on such reduction in costs as benefits to users of the app.

Beyond the economic benefits, the policyholders can potentially lead healthier, longer and more productive lives.

Granular from Verily

In 2021, Swiss Re made an investment in Granular (and originally called Coefficient Insurance Company), a subsidiary of Verily, an Alphabet company, which is offering an "employer stop-loss" solution. It is a segment of commercial insurance that protects self-funded employers from unexpected and large employee health benefit claims by reimbursing employers for claims above a defined amount.

Granular uses an analytics-based underwriting engine to identify unexpected areas of cost volatility and offers a more predictable and precise insurance policy provisions. For instance, rather than treating insurance-covered employee population as one unit and providing a single deductible for each employer, Granular segments the population into as many as 22 unique cohorts.

Granular plans to integrate Verily's employer health solutions, that includes mobile health devices and innovative care management programs such as its Onduo virtual diabetes clinic, in order to align payment models with better health outcomes.[42]

Discovery

Ecosystem & Experiencers

Discovery is an insurance company from South Africa that has pioneered a shared-value business model.[43] It delivers better health and value for clients, superior actuarial dynamics for the insurer, and a healthier society. (See Figure 15.)

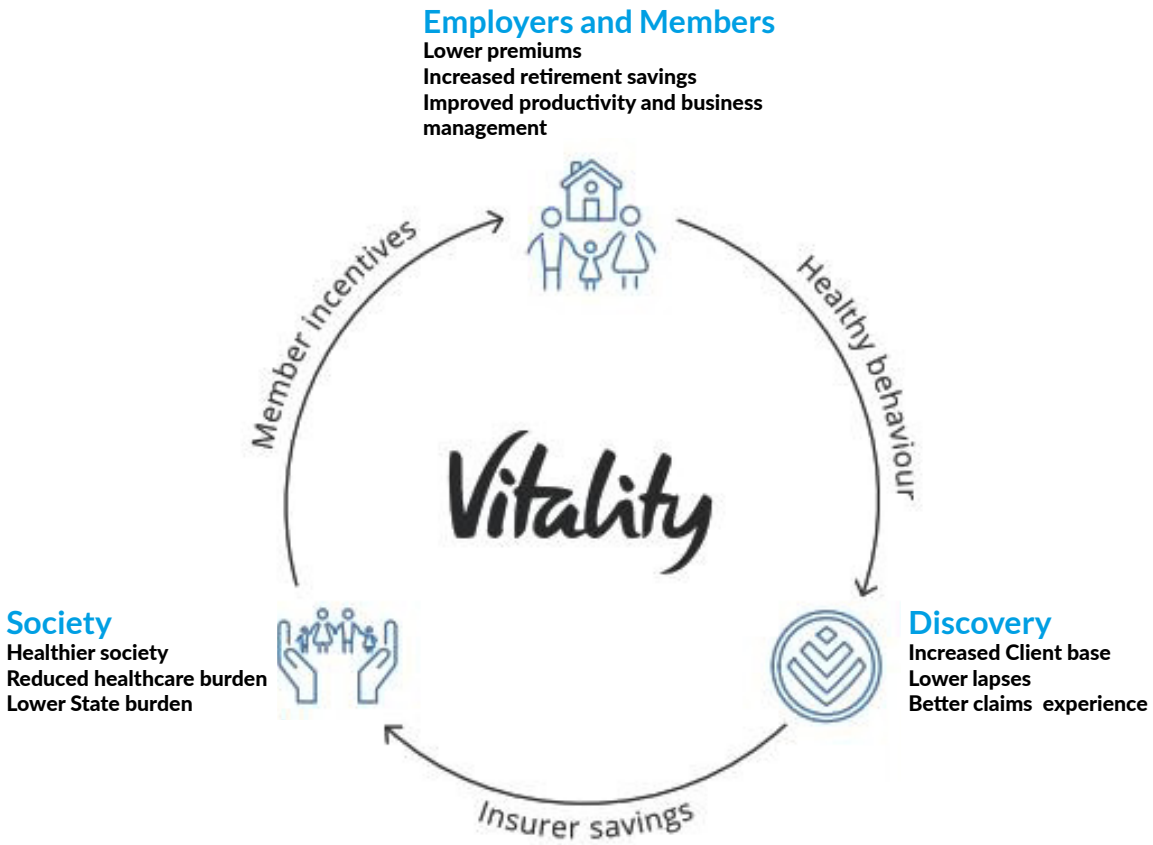

Figure 15: Discovery Shared value Business Model (Source: www.discovery.co.za)

Discovery's Vitality offering offers employees of businesses a science-based behaviour change programme that helps them keep track of their progress towards becoming healthier and rewards them for making better choices with a premium range of health, lifestyle, and leisure benefits. For instance,

- 'Vitality Active Rewards' offers reward points on achieving personalised weekly exercise, drive (with respect to car insurance), and money (with respect to personal finances) goals for a healthier life. Discovery offers an Apple Watch when employees meet exercise goals over 24 months.
- Discovery has partnered with retailers like Pick n Pay and Woolworth and offers 25% back on healthy groceries.
- Discovery has partnered with fitness-related companies like Strava, the world's leading running and cycling platform, to recognize and reward members as they get active. Community members of Team Vitality, South Africa's favourite running and cycling club, can connect and compete with millions of runners and cyclists across the world.
- Employees get big reward points for completing online health assessments and performing a health check.

Discovery's healthcare ecosystem goes well beyond the traditional offerings of businesses. While its Health Medical Scheme offers a wide choice of health plan options for employees and their families at all levels of affordability, its Healthy Company offers digitally-enabled, comprehensive employee assistance programmes.

Platforms & Engagements

At the heart of Discovery's strategy is Vitality, the world's largest behavioural platform linked to financial services, which rewards and incentivizes people to make healthier choices and adopt behaviours that contribute to better health outcomes. The Vitality engagement platform journey is shown in Figure 16.

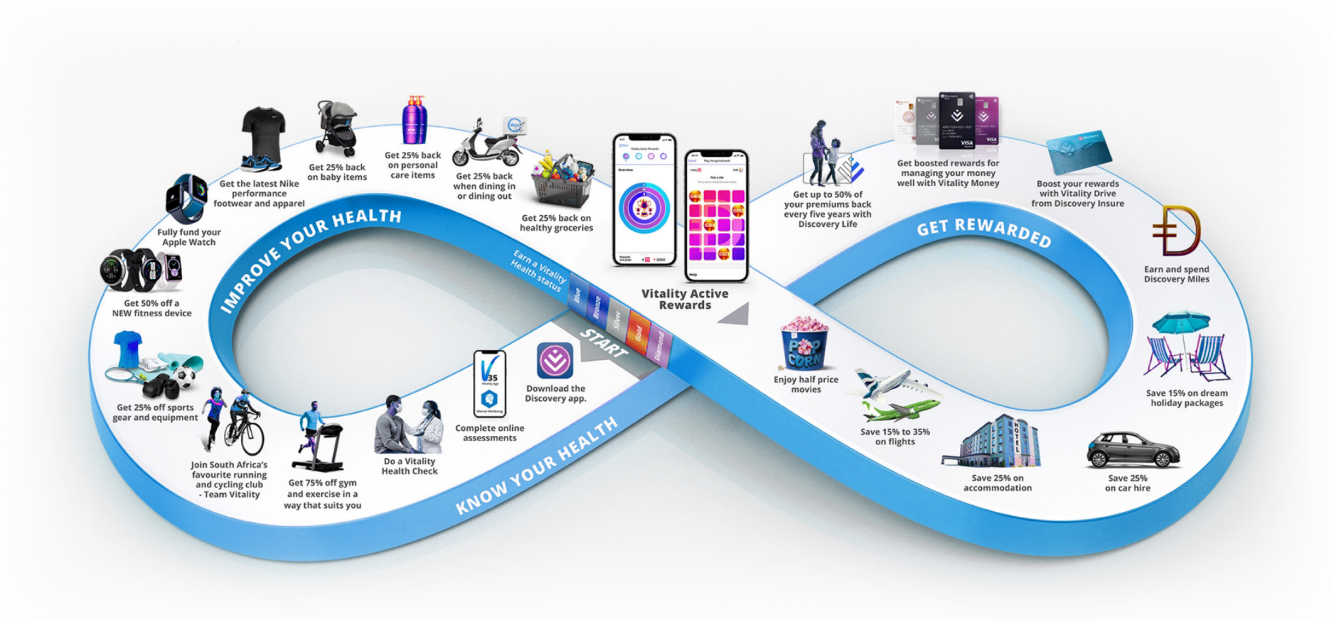

Figure 16: The Vitality journey. (Source: discovery.co.za)

When one joins Vitality, there is a health assessment and selection of a set of personal goals to improve overall health and fitness. As an employee of a business, a comprehensive health and wellness screening is conducted, and a risk profile is generated. Employees are classified accordingly across key dimensions of wellbeing – physical, emotional and financial wellbeing, as well as legal support. A proactive, customised support plan is created that includes interventions from prevention and education to episodic or ongoing management across all dimensions of wellbeing.

As members engage through the Vitality platform, members earn points by working out at the gym and upon check-ups at Discovery associated wellness centres. However, failure to meet goals after getting an Apple Watch means that members have to pay monthly instalments to retain it. Following behavioural theory of losses looming larger than gains, losing a benefit already received makes for stronger motivation than the prospect of a future reward.

Vitality, as a personal, social, and collective engagement platform, emphasizes how a healthier individual can influence healthier family, and in turn, a community to which one belongs. And when society at large becomes healthy, it reduces the burden on the healthcare system. As for Discovery, it brings productivity into its value chain with a scale-efficient operating model, even as it gains with fewer policy lapses and lower claims.

Impacts

Having started in South Africa in 1992, Discovery has seen a phenomenal growth across the world. Discovery impacts 25.7 million lives globally and 11.2 million lives on Vitality in 20 countries.[44]

During the pandemic, Discovery came up with several winning and innovative offerings. They include:

- A prepaid health platform, similar to prepaid telecom model, that allowed anyone in South Africa who has internet or WhatsApp to buy vouchers to see a private doctor. Only 16% of South Africa's population has private medical aid, and up to 50% of the population chooses to access primary healthcare in the private sector. This offering proved popular with the non-insured consumers, and Discovery added 2.78 million more members in a year.[45]

- It also expanded its popular Vitality Active Rewards programme to include kids and partnered with Apple Pay. With the pandemic-induced lockdowns, parents were spending more time with their children at home. Discovery allowed parents to co-opt their children in healthy activities, such as “Eating a health breakfast” and “making exercising fun”, that were gamified to earn rewards.[46]

- Discovery, in a model of private-public partnership, opened five mass vaccination centres in South Africa, and offered its internal Covid-19 Vaccination Navigator system to citizens for booking their slots.

- Consequently, Discovery’s brand value saw a sharp increase. Kantar, in its Most Valuable South African Brands 2021, identified that Discovery had outpaced all other brands in South Africa, growing by more than 26% over the past year.[47]

Next, we look at examples of industry clouds for healthcare.

Oracle Cloud for Healthcare

Ecosystem & Experiencers

One of the critical global challenges today, a need accentuated by the pandemic, is to dramatically improve the healthcare experiences and outcomes. Oracle Health is looking at creating solutions for a more effective, efficient, and secure healthcare, involving all stakeholders in the ecosystem – patients, providers, payers, public health and citizens. Their healthcare solutions promise to deliver better patient outcomes, help caregivers make informed treatment decisions, enable governments to respond faster to public health crises and so on. (See Figure 17.)

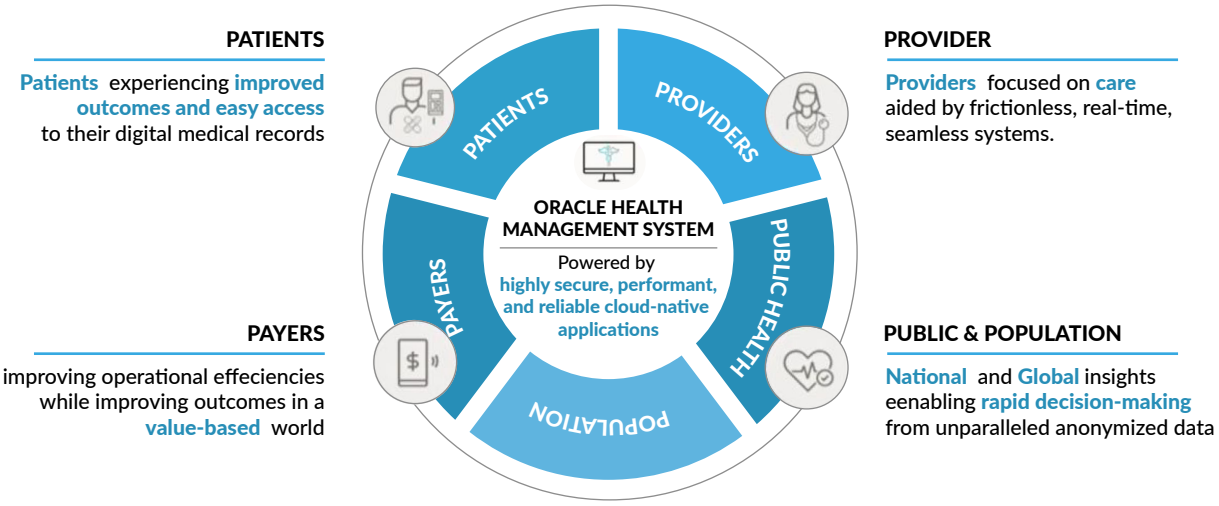

Figure 17: Digital Health Transformation with Oracle Health Cloud (Source: Oracle)

Let us consider a few scenarios from the point of view of a healthcare provider. There is a trend among hospitals in the US which are shifting from a fee-for-service model to a value-based care or quality-metrics-based reimbursement model.[48] This places pressure on the doctors to be more thorough with their paperwork and filling in relevant details of patients and their treatment plans, so that the reimbursements are maximised. But research shows that doctors already spend nearly twice as much time on administrative work as they do in engaging with patients.[49] The doctors need digital health solutions that reduce their non-clinical workload and give them more time for patient-care.

Hospitals have to contend with a new trend when it comes to human capital management. Healthcare workers (such as nurses, therapists) have embraced the gig economy – where they take on short term, more remunerative engagements and shift frequently between hospitals. Thus, providers need new systems to handle their workforce.[50]

Platforms & Engagements

Oracle has created a number of products for various solutions for healthcare organisations, as shown in Figure 18.[51]

Health insurance administration and operations	*Policy Administration and Claims Management* *Health Insurance Revenue Management and Billing*
Healthcare finance, operations, and HR	*Enterprise Resource Planning* *Supply Chain Management and Procurement* *Enterprise Performance Management* *Human Capital Management* *Customer Experience*
Healthcare analytics, artificial intelligence, and data management	*Oracle Analytics Cloud* *Oracle Cloud Infrastructure Data Science* *Oracle Healthcare Foundation* *Oracle Master Person Index* *Oracle Healthcare Translational Research*
Healthcare information exchange	*Oracle Healthcare Data Repository*

Figure 18: Oracle Cloud for Healthcare offerings. (Source: Oracle)

Consider the Oracle Health data platform, which consists of a data lakehouse on Oracle Cloud Infrastructure (OCI). It brings disparate data sources for analysis to provide a predictive, preventive, personalized, and participative patient experience. For instance, for specific medical conditions, it can help create correlations between diagnosis-treatment-length of inpatient stay-time to return-to-work. The Oracle data platform can also help with optimizing standards of care. Analysing data from a variety of sources can ensure mistakes in records are corrected, fraudulent claims patterns for providers / payers are identified, and processes and procedures are optimized. It also supports population health management programs which help improve the outcome of patient care while controlling costs by means of stratifying patients via risk profile and by designing holistic coordinated care programs for a targeted group of patients.[52] (See Figure 19.)

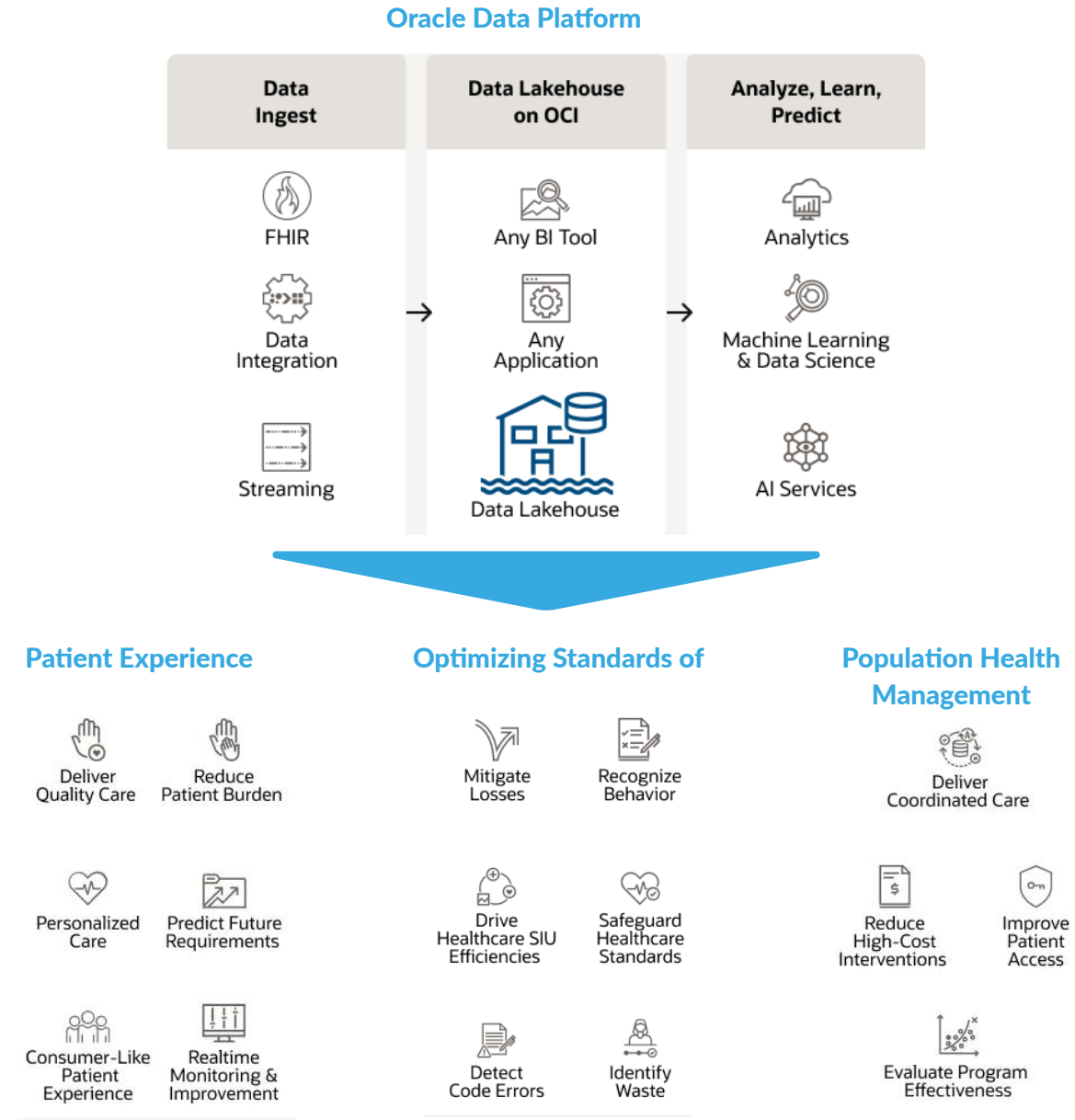

Figure 19: Oracle Data Platform (Source: Oracle)

Oracle Health offers solutions for human capital management for a healthcare provider. (See Figure 20.) For instance, in response to the trend of gig healthcare workers, Oracle offers an "Uber (the mobility-as-a-service company)" like scheduling engine, rather than only a workforce management system. The scheduling functionality is tied into EMR / EHR – so if a hospital has more nurses, it also needs to have enough ICU beds and supplies that the nurses manage / need. Oracle, which acquired Cerner, aims to provide enterprise solutions that address such linkages through a comprehensive "end-to-end" health industry cloud approach.

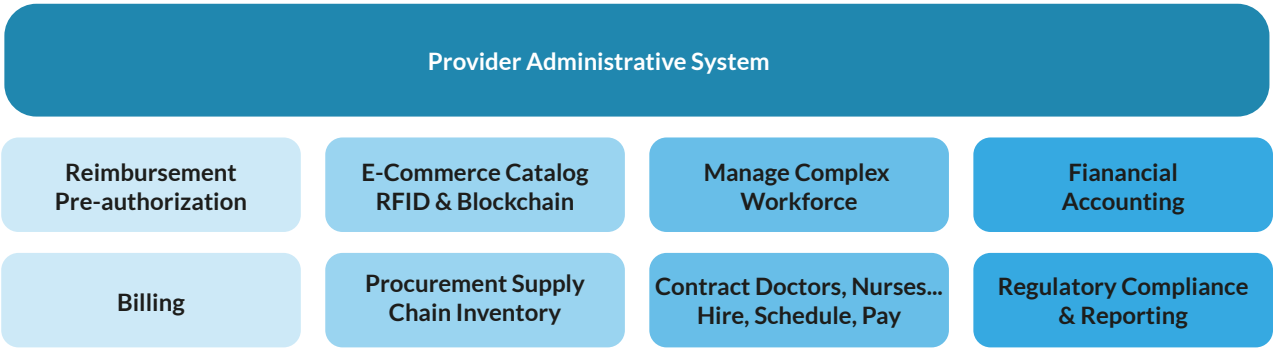

Figure 20: Oracle Fusion and Human Capital Management for healthcare provider (Source: Oracle)

Impacts

Consider a few specific examples of adoption of Oracle Health by its enterprise clients to understand the impacts the health-cloud solutions can bring. Experian, the leading global information services and credit reporting company, migrated their fraud detection systems, call center analytics, financial analytics, and credit ratings system in select geographies to OCI lakehouse. It helped deliver superior performance and 40% to 60% cost reduction as compared to other clouds.[53]

Prosperdtx provides digital healthcare plans for patients with cancer. It chose OCI Data Science to build machine learning models that would predict patients' risk factors for hospitalization, and then recommend ways to prevent those risks. Prosperdtx reduced its development time for migrating data and developing machine learning models from months to weeks. It also saved 25% in costs during the first 6 months of developing its product.[54]

Prospect Medical, which operates 17 hospitals and 165 medical care clinics across 5 states, wanted to lower the cost of patient care while enhancing the quality. They implemented Oracle Fusion Cloud HCM and consolidated information pertaining to 17000 employees spread across 34 different systems. This allowed HR leaders instant access to employee records for the first time. They also adopted Oracle Fusion Cloud SCM to face the supply chain challenges brought on by the pandemic.[55]

At a macro-level, Oracle's strategy of creating a large number of small data centres allows them to bring data centres to the country where they operate. They store the customer's health data, including de-identified data, in the local data centres and ensure the citizen's data does not leave the shores of the country. Such a strategy addresses the strong trend towards data localisation across various countries.[56] Oracle's partnership with Microsoft, of connecting OCI and Microsoft Azure, to give customers more choice for multi-cloud architectures is an example of how industry

cloud vendors are addressing the need for greater interoperability of data in the ecosystem. Other traditional cloud and SaaS vendors, such as Amazon, Microsoft and Salesforce, too are creating healthcare industry specific cloud offerings. Figure 21 provides a list of AWS purpose-built and HIPAA-eligible services for healthcare and life sciences.[57]

AWS purpose built and HIPAA eligible services for healthcare and life sciences	*Amazon HealthLake provides a complete view of individual or patient population health data for query and analytics at scale.*
	Amazon Comprehend Medical is a natural language processing service that uses pre trained machine learning algorithms to understand and extract health data from medical text.
	Amazon Transcribe Medical is an automatic speech recognition (ASR) service that enables transcribing physician patient conversations for clinical documentation.
	Amazon Textract is a machine learning (ML) service that automatically extracts text, handwriting, and data from scanned documents.
	Amazon Rekognition offers pre-trained and customizable computer vision (CV) capabilities to extract information and insights from images and videos.
	Amazon Chime SDK allows builders to add real time voice, video, and messaging powered by machine learning into their applications.
	Amazon SageMaker helps create, train and deploy ML models on the cloud, for automatically identifying anomalies in medical images or making personalized healthcare treatment plans.

Figure 21: AWS purpose-built and HIPAA-eligible services for healthcare and life sciences

Microsoft developed the Azure Health Bot that helped during the pandemic to triage symptoms, answer lab and COVID-related questions, and locate nearby clinics. Thousands of bots were built on the Microsoft Health Cloud, and they delivered close to 1 billion messages to over 80 million people worldwide, spanning 25 countries.[58]

In contrast to the above industry cloud approaches, which are more anchored in the private sector and striving to be as interoperable as possible, in the India context we saw a different and novel way through "digital public good protocols" such as UHI and HCX, in which such interoperability was aimed to be inbuilt, and being anchored more in the public sector. In both cases, there are also specific societal ecosystem coalitions whose alliances are orchestrated more by the plural sector.

Next, we will turn our attention to two such examples of societal ecosystem-driven innovations that were catalysed as part of a global COVID-19 pandemic response – Every Breath Counts Coalition and the Centre for Cellular and Molecular Platforms (C-CAMP).

Every Breath Counts Coalition

Ecosystem & Experiencers

As part of the Access to COVID 19 Tools Accelerator (ACT-A) initiative, a COVID 19 Oxygen Emergency Taskforce was launched in February 2021, involving more than 20 UN and global health agencies, including Unitaid, Wellcome Trust, WHO Biomedical Consortium, UNICEF, UNOPS, Global Fund, World Bank, and Every Breath Counts Coalition, to work together to support low and middle income countries (LMICs) to mitigate pandemic related medical oxygen shortages.

Every Breath Counts (E B C) Coalition one of the entities in the ACT-A ecosystem, originally focused on closing the critical gaps in pneumonia prevention, diagnosis and treatment. However, during the COVID-19 crisis, given the many respiratory care experts in its ecosystem, EBC shifted its focus to mobilizing its members to distribute oxygen supplies to LMICs to treat COVID-19 patients. It also managed the advocacy and communications objectives of the ACT- A oxygen taskforce engaging LMIC COVID-19 decision makers and donors (governments and foundations) to #InvestinOxygen, and elevating oxygen advocacy among these different stakeholders.

Platforms & Engagements

The initial engagement was around assessing acute and longer term oxygen needs in LMICs. During this process, the Coalition became aware of the wide scale problem of broken idle oxygen plants across Africa and Asia. But the challenge was that such information was either not readily available to LMIC governments and their international donors, or they had the information but were reluctant to share it.

To collect the information, EBC crowdsourced data about the names and location of broken/idle oxygen plants from the local community - typically hospital staff, NGOs, and government officials many of whom wanted to remain anonymous. To protect the privacy of the data provider, an open access Google sheet was created which allowed anyone to upload data anonymously. Other digital platforms including Zoom, Twitter and LinkedIn, were used to invite people to submit plant names and locations.

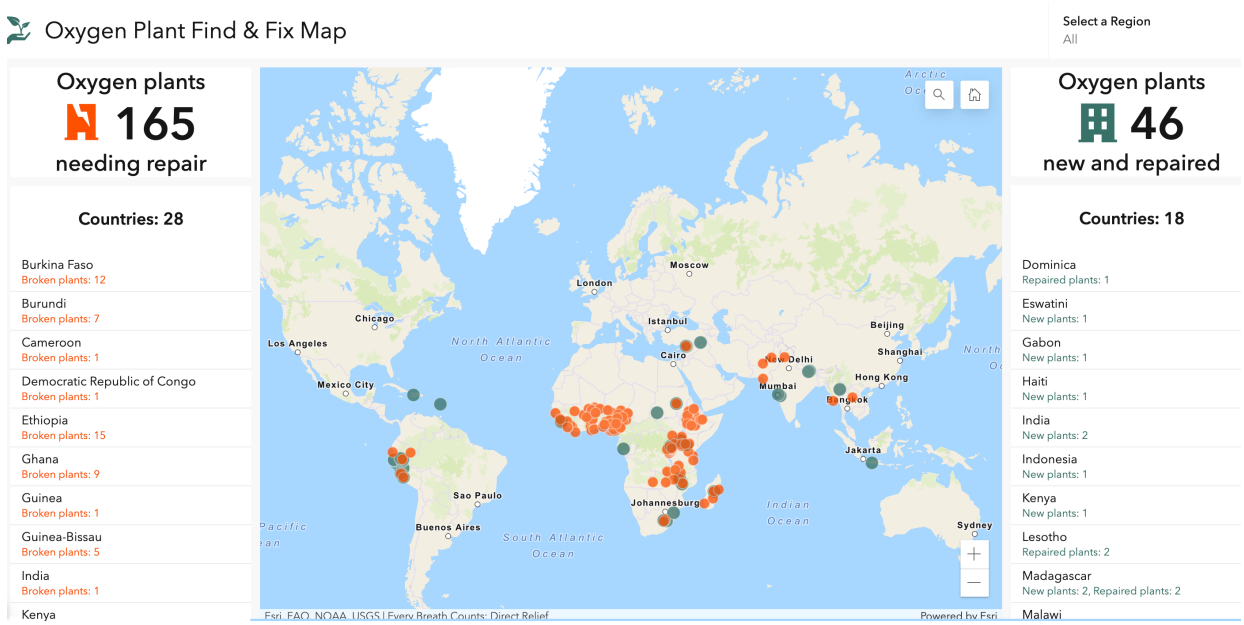

Figure 22 Oxygen Plant Find and Fix Map (Source: experience.arcgis.com)

The Coalition then turned this information into an online map that is regularly updated.[59] There are currently 164 oxygen plants in need of repair on the map, with 46 repaired. (See Figure 22.)

Further, to demonstrate the massive amounts of oxygen needed by COVID 19 patients in each LMIC, an online Tableau map was created which showed the daily need for oxygen in cubic meters and number of cylinders for each LMIC with a three month trend line. The purpose was to educate pandemic response decision makers about the urgent need for oxygen and trigger greater investments domestically and internationally. [60]

This information was provided to the ACT-A oxygen taskforce which began to focus on addressing s upply gaps and bottlenecks for services and related equipment with a special focus on monitoring PSA (Pressure Swing Adsorption) gas plant repairs and coordinating financing for technical support, on unlocking liquid oxygen supply agreements, expanding service offerings on PSA plants, and resolving bottlenecks in the supply of components and spare parts. The Coalition has helped identify a local network of service providers in specific LMICs to help the taskforce deliver on these objectives.

Impacts

A lack of access to medical oxygen is a defining health inequity that most LMICs still face, even with the support that was provided during the height of the COVID 19 oxygen crisis. Oxygen remains one of the only treatments available for COVID 19 in low resource setting and without medical oxygen, other COVID 19 therapies such as dexamethasone are not as effective. Oxygen is also a treatment for many other infectious and chronic conditions for adults and children, for childbirth and safe surgery. It is an essential medicine as it were. Given this background, EBC felt morally compelled to change its strategic focus on pneumonia to a focus on oxygen access for COVID 19. [61]

Since its establishment in February 2021, the taskforce has provided around $US 700 million worth of oxygen supplies to more than 80 LMICs, including liquid oxygen, oxygen plants and concentrators.[62] Efforts to fix the more than 160 broken oxygen plants that the Coalition has identified are underway.

Investing in oxygen now will not only help countries reduce COVID 19 deaths but will continue to save lives beyond the pandemic. For example, it is estimated that 7.2 million children with hypoxemia due to pneumonia enter LMIC hospitals each year with a need for oxygen but just one in five are likely to receive it. Other studies show that if every hospitalized child who needed oxygen received it, child deaths could be halved. [63, 64]

Centre for Cellular and Molecular Platforms (C-CAMP)

Ecosystem & Experiencers

C-CAMP was set-up by the Department of Biotechnology, Government of India, in 2009. It facilitates bioscience research and entrepreneurship by providing research, development, training and services in state-of-the-art technology platforms. C-CAMP has provided access to its technology platforms to over 250 institutions in India, supported over 100 publications, and has directly funded, incubated and mentored over 100 startups over the last few years.

The C-CAMP COVID-19 Innovations Deployment Accelerator (C-CIDA) program, started in March 2020 as a response to the pandemic, helped accelerate COVID-19 innovations to the market. C-CIDA joined hands with a network of Indian and international partners from the innovation and investor community such as Social Alpha, United Nations Health Innovation Exchange, Centre for Cellular & Molecular Biology (CCMB), India Health Fund, and Action Covid-19 Team (ACT).

Within a month of launch, C-CIDA received over 1100 applications, out of which 30 innovations were selected. These entrepreneurs were called "Stars for Impact". The underlying principle guiding the startup selection was the spirit of 'Atmanirbhar Bharat' or self-reliant India – these would lead to low-cost, innovative and accessible solutions for India, and by India.[65]

Platforms & Engagements

The C-CIDA partners collaborated on various aspects of developing and taking the innovations to market – i) pilot deployment and field validation and implementation, ii) scaling through industry and manufacturing partnerships, iii) crossing the regulatory pathways, and iv) connecting with investors and fund raising. While these engagements were not driven through a purpose-built digital platform, they are examples of ecosystem-driven innovations involving intentional co-ordination among stakeholders.

In parallel, C-CAMP launched a digital platform, called Indigenisation of Diagnostics (InDx), to connect Indian MSMEs in supply-chain of indigenous reagents, components, critical raw materials and diagnostic kits for SARS CoV 2. This platform aims to provide visibility to manufacturing capacity for indigenous solutions for SARS CoV 2 along with detailed quality parameters. InDx, supported by the Office of Principal Scientific Adviser, Government of India and funded by the Rockefeller Foundation, was developed by TCS and comprises a blockchain-based digital supply chain platform.

Impacts

Under C-CIDA, over 22 innovations went into deployment in the COVID-19 fight and touched 1 million+ lives. They cover a wide range of COVID-19 care including rapid diagnostic kits, assisted respiratory devices, AI/ML based pre-screening and monitoring tools to detect COVID-19, preventive technologies including air and surface sanitizers, remote vital stats monitoring systems in healthcare spaces, telemedicine, end-to-end cold chain transport of viral specimens from remote locations and plasma & immunomodulatory therapies.

As a result of the C-CIDA program, 12 startups raised funding, 3 startups established partnerships for industrial manufacturing of technologies, and 4 startups deployed their technologies Internationally.[66]

The InDx platform, which has over 188 members and over 200 products registered, aggregates test kit supply data of Tier 2 and 3 manufacturers of kits, enzymes, primers and antibodies, and provides ready visibility to Tier 1 suppliers in India.[67] InDx in conjunction with National Biomedical Resources Consortium (N-BRIC), enabled mass-scale availability of indigenously developed, Indian regulator-approved COVID-19 diagnostic kits for government and private diagnostic labs.[68]

4. Risk-managed levers for expanding PIE X-verse ecosystem innovation and stakeholder value co-creation

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

As the above examples suggest, transformational shifts to the X-verse require going beyond the conventional loci of interaction, value, innovation, strategy, and performance. The PIE X lens helps do this by visualizing platforms (and underlying protocols in interactive ecosystems, whose environments of engagements are intentionally configured for enactment of interactional creation. Such enactment entails the interactive agency of experiencers coming together with the interactive structures of ecosystems. It requires socio-technical architectures that are purpose-built based on event-sensed flows of lived-journey engagements. Valuable impacts must be sustainably amplified at speed, scale, and scope. This requires adaptive design of enhanced networks of capabilities across private-public-plural sector experience ecosystems. It entails ongoing co-innovation of risk-managed solutions with stakeholders, and leading ecosystemic change through adaptive design, so as to bring about "all-win more" developmental transformation of markets, economies, and society at large.

In the previous report in this series, we introduced some key levers that enterprises can use in navigating transformational PIE X shifts.[69] These levers focused on risk-managed configuration of:

- interactive system-environments associated with platforms (and underlying protocols, by bringing together Artifacts, Persons, Processes, and Interfaces ("APPI") in event-sensed flows of data, content, and service exchange;
- enactment of interactional creation associated with engagements that create value through Dialogue, Access, Reflexivity, and Transparency ("DART") in the lived-journeys of experiencers;
- wellbeing amplification associated with impacts, by harnessing Creativeness, Intentionality, Transformativity, and Integrativity ("CITI" in cross-sector actor-networks at speed, scale, and scope.

In the current context of healthcare X-verse innovation, consider for instance the smart connected pacemaker example mentioned earlier. (See Figure 7 in section 2 of this report.) The (DART-configured) enactment of the patient's engagement with the doctor, the family, and the ER at the out-of-town hospital through (APPI-configured) interactive system-environments, together determine the quality of the patient's overall experience, affecting actual "realized" value (i.e., beyond the "proposition" of value as such. The meaning of value itself changes from the physical product, the pacemaker, to the emergent experience of a specific patient. This emergent experience originates in the patient's interactions with the digitalized ecosystem and activated network capabilities, whose (CITI-configured) wellbeing impacts are amplified by different stakeholding entities in their own focal ecosystems, of which the pacemaker company is a part. These interactions are both individual-to-network-to-individual (I2N2I and from the network-to-individual-to-network (N2I2N.

We now introduce two additional sets of levers of PIE X Ecosystem transformation, this time associated with networked interactions (I2N2I and N2I2N) of eXperiencer ecosystems and growing the pie of interactional value creation across all stakeholders-as-experiencers. These levers can help identify new innovation pathways for enhancing the enactment of risk-managed interactional creation between a focal enterprise and its internal and external stakeholders, and also facilitating stakeholders in the enterprise's network as co-creators of value through their own relational ecosystems that generate value back to the focal enterprise. We saw an example of the latter in the

Vitality example through integration of Apple Watch in its wellness program to promote healthier behaviours, even as Apple aims to improve health impacts at a large scale while simultaneously managing privacy risk.

Applying R-GELI levers of interactive structures and R-SCIM levers of interactive agency

The experience-centric innovation of value creation in X-verse ecosystems can be enhanced via four specific (risk-managed) "**GELI**" levers of **G**enerativity, **E**volvability, **L**inkability, and **I**nclusivity, which are often applied in the following sequence:

Generativity: How might we make interactive structures of ecosystems, within and across interactive system-environments of various stakeholders, more generative?

Linkability: How might we link together experience ecosystem environments to facilitate better networked interactions of event-sensed flows in lived-journey engagements of interactional creation?

Inclusivity: How might we make networked experience environments more inclusive, so as to recognize all stakeholders as both experiencers and creators in lived-journey engagements of interactional creation?

Evolvability: How might we better evolve the capabilities of experience ecosystems to expand wellbeing-impacts at speed, scope, and scale?

As we saw in the previous section, several of the examples entail ways of making the engagement platforms enabled by digital infrastructure more generative, linking together ecosystem environments in innovative ways, and making them more inclusive.

In the Swasth Alliance, digital technologies are leveraged to drive healthcare inclusion and improve health outcomes. Swasth aims to be a patient-centric collaborative that builds and supports the adoption of digital public goods in health (as we saw with the HCX example) as well as evidence-based standards and policies in the Indian health sector. After having worked on telemedicine, home care, and last-mile oxygenation in the first wave of the COVID-19 pandemic in India, the collaborative broadened and scaled its efforts during the second wave, working with partners to build infrastructure in 500 districts in India, providing patients and caregivers with access to verified hyper-local information, and working with clinicians, academics and scientists to create evidence-based guidance and toolkits for patient care.

Swasti, a health catalyst (recall also the example of EkStep as a catalyst in the education X-verse, discussed in the previous report), aims to change the way wellbeing pathways are achieved, starting with primary healthcare and tackling social determinants that directly affect how we experience everyday wellbeing. In addition to (**CITI**-configured) wellbeing impact amplification, the **GELI** levers help expand and co-evolve the generative, linked, inclusive footprint of cross-sector collaborative stakeholder ecosystem engagements, and the scope, speed, and scale of bottom-up community-based "hyperlocal" societal wellbeing impacts.

Swasti recognizes that challenges to wellbeing are not just limited to health, and that personal, social, economic, and environmental factors determine the health outcomes of people and communities. Hence, its models explicitly focuses on interrelationships across ecosystems, with an integrative systemic approach that rises beyond fighting 'ill-health' to enabling 'everyday wellbeing'. Its digitalized ecosystem engineers work closely with partners, focusing on key "intersections where tasks and processes meet" in everyday moments of engagements of experiencers, and its community champions trying to ensure that every generated solution goes through the community, with a focus on prevention that promotes health outcomes among the poor, and at all times aligning to ground and contextual realities.[70] The Swasthi Alliance and Swasti health catalyst examples, together with all the other examples we discussed in the previous section, suggest that in the **X-verse**, while the R-GELI levers of interactive ecosystem structures facilitate the configuration of N2I2N interactions in expansive ways, it must simultaneously be coupled with configuration of unique experience-centric I2N2I interactions, across all stakeholding individuals.

This can be facilitated via four specific (risk-managed) **SCIM** levers of **S**patiotemporality, **C**ontextualization, **I**nvolvements, and **M**eaning-making, which are often applied in the following sequence:

Contextualization: How might we recognize the varying contexts of interactive agency in co-creating unique value, to facilitate better experienced outcomes and wellbeing impacts in the lived-journey engagements of individuals?

Spatiotemporality: How might we recognize the ***spatiotemporality*** of events associated with interactive agency?

Involvements: How might we recognize heterogeneous ***involvements*** in events associated with interactive agency, in co-creating unique value in the lived-journey engagements of individuals?

Meaning: How might we recognize the ways by which individuals attach personal ***meaning*** to events associated with interactive agency?

Apple's Health X-verse Innovation

Let us now take a look at the health X-verse ecosystem from Apple's perspective. Apple's work to advance health rests on two related pillars of "empowering patients on their personal health journey" and "supporting the health ecosystem by collaborating with the medical community".[71] Apple has introduced a wide array of innovative health and fitness features to help people take care of their daily health and fitness with a focus on easy-to-understand, meaningful insights that empowers them to live a healthier life. For starters, Apple's in-house clinicians are deeply involved in the product development process and work hand-in-hand with its engineers and product designers ("internal" stakeholders, even as it engages with "external" stakeholders from patient-side networks of medical device manufacturers (as in the pacemaker example, application developers, and other care delivery partners on the one hand, and deep collaboration with experts from leading research institutions and clinical knowledge partners on the other, all the while adapting the design of its offerings to be user-friendly with patients, nurse practitioners, and doctors, while working together with the scientific medical establishment on advancing clinical research and practice.

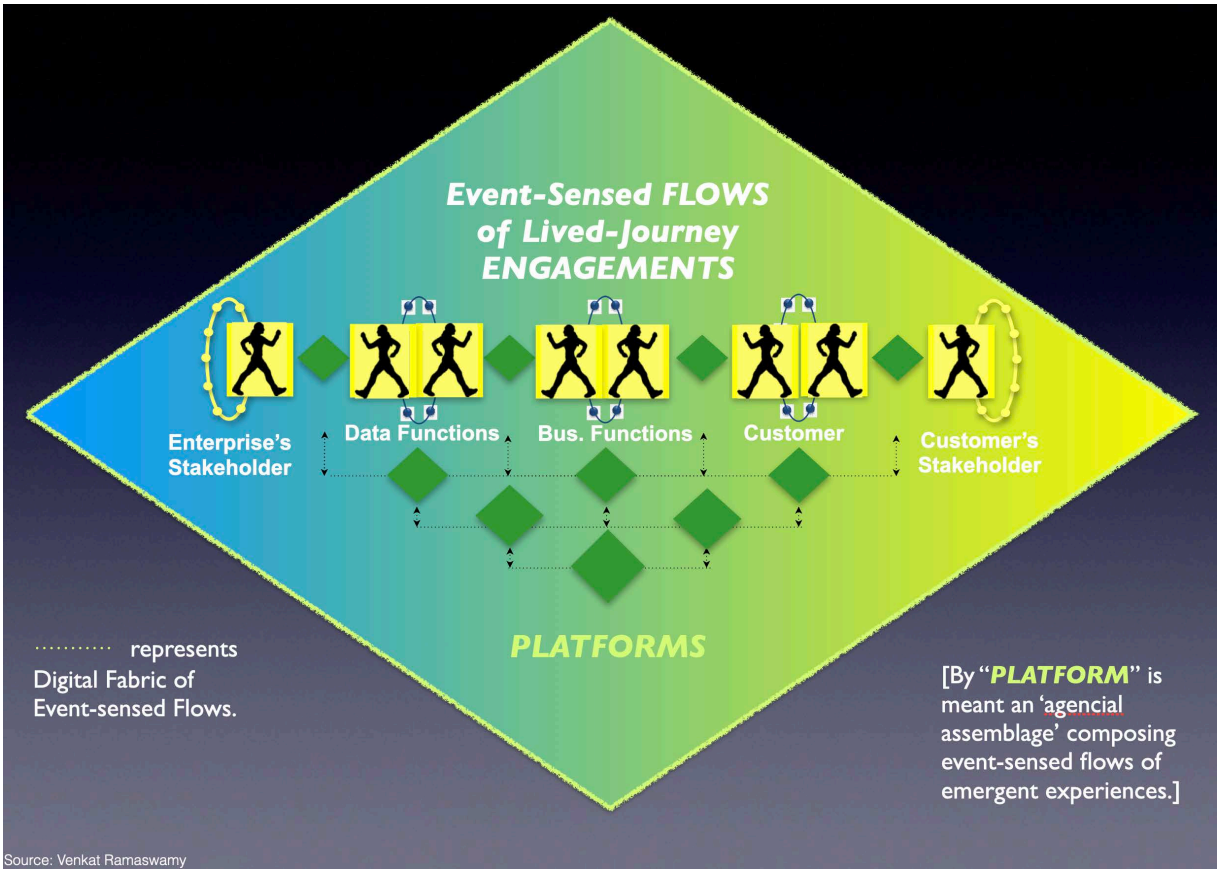

Figure 23 : Engagement and Event sensed Flows (Source: Venkat Ramaswamy)

Recall from the first report in this series (see Figure 23, reproduced here), the X-verse revolution is grounded in the environments of experiences of individuals-as-experiencers in their lived-journey engagements, through a digital fabric of event-sensed flows, which applies equally to ***all*** stakeholders. While patient-centricity calls attention to patient-centred relationships, especially the patient-physician interaction, the emergent experiences of patients and doctors alike from these relationships, are a function of outcomes from interactions elsewhere in the fabric of the enterprise's broader relational stakeholder ecosystem. This not only includes enhancing patient experience with a doctor's visit, augmenting patient experience in hospitals, and using hospital resources more effectively, but also extending healthcare experiences into the home (beyond a doctor or hospital visit with technology that supports care from anywhere.

Central to this is Apple's Health app which aims to provide one central view of the patient's health, and supported by its HealthKit and CareKit, which makes available a number of "open-source APIs" for third-party developers to build innovative application integrations that keep patients connected to healthcare teams. HealthKit, given Apple's strong stance on privacy, lets users control each health data type that is read and written to the Health app, acting as an 'intelligent guardian' for users' health. If users decide to share their health data, the Health app provides users with granular control over what types of data they share and with whom they share it, with appropriate permissions.

The data ranges from health and fitness (also linked through its Fitness app)from resting heart rate to cardio fitness to sleep and exercise, etc. to health records, including medication records, immunizations, lab results, etc. With CareKit, care teams can continue to remotely monitor patients with apps that deliver personalized treatment, and tracks progress, and analyses trends over time. ResearchKit is an open-source framework that helps researchers create powerful apps for medical research that facilitates more inclusiveness of at-risk populations. It initiates studies that engage participants at scale, from enrollment to gathering informed consent, and allows developers to design custom research studies, with active tasks that capture participants' sensor information, collect data with far more regularity, and enable the generation of actionable insights. In 2017, Apple collaborated with Stanford University School of Medicine to conduct the Apple Heart Study on Atrial fibrillation (AFib) detection, a heartbeat irregularity that can often go undiagnosed and is a leading cause of stroke and hospitalization. Since then, following extensive studies on heart health, involving various other research collaborations, Apple Watch now offers a heart rate app, high and low heart rate notifications, ECG app, irregular rhythm notifications, AFib history, and cardio fitness levels. Thus, while strengthening the physician-patient relationship with meaningful data, Apple is also equipping researchers to make new discoveries and health organizations like Vitality to promote healthy lifestyles with Apple Watch, while also supporting public health and government initiatives.

The Apple example suggests a shared X-verse innovation goal of different cross-sector actors in co-evolving a complex ecosystem of resourced capabilities of underlying digital infrastructure and technology platforms, orchestrated to support a portfolio of connected eXperiencer environments and interactional creation of value, engendered in different emergent experience scenarios, with varying roles of network participants and ecosystem interactivity at scale, speed, and scope, sustainably.

Consider a medical device (e.g., pacemaker) company generating data through its smart connected offering, with patients-as-experiencers using Apple devices (Apple Watch and Apple iPhone) engaging with health care providers in the patient's healthcare network. As we saw earlier (see Figure 7, various patient experience scenarios can activate multiple eXperiencer environments of I2N2I-N2I2N interactions. Consider the scenario of a "crisis out of town."

The patient may activate and engage in I2N2I interactions with an emergency call center, medical support, and hospital emergency services. The patient may need directions to the closest hospital, and the attending physician may need access to the patient's medical history (as we also saw in the Apollo 24/7 example. How do the two doctors—the primary care provider back home and the physician on call at the out-of-town hospital—coordinate their diagnosis and treatment? It becomes important for the pacemaker company to understand deeply the nature of these N2I2N interaction events, sensed at a granular level using telemetry and other patient experience data (including unstructured data like patient-communicated v ideos, for instance, together with its relational partners in the ecosystem, while interfacing and integrating health data through its own app with that of the Apple Health app, in effective (APPI-DART-CITI-configured) ways.

Further, the interplay of (GELI-configured)interactive ecosystem structure and (SCIM-configured) interactive eXperiencer agency through N2I2N and I2N2I interactions is at the heart of enterprises expanding the pie of risk-managed X-verse ecosystem innovation and value co-creation with

stakeholders through the PIE X lens. Seen from the perspective of both a smart connected medical device company and Apple, as well as hospital ERs (and other healthcare providers), and through a patient-centered care and research collaboration perspective, it raises several sample illustrative questions for consideration:

- How is data updated and integrated between the medical device company app and Apple Health as a connected engagement platform? Can patients participate as co-creators of their wellbeing by inputting data and annotations (text, audio, video from their lived-experiences into the engagement platform, both in terms of care delivery and longitudinal research studies? How do the quality of the patient's interactions with the network (e.g., primary and on-call doctor/hospital staff) affect the quality of the patient's overall experience? What if the patient values the whole experience co-created with the network and not just with the medical device?

- What is the basis of value for different stakeholders as experiencers and co-creators of value? What role does the combined network of related products, services, and caregivers and the patient community play in co-creating value? How can any one of them create unique value with the patient at any given point in time?

- How does the network's ability to accommodate different situations affect the patient experience—different time, date, and location of a healthcare event? Can the same individual have a different experience with the network under different circumstances, depending on the context of events and the patient's personal preferences at that moment in time? Given the same network, can individuals have different experiences, depending not only on the situational context (time and space of events but also on the social and cultural context of events? How much do intangible aspects of a patient's context, the meanings they attach to outcomes, and their involvements influence the experience and wellbeing impacts?

- How can nutritionists, lifestyle, fitness and other entities, including thematic communities, participate in meaningfully coordinated ways in the lived-journey engagements of people that goes beyond the empowerment of patients with data, to seamlessly enact a healthy day by co-creating I2N2I2N2I interactions that engender valuable wellbeing impacts?

Value ultimately lies at the intersection of resources and opportunities, in the actualization of co-creational experience outcomes and impacts engendered of a specific patient, at a specific point in time, in a specific location, and in the context of a specific event. The total co-creation experience with the network results in more personal and unique value for each patient. This is the case for all stakeholding individuals besides the patient, from the doctor to the nurse to all other participating entities. As noted by Ramaswamy and Ozcan, "The common denominator for value creation is the co-creation experiences of all individuals that enterprises must connect with, understand, and gain insights from. ***Each stakeholding individual has both a demand and supply side***".[72] This means that the strategic architecture of engagement platforms must enable the "demand" side of each individual to be engaged co-creatively with the "supply" side that supports that individual. Thus, rather than fixed roles of stakeholders in the system—customers, employees, partners, suppliers, and investors—there are ***roles of the moment*** for ecosystem entities that shift and morph as circumstances change. This calls for a **C**omplex **A**daptive **R**elational **E**cosystem architecture in enterprise transformation - call it a new **CARE** enterprise architecture – that brings ecosystem fluidity in enacting interactional creation via event-sensed flows of lived-journey engagements through the PIE X lens.[73]

5. Conclusion

HEALTHCARE X-VERSE INNOVATION

Applying the PIE X lens to digitalized health and insurance experiences

In this report, we built on the concepts of the eXperience-verse and the PIE X lens that we first introduced in our original report in the "Digital India Innovation and the Experience-verse Revolution" series. We explored healthcare X-verse innovation and applied the PIE X lens to various digitalized health and insurance experiences.

The healthcare sector has been traditionally slower compared to other industries in adopting digital technologies on a large scale. Catalysed by the pandemic, the sector has begun its march towards digital health. We considered transformational shifts in the healthcare X-verse along five different loci of value creation: locus of interaction, locus of value, locus of innovation, locus of strategy, and locus of performance.

We then applied the PIE X lens to digitalized health and insurance experiences in the real world. We examined digital health initiatives in India, led by the government, private and plural sectors, such as Ayushman Bharat Digital Mission and Apollo 24/7. We saw how the Indian digital health stacks, such as Unified Health Interface (UHI) and the Health Claims Data Exchange (HCX), are open, but protocol-driven, allowing for democratization of innovation in the ecosystem and represent a new model of Web3 decentralization as such.

We also saw examples of new digitalized insurance experiences at Discovery and Swiss Re – Gro Health. They reimagined risk coverage in an innovative shared-value model that benefits the insured, the insurer and the society at large.

Next, we looked at how cloud vendors such as Oracle, Amazon and Microsoft are offering health clouds and making available advanced data analytics and highly scalable and secure digital infrastructure to all healthcare businesses.

We also studied two examples of institutions, EBC Coalition and C-CAMP, that reprioritized their purpose and immediate focus to addressing COVID-19, and then leveraged a network of geographically distributed set of partners to co-create innovative solutions.

Following these examples, we introduced two new sets of key risk-managed levers (namely R-GELI levers of interactive structures and R-SCIM levers of interactive agency) for expanding PIE X-verse ecosystem innovation and value co-creation with stakeholders, while also discussing them in the context of Swasth Alliance, Swasti, and the Apple healthcare ecosystem.

In the next report in this series, we will introduce two final sets of key risk-managed levers, for the co-innovation and adaptive design of experience ecosystems together with stakeholders-as-experiencers-innovators-creators. We will motivate these levers in the broad context of agricultural, food, and retail X-verse innovation, and showcase all of the transformation levers with a comprehensive illustrative enterprise example in this space. In doing so, we will also delve into the building of CARE enterprise architectures in more detail, which are essential to thriving in the X-verse revolution, as it spreads across diverse industry sectors of digitalized society, economies, and markets.

6. References

1 Krishnan Narayanan and Venkat Ramaswamy (2022), “Digital India Innovation and the Experience-verse Revolution,” itihaasa Research and Digital Report.

2 C. K. Prahalad and Venkat Ramaswamy (2004), The Future of Competition: Co-Creating Unique Value with Customers, (Harvard Business School Press). See also: Ramaswamy, Venkat (2020), “Leading the Experience Ecosystem Revolution - Innovating Offerings as Interactive Platforms,” Strategy and Leadership, 48, 3, 3-9.

3 Venkat Ramaswamy and Krishnan Narayanan, "Into the eXperience-verse: The Strategic Frontier of Cloud Business Innovation and Value Co-Creation," Strategy and Leadership, 50, 5.

4 See Krishnan Narayanan and Venkat Ramaswamy (2022), “Education X-verse Innovation: Applying the PIE X lens to digitalized learning and skill development experiences,” itihaasa Research and Digital Report.

5 Krishnan Narayanan and Ajay Bakshi, “History and Future of Digital Health”, itihaasa Research and Digital, November 2021,
https://itihaasa.com/public/pdf/History_and_Future_of_Digital_Health_in_the_World_and_India.pdf?v=1.1

6 ibid

7 Shubham Singhal et al., "The next wave of healthcare innovation: The evolution of ecosystems", McKinsey & Company, June 2020

8 C. K. Prahalad and Venkat Ramaswamy (2004), The Future of Competition: Co-Creating Unique Value with Customers, (Harvard Business School Press).

9 ibid

10 Kris Gopalakrishnan, Krishnan Narayanan, N Dayasindhu, “Leveraging Digital in India for Impact: Analysing digital healthcare through an IT architecture lens”, itihaasa Research and Digital, September 2022

11 “Market Guide for Digital Health Platform for Healthcare Providers”, Gartner, October 2021,
https://www.gartner.com/en/documents/4006616

12 Ebrahimzadeh A., Maier M, “Toward 6G: A New Era of Convergence”, Wiley, 2020

13 Venkat Ramaswamy and Kerimcan Ozcan (2014), The Co-Creation Paradigm (Stanford University Press)

14 Venkat Ramaswamy (2022), “Embracing a Co-Creation Paradigm of Lived-Experience Ecosystem Value Creation,” pp. 95-110, in The Routledge Companion to Corporate Branding, edited by Oriol Iglesias, Nicholas Ind, and Majken Schultz.

15 C. K. Prahalad and Venkat Ramaswamy (2004), The Future of Competition: Co-Creating Unique Value with Customers, (Harvard Business School Press).

16 Venkat Ramaswamy (2006), "Co-Creating Experiences of Value with Customers", Infosys SETLabs Briefings, 4 (1), 25-36.

17 ***https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/The-Digital-Divide-and-the-Covid-19-Pandemic-1.pdf***

18 ***http://www.healthdata.org/india***

19 "Measuring universal health coverage", The Lancet, 2020, ***https://doi.org/10.1016/S0140-6736(20)30750-9***

20 Krishnan Narayanan, "Digital Health in India", itihaasa Research and Digital, June 2021, ***https://itihaasa.com/public/pdf/Digital_Health_in_India.pdf***

21 ***https://ndhm.gov.in/assets/uploads/consultation_papersDocs/UHI_Consultation_Paper.pdf***

22 Kris Gopalakrishnan, N Dayasindhu and Krishnan Narayanan, "Web3 and India", itihaasa Research and Digital, September 2022

23 Adapted from an upcoming book – "Against All Odds– The IT Story of India", Kris Gopalakrishnan, N. Dayasindhu, Krishnan Narayanan, Penguin Random House India, 2022

24 Krishnan Narayanan and Ajay Bakshi, "History and Future of Digital Health", itihaasa Research and Digital, November 2021, ***https://itihaasa.com/public/pdf/History_and_Future_of_Digital_Health_in_the_World_and_India.pdf?v=1.1***

25 ***https://pib.gov.in/PressReleseDetailm.aspx?PRID=1706007***

26 Adapted from an upcoming book – "Against All Odds– The IT Story of India", Kris Gopalakrishnan, N. Dayasindhu, Krishnan Narayanan, Penguin Random House India, 2022

27 ***https://www.mohfw.gov.in/***

28 ***https://www.apollohospitals.com/***

29 ***https://www.moneycontrol.com/news/business/earnings/apollo-hospitals-creates-indias-largest-omni-channel-health-platform-reports-rs-170-crore-net-profit-for-q4fy21-7078671.html***

30 ***https://yourstory.com/2021/07/top-of-the-funnel-apollo-247-content-marketing-strategy/amp***

31 ***https://news.microsoft.com/en-in/apollo-247-uses-microsoft-azure-to-bring-healthcare-services-closer-to-indians/***

32 ***https://www.apollo247.com/apollo-pro-health***

33 ***https://news.microsoft.com/en-in/features/microsoft-ai-network-healthcare-apollo-hospitals-cardiac-disease-prediction/***

34 ***https://www.moneycontrol.com/news/business/earnings/apollo-hospitals-creates-indias-largest-omni-channel-health-platform-reports-rs-170-crore-net-profit-for-q4fy21-7078671.html***

35 ***https://yourstory.com/2021/07/top-of-the-funnel-apollo-247-content-marketing-strategy/amp***

36 ***https://www.apollotelehealth.com/public-private-partnerships/***

37 Agarwal Y, Jain M, Sinha S, Dhir S. Delivering high-tech, AI-based health care at Apollo Hospitals. GBOE. 2020;39(2): 20–30. https://doi.org/10.1002/joe.21981

38 *https://swasthalliance.org/*

39 *https://www.lemonade.com/blog/lemonade-acquires-metromile/;* see Krishnan Narayanan and Venkat Ramaswamy (2022), "Education X-verse Innovation: Applying the PIE X lens to digitalized learning and skill development experiences," itihaasa Research and Digital Report, for a discussion of the DIKSHA example in education.

40 *https://www.insurancebusinessmag.com/us/news/breaking-news/tesla-rolls-out-new-auto-insurance-product-313432.aspx*

41 *https://www.swissre.com/risk-knowledge/building-societal-resilience/using-technology-to-help-manage-diabetes.html*

42 *https://www.fiercehealthcare.com/payer/alphabet-s-verily-breaks-into-stop-loss-health-insurance-market-backed-by-swiss-re*

43 *https://www.forbes.com/sites/sap/2021/09/08/how-shared-value-insurance-is-transforming-peoples-lives-and-the-industry/?sh=33be07c24533*

44 *https://www.discovery.co.za/corporate/sustainability-who-we-are*

45 *https://www.news24.com/fin24/companies/health/discovery-prepaid-doctor-vouchers-could-bring-more-people-into-the-private-healthcare-net-20201207*

46 *https://www.businessinsider.co.za/kids-can-now-earn-vitality-points-and-win-a-playstation-if-they-exercise-eat-healthy-2021-1*

47 *https://www.businessinsider.co.za/the-most-valuable-brands-in-south-africa-2021-8*

48 *"Oracle Healthcare Industry Cloud Battleground" Session by Mike Sicilia, Cloud Wars Expo 2022*

49 *https://blogs.oracle.com/healthcare/post/oracle-acquisition-of-cerner-the-future-of-healthcare*

50 *"Oracle Healthcare Industry Cloud Battleground" Session by Mike Sicilia, Cloud Wars Expo 2022*

51 *https://www.oracle.com/industries/healthcare/products/*

52 *https://www.oracle.com/industries/healthcare/cloud/*

53 *https://www.oracle.com/data-lakehouse/*

54 *https://www.oracle.com/customers/prosperdtx/*

55 *https://www.oracle.com/customers/prospect-medical-holdings/*

56 *"Oracle Healthcare Industry Cloud Battleground" Session by Mike Sicilia, Cloud Wars Expo 2022*

57 *https://aws.amazon.com/health/machine-learning/*

58 ***https://azure.microsoft.com/en-us/blog/introducing-azure-health-bot-an-evolution-of-microsoft-healthcare-bot-with-new-functionality/***

59 ***https://experience.arcgis.com/experience/c3584c0ebcba4833a0159ffff17c2c89***

60 ***https://www.path.org/programs/market-dynamics/covid-19-oxygen-needs-tracker/***

61 Authors in conversation with Leith Greenslade, Coordinator Every Breath Counts Coalition

62 ***https://stoppneumonia.org/latest/covid-19/***

63 ***https://www.sciencedirect.com/science/article/pii/S2214109X21005866***

64 ***https://gh.bmj.com/content/6/12/e007468***

65 ***https://yourstory.com/2020/05/covid-19-indian-innovators-startups-c-camp-aatmanirbhar/amp***

66 ***https://www.ccamp.res.in/covid-19-innovations-deployment-accelerator***

67 ***https://www.business-standard.com/article/news-cm/tcs-partners-with-c-camp-to-scale-up-india-s-covid-testing-capacity-120120100809_1.html***

68 ***https://www.ccamp.res.in/c-camp-indx-announces-immediate-mass-scale-availability-and-online-marketplace-help-india-meet-dire***

69 See Krishnan Narayanan and Venkat Ramaswamy (2022), "Education X-verse Innovation: Applying the PIE X lens to digitalized learning and skill development experiences," itihaasa Research and Digital Report, for a discussion of the DIKSHA example in education.

70 ***https://swastihc.org***

71 ***https://www.apple.com/newsroom/2022/07/how-apple-is-empowering-people-with-their-health-information/***

72 See Venkat Ramaswamy and Kerimcan Ozcan (2014), The Co-Creation Paradigm (Stanford University Press)

73 ibid